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Senior Research Scientist, Institute for Software Integrated Systems, Vanderbilt University

Research Interests

My research is focused on the design and operation of resilient and fault tolerant decision support systems for societal scale cyber-physical systems such as transit systems, emergency response systems, and electrical power grids.

Research Topics System Assurance and Resilience, Anomaly detection and fault diagnostics, Computation platforms and middleware for cyber-physical systems, Adaptive performance management, Model integrated computing.

Research Domains Public transit systems, Emergency response systems, Smart grid, and Transactive energy systems.

Research Impact

Publications I have written more than 150 papers. These papers have been cited 2125 time with an $h-index$ of 23 and an $i-10$ index of 55. The metrics for papers published since 2015 are ($h-index$: 20 and an $i10-Index$: 23)

Publication Topics Distributed power generation, learning (artificial intelligence), power engineering computing, Internet of Things, middleware, security of data, cyber-physical systems, power generation control, smart power grids, traffic engineering computing, cloud computing, resource allocation, control engineering computing, data privacy, distributed control, power grids, road traffic, software architecture, Big Data, cryptocurrencies, decision support systems, distributed processing, embedded systems, fault tolerance, mobile computing

Invited talks As an Assistant Professor I have given 28 invited presentations (not including paper presentations) at various conferences, NSF workshops, universities and industry.

Software Products The software products I have developed have been actively used by the research community. Notable software products include (a) an ARINC-653 emulator for Linux and (b) first open source operating system implementation for FACE standard, (c) Modular platform for integrating blockchain and CPS called SolidWorx, (d) CHARIOT toolsuite for designing resilient and reconfigurable cyber physical system software assemblies, (e) TRANSAX - a middleware for transactive energy systems and (f) MODICUM - a decentralized edge computing solution.

Patents I have been granted one provisional patent for Method and System for Secure and Private Forward Trading Platform in Transactive Microgrids. There are two submitted and pending patents: (1) Method and System for Data-Driven Forecasting of Cascading Effects in Networked Systems and (2) Decentralized Method and System for Real Time Anomaly Detection In Transportation Networks.

Research Grants

Total grant support in the PI position as an assistant professor is 7.9 million dollars. Grant support as a PI in research scientist position from 2009 to 2016 was $526,294. Total grant support as a Co-PI as an assistant professor is approximately 16.6 million dollars. My cumulative grant support throughout my career as a researcher is over 60 million dollars. I have received these grants from NSF, DARPA, DOE, DOD, ARPA-E, ARL, Siemens, IBM , CISCO, NASA and AFOSR.

Professional Research Service

I have served 11 times as a chair or co-chair for international conferences during my career. In addition I have served over 20 times as a program committee member. Over the years, I have also frequently reviewed grants for NSF, NASA and DOE.

Research in Practice

My research work in the public transit and emergency response area has been adopted by Nashville departments and Chattanooga departments and has been frequently cited the press. The CHARIOT, ARINC-653 Component Model and RIAPS toolsuites have been transitioned to open source community.

Teaching Impact

Department Courses

I have taught both graduate and undergraduate courses in my professional career. I have also led both undergraduate and graduate students in independent studies and research projects. I started my teaching career with the course on "Introduction to Operating Systems" at Vanderbilt University. I have taught this course more than 10 times over the years. In addition, I developed a new graduate course on resilient and dependable computing two years ago. I have offered this course three times. Recently, I have redesigned the course on "Topics in Big Data" and offered it in Spring 2020.

University Courses

In addition I have offered a a multi-disciplinary university course, titled "Data Science for Smart City Applications" in Spring 2018 and Spring 2020. In this course, we approach the problem space of smart and connected community applications from the perspective of engineering, mathematics and social science domains. This is especially important considering that the problem space of smart communities is complex and multi-domain. Solutions often require creative partitioning of problems into sub-problems that can be solved separately and then integrated into a final solution. This requires knowledge about several subject matters, as well as creative thinking skills. Thus, our goal in this new course has been to encourage project oriented learning. For example, one of the teams designed a campus wide navigation application for the course.

Industrial Courses

I have designed an course on "Internet Of Things" for Marriot, Inc as part of a grant.

Educational Background

2009 Ph.D., Electrical Engineering, Vanderbilt University, Nashville, TN

Dissertation Using Model-Based Techniques for Improving Performance and Reliability in High-Performance Scientific Computing.

2005 M.S., Electrical Engineering, Vanderbilt University, Nashville, TN

Thesis Metamodel Based Language and Computation Platform for Algorithmic Analysis of Hybrid Systems.

2001 B.Tech. (Bachelor of Technology) with Honors, Electrical Engineering, Indian Institute of Technology, Banaras Hindu University, Varanasi, India

Appointments

2016-Present	Assistant Professor, Computer Science and Computer Engineering, Department of Electrical Engineering and Computer Science, Vanderbilt University
2016-Present	Senior Research Scientist, Institute for Software Integrated Systems, Vanderbilt University
2014-2016	Adjunct Assistant Professor, Computer Science and Computer Engineering, Department of Electrical Engineering and Computer Science, Vanderbilt University
2009-2016	Research Scientist, Institute for Software Integrated Systems, Vanderbilt University
2003-2009	Research Assistant, Department of Electrical Engineering and Computer Science, Vanderbilt University
Summer 2008	Research Intern, IBM T.J Watson Research Center, Hawthorne, NY
Summer 2003	Research Intern, General Motors, Technical Center, Warren, MI
2001-2003	Software Engineer, IBM Global Services, India

Research Topics and Selected Publications

System Assurance and Resilience

Resilience is an essential property of all societal scale cyber-physical systems. A resilient system is trusted and effective out of the box in a wide range of contexts, easily adapted to many others through reconfiguration or replacement, with graceful and detectable degradation of function. Unfortunately, construction of resilient systems necessitates sophisticated software and systems engineering processes, where often decisions made have system-wide implications. My research has been addressing this gap by developing models to reconfigure the system dynamically upon failure and develop assessment metrics that ensure that the system design at all stages can be evaluated for reliability and resilience. Five publications from this area are listed below.

1. Ramakrishna, Shreyas, Harstell, Charles, Burruss, Matthew P., Karsai, Gabor, and **Dubey, Abhishek**. **2020**. "Dynamic-weighted simplex strategy for learning enabled cyber physical systems". In: *Journal of Systems Architecture* 111 (), p. 101760. ISSN: 1383-7621
2. Pradhan, Subhav, **Dubey, Abhishek**, Khare, Shweta, Nannapaneni, Saideep, Gokhale, Aniruddha S., Mahadevan, Sankaran, Schmidt, Douglas C., and Lehofer, Martin. **2018**. "CHARIOT: Goal-Driven Orchestration Middleware for Resilient IoT Systems". In: *Transactions of Cyber Physical Systems* 2.3 (), 16:1–16:37
3. Hasan, Saqib, Ghafouri, Amin, **Dubey, Abhishek**, Karsai, Gabor, and Koutsoukos, Xenofon D. **2018**. "Vulnerability analysis of power systems based on cyber-attack and defense models". In: *2018 IEEE Power & Energy Society Innovative Smart Grid Technologies Conference, ISGT 2018, Washington, DC, USA, February 19-22, 2018*, pp. 1–5
4. Pradhan, Subhav, **Dubey, Abhishek**, Levendovszky, Tihamer, Kumar, Pranav Srinivas, Emfinger, William, Balasubramanian, Daniel, Otte, William, and Karsai, Gabor. **2016**. "Achieving resilience in distributed software systems via self-reconfiguration". In: *Journal of Systems and Software* 122 (), pp. 344–363
5. Mahadevan, Nagabhushan, **Dubey, Abhishek**, Balasubramanian, Daniel, and Karsai, Gabor. **2013**. "Deliberative, search-based mitigation strategies for model-based software health management". In: *ISSE* 9.4 (), pp. 293–318

Anomaly Detection and Fault Diagnostics

Anomaly detection and fault diagnostics is critical for large cyber-physical systems such as power grid. The challenge is to design efficient and robust online mechanisms that can provide plausible hypothesis explaining fault signatures. However, this hard because with naive statistical methods there is a high-likelihood that we find secondary or tertiary affects and are not able to isolate the true cause of failure, which in some cases might be unobservable. For example, there are studies by North Electric Reliability Corporation (NERC) which states that relay or automatic control misoperations account for nearly all major system events and these secondary effects of primary faults are often overlooked by state of the art diagnostic methods. My research in this area has been focused on developing efficient anomaly detectors and temporal causal diagrams for consistent diagnosis accounting for protection system failures in these systems. Five publications from this area are listed below.

1. Basak, Sanchita, **Dubey, Abhishek**, and Leao, Bruno P. **2019**. "Analyzing the Cascading Effect of Traffic Congestion Using LSTM Networks". In: *2019 IEEE International Conference on Big Data (Big Data)*, pp. 2144–2153
2. Basak, Sanchita, Sengupta, Saptarshi, and **Dubey, Abhishek**. **June 2019**. "Mechanisms for Integrated Feature Normalization and Remaining Useful Life Estimation Using LSTMs Applied to Hard-Disks". In: *IEEE International Conference on Smart Computing, SMARTCOMP 2019, Washington, DC, USA*, pp. 208–216
3. Wilbur, Michael, **Dubey, Abhishek**, Leão, Bruno, and Bhattacharjee, Shameek. **June 2019**. "A Decentralized Approach for Real Time Anomaly Detection in Transportation Networks". In: *IEEE International Conference on Smart Computing, SMARTCOMP 2019, Washington, DC, USA*, pp. 274–282
4. Chhokra, Ajay, **Dubey, Abhishek**, Mahadevan, Nagabhushan, Hasan, Saqib, and Karsai, Gabor. **2018**. "Diagnosis in Cyber-Physical Systems with Fault Protection Assemblies". In: *Diagnosability, Security and Safety of Hybrid Dynamic and Cyber-Physical Systems*. Ed. by Moamar Sayed-Mouchaweh. Cham: Springer International Publishing. Chap. Chapter 8, pp. 201–225. ISBN: 978-3-319-74962-4
5. Chhokra, Ajay, **Dubey, Abhishek**, Mahadevan, Nagabhushan, Karsai, Gabor, Balasubramanian, Daniel, and Hasan, Saqib. **Feb. 2018**. "Hierarchical Reasoning about Faults in Cyber-Physical Energy Systems using Temporal Causal Diagrams". In: *International Journal of Prognostics and Health Management* 9.1 ()

Computation Platforms and Middleware for Cyber-Physical Systems

Middleware implements core functions needed for distributed systems (e.g. location transparency, marshaling/unmarshaling data structures, etc.) but it can also be used to implement the generic, reusable functions needed for implementing resilience patterns and coordinating the anomaly detectors and diagnosers. The challenge in cyber-physical systems is to design middleware that provide robust operations and solve the problem of managing consensus and provide performance management guarantees. My research in this area focuses on component based design and use of model-based metholodgy for correct by construction deployment of these systems. I also investigate the integration of blockchains as a middleware service for CPS. Five publications from this area are listed below.

1. Eisele, Scott, Eghtesad, Taha, Troutman, Nicholas, Laszka, Aron, and **Dubey, Abhishek**. **2020**. "Mechanisms for Outsourcing Computation via a Decentralized Market". In: *14TH ACM International Conference on Distributed and Event Based Systems*

2. Eisele, Scott, Barreto, Carlos, **Dubey, Abhishek**, Koutsoukos, Xenofon, Eghtesad, Taha, Laszka, Aron, and Mavridou, Anastasia. **2020**. "Blockchains for Transactive Energy Systems: Opportunities, Challenges, and Approaches". In: *IEEE Computer* ()
3. Eisele, Scott, Laszka, Aron, Mavridou, Anastasia, and **Dubey, Abhishek**. **2018**. "SolidWorx: A Resilient and Trustworthy Transactive Platform for Smart and Connected Communities". In: *IEEE International Conference on Internet of Things and Blockchains*, pp. 1263–1272
4. Eisele, Scott, Madari, István, **Dubey, Abhishek**, and Karsai, Gabor. **2017**. "RIAPS: Resilient Information Architecture Platform for Decentralized Smart Systems". In: *20th IEEE International Symposium on Real-Time Distributed Computing, ISORC 2017, Toronto, ON, Canada, May 16-18, 2017*, pp. 125–132
5. **Dubey, Abhishek**, Karsai, Gabor, and Mahadevan, Nagabhushan. **2011**. "A component model for hard real-time systems: CCM with ARINC-653". In: *Softw., Pract. Exper.* 41.12 (), pp. 1517–1550

Adaptive Performance Management

While resilience is focused on ensuring a failure free operation of the system, the problem of performance management is related to quality of service of the operation. An integral part of this activity is the exploration of the problem of component placement in response to performance concerns. Scheduling sensors without affecting the performance of the rest of the system is important. Further, we need mechanisms that can adapt system and manage performance even under degraded scenarios. System specification and modeling is critical for this problem. My work in this area includes a novel feedback control based for scheduling the sensors, approaches based on runtime adaption while ensuring that the other partitions or applications in the system are not affected. Recently we have studying the impact of sensor uncertainty on performance models. Five publications from this area are listed below.

1. Shekhar, Shashank, Chhokra, Ajay, Sun, Hongyang, Gokhale, Aniruddha, **Dubey, Abhishek**, Koutsoukos, Xenofon, and Karsai, Gabor. **2020**. "URMILA: Dynamically Trading-off Fog and Edge Resources for Performance and Mobility-Aware IoT Services". In: *Journal of Systems Architecture* (). ISSN: 1383-7621
2. **Dubey, Abhishek**, Emfinger, W., Gokhale, A., Kumar, P., McDermet, D., Bapty, T., and Karsai, G. **July 2019**. "Enabling Strong Isolation for Distributed Real-Time Applications in Edge Computing Scenarios". In: *IEEE Aerospace and Electronic Systems Magazine* 34.7 (), pp. 32–45. ISSN: 1557-959X
3. Martins, G., Bhattacharjee, A., **Dubey, Abhishek**, and Koutsoukos, X. **Aug. 2014**. "Performance evaluation of an authentication mechanism in time-triggered networked control systems". In: *2014 7th International Symposium on Resilient Control Systems (ISRCS)*, pp. 1–6
4. Roy, Nilabja, **Dubey, Abhishek**, and Gokhale, Aniruddha S. **2011**. "Efficient Autoscaling in the Cloud Using Predictive Models for Workload Forecasting". In: *IEEE International Conference on Cloud Computing, CLOUD 2011, Washington, DC, USA, 4-9 July, 2011*, pp. 500–507
5. **Dubey, Abhishek**, Karsai, Gabor, and Abdelwahed, Sherif. **2009**. "Compensating for Timing Jitter in Computing Systems with General-Purpose Operating Systems". In: *2009 IEEE International Symposium on Object/Component/Service-Oriented Real-Time Distributed Computing, ISORC 2009, Tokyo, Japan, 17-20 March 2009*, pp. 55–62

Model Integrated Computing for Cyber-Physical Systems

Complex sensing, processing and control applications running on distributed platforms are difficult to design, develop, analyze, integrate, deploy and operate, especially if resource constraints, fault tolerance and security issues are to be addressed. While technology exists today for engineering distributed, real-time component-based applications, many problems remain unsolved by existing tools. Model-driven development techniques are powerful, but there are very few existing and complete tool chains that offer an end-to-end solution to developers, from design to deployment. My research in this area has been focusing on designing domain specific modeling languages for addressing all phases of application lifecycle including design, development, assurance case construction, analysis, integration, deployment, operation and maintenance, with supporting automation in every phase. Five publications from this area are listed below.

1. Hartsell, Charles, Mahadevan, Nagabhushan, Nine, Harmon, Bapty, Ted, **Dubey, Abhishek**, and Karsai, Gabor. **Apr. 2020**. "Workflow Automation for Cyber Physical System Development Processes". In: *2020 IEEE Workshop on Design Automation for CPS and IoT (DESTION)*. IEEE. ISBN: 9781728199948
2. Pradhan, Subhav M., **Dubey, Abhishek**, Gokhale, Aniruddha S., and Lehofer, Martin. **2015**. "CHARIOT: a domain specific language for extensible cyber-physical systems". In: *Proceedings of the Workshop on Domain-Specific Modeling, DSM@SPLASH 2015, Pittsburgh, PA, USA, October 27, 2015*, pp. 9–16
3. Balasubramanian, Daniel, **Dubey, Abhishek**, Otte, William, Levendovszky, Tihamer, Gokhale, Aniruddha S., Kumar, Pranav Srinivas, Emfinger, William, and Karsai, Gabor. **2015**. "DREMS ML: A wide spectrum architecture design language for distributed computing platforms". In: *Sci. Comput. Program.* 106 (), pp. 3–29
4. Balasubramanian, Daniel, Levendovszky, Tihamer, **Dubey, Abhishek**, and Karsai, Gabor. **2014**. "Taming Multi-Paradigm Integration in a Software Architecture Description Language". In: *Proceedings of the 8th Workshop on Multi-Paradigm Modeling co-located with the 17th International Conference on Model Driven Engineering Languages and Systems, MPM@MODELS 2014, Valencia, Spain, September 30, 2014*, pp. 67–76
5. **Dubey, Abhishek**, Karsai, Gabor, and Mahadevan, Nagabhushan. **2013**. "Fault-Adaptivity in Hard Real-Time Component-Based Software Systems". In: *Software Engineering for Self-Adaptive Systems II: International Seminar, Dagstuhl Castle, Germany, October 24-29, 2010 Revised Selected and Invited Papers*. Ed. by Rogério de Lemos, Holger Giese, Hausi A. Müller, and Mary Shaw. Berlin, Heidelberg: Springer Berlin Heidelberg, pp. 294–323. ISBN: 978-3-642-35813-5

Research Domains and Selected Publications

I focus on applying the fundamental research topics discussed in the previous section in the context of practical systems. This is very important to have a socio-technical impact of the work. Towards that goal I co-lead the Vanderbilt Initiative for Smart City Operations and Research and through this group and through the group make signficant contribution to power grids, emergency response systems and transit systems in our cities. Specific research domains are listed below.

Statistical Decision Support for Public Transit Systems

This research topic addresses the problem of urban transportation and congestion by engineering robust decision support systems that help the customers and the transit agencies reduce uncertainties and optimize the transit operations. We address this problem at three fronts - Data Analytics, Planning and analysis tool for understanding and projecting the impact of transportation choices. Recently, we have been investigating mechanisms to predict and optimize energy efficiency of transit systems. This is critical because transportation accounts for 28% of the total energy use in US. Switching from personal vehicles to public transit systems can significantly reduce energy use and environmental impact. However, even public transit systems require substantial amounts of energy; for example, public bus transit services in the U.S. are responsible for at least 19.7 million metric tons of CO_2 emission annually. Five publications from this area are listed below.

1. Ayman, Afiya, Wilbur, Michael, Sivagnanam, Amutheezan, Pugliese, Philip, **Dubey, Abhishek**, and Laszka, Aron. **June 2020**. "Data-Driven Prediction of Route-Level Energy Use for Mixed-Vehicle Transit Fleets". In: *2020 IEEE International Conference on Smart Computing (SMARTCOMP) (SMARTCOMP 2020)*. Bologna, Italy
2. Sun, Fangzhou, **Dubey, Abhishek**, White, Jules, and Gokhale, Aniruddha. **Jan. 2019**. "Transit-hub: a smart public transportation decision support system with multi-timescale analytical services". In: *Cluster Computing* 22.Suppl 1 (), pp. 2239–2254
3. Basak, Sanchita, Sun, Fangzhou, Sengupta, Saptarshi, and **Dubey, Abhishek**. **2019**. "Data-Driven Optimization of Public Transit Schedule". In: *Big Data Analytics - 7th International Conference, BDA 2019, Ahmedabad, India*, pp. 265–284
4. Oruganti, Aparna, Basak, Sanchita, Sun, Fangzhou, Baroud, Hiba, and **Dubey, Abhishek**. **2019**. "Modeling and Predicting the Cascading Effects of Delay in Transit Systems". In: *Transportation Research Board Annual Meeting*
5. Sun, Fangzhou, **Dubey, Abhishek**, Samal, Chinmaya, Baroud, Hiba, and Kulkarni, Chetan. **2018**. "Short-Term Transit Decision Support System Using Multi-task Deep Neural Networks". In: *2018 IEEE International Conference on Smart Computing, SMARTCOMP 2018, Taormina, Sicily, Italy, June 18-20, 2018*, pp. 155–162

Statistical Decision Support for Emergency Response Systems

This research topic addresses the problem of efficient and robust emergency response using proactive resource management that minimizes time and maximizes the effectiveness of the response. The process of managing emergencies requires full integration of planning and response data and models and their implementation in a dynamic and uncertain environment to support real-time decisions of dispatching emergency response resources. Our work in ERM has spanned the last six years. We use continuous-time generative models to forecast spatiotemporal incidents and the decision-theoretic problem of dispatching responders based on semi-Markovian dynamics. We have also developed efficient and scalable approaches to solve the high-dimensional optimization problem of proactive stationing and dispatch under uncertainty by using Multi-agent Monte Carlo Tree Search (MMCTS). Five publications from this area are listed below.

1. Pettet, Geoffrey, Mukhopadhyay, Ayan, Kochenderfer, Mykel, Vorobeychik, Yevgeniy, and **Dubey, Abhishek**. **2020**. "On Algorithmic Decision Procedures in Emergency Response Systems in Smart and Connected Communities". In: *Proceedings of the 19th Conference on Autonomous Agents and MultiAgent Systems, AAMAS 2020, Auckland, New Zealand*

3. Mukhopadhyay, Ayan, Pettet, Geoffrey, Vazirizade, Sayyed, Vorobeychik, Yevgeniy, Kochenderfer, Mykel, and **Dubey, Abhishek**. **2020**. "A Review of Emergency Incident Prediction, Resource Allocation and Dispatch Models". In: *Preprint at Arxiv* ()
3. Mukhopadhyay, Ayan, Pettet, Geoffrey, Samal, Chinmaya, **Dubey, Abhishek**, and Vorobeychik, Yevgeniy. **2019**. "An online decision-theoretic pipeline for responder dispatch". In: *Proceedings of the 10th ACM/IEEE International Conference on Cyber-Physical Systems, ICCPS 2019, Montreal, QC, Canada*, pp. 185–196
4. Mukhopadhyay, Ayan, Vorobeychik, Yevgeniy, **Dubey, Abhishek**, and Biswas, Gautam. **2017**. "Prioritized Allocation of Emergency Responders based on a Continuous-Time Incident Prediction Model". In: *Proceedings of the 16th Conference on Autonomous Agents and MultiAgent Systems, AAMAS 2017, São Paulo, Brazil, May 8-12, 2017*, pp. 168–177
5. Pettet, Geoffrey, Nannapaneni, Saideep, Stadnick, Benjamin, **Dubey, Abhishek**, and Biswas, Gautam. **2017**. "Incident analysis and prediction using clustering and Bayesian network". In: *2017 IEEE SmartWorld*, pp. 1–8

Resilience for Smart Grids

Reliable operation of CPS such as Smart Electric Grids is critical for the seamless functioning of a vibrant economy. Sustained power outages can lead to major disruptions over large areas costing millions of dollars. Efficient computational techniques and tools that curtail such systematic failures by performing fault diagnosis and prognostics are critical. Traditional approach is to use high-fidelity physics model to study the failure in these systems. However, these models fail to scale to large networks, especially when several multiple contingencies occur as a result of both physical failures and cyber failures. In my research, I have co-developed a novel graphical modeling formalism called temporal causal diagrams that can efficiently model fault progression paths in connected cyber-physical systems, even in systems with the built-in automatic fault-protection mechanisms like protection relays. Five publications from this area are listed below.

1. Sajan, Kaduvettykunnal, Bariya, Mohini, Basak, Sanchita, Srivastava, Anurag K., **Dubey, Abhishek**, von Meier, Alexandra, and Biswas, Gautam. **2020**. "Realistic Synchrophasor Data Generation for Anomaly Detection and Event Classification". In: *8th Workshop on Modeling and Simulation of Cyber-Physical Energy Systems, MSCPES@CPSIoTWeek*
2. Hasan, Saqib, **Dubey, Abhishek**, Karsai, Gabor, and Koutsoukos, Xenofon. **2020**. "A game-theoretic approach for power systems defense against dynamic cyber-attacks". In: *International Journal of Electrical Power & Energy Systems* 115 (). ISSN: 0142-0615
2. Chhokra, Ajay, Hasan, Saqib, **Dubey, Abhishek**, and Karsai, Gabor. **2020**. "A Binary Decision Diagram Based Cascade Prognostics Scheme For Power Systems". In: *2020 American control conference*. accepted for publication. IEEE
4. Chhokra, Ajay, **Dubey, Abhishek**, Mahadevan, Nagabhushan, Hasan, Saqib, and Karsai, Gabor. **2018**. "Diagnosis in Cyber-Physical Systems with Fault Protection Assemblies". In: *Diagnosability, Security and Safety of Hybrid Dynamic and Cyber-Physical Systems*. Ed. by Moamar Sayed-Mouchaweh. Cham: Springer International Publishing. Chap. Chapter 8, pp. 201–225. ISBN: 978-3-319-74962-4
5. Hasan, S., Ghafouri, A., **Dubey, Abhishek**, Karsai, G., and Koutsoukos, X. **Sept. 2017**. "Heuristics-based approach for identifying critical N-k contingencies in power systems". In: *2017 Resilience Week (RWS)*, pp. 191–197

Transactive Energy Systems

Transactive energy systems have emerged as a transformative solution for the problems faced by distribution system operators due to an increase in the use of distributed energy resources and rapid growth in renewable energy generation. They are tightly coupled cyber and physical systems, which require resilient and robust financial markets where transactions can be submitted and cleared, while ensuring that erroneous or malicious transactions cannot destabilize the grid. The key innovation in this work has been the design of TRANSAX platform and protocol. It provides privacy to participants by anonymizing their trading activity using a distributed mixing service, while also enforcing constraints that limit trading activity based on safety requirements, such as keeping power flow below line capacity. An important develop has been the design of the hybrid solver concept, combining the trustworthiness of distributed ledgers with the efficiency of conventional computational platforms. This hybrid architecture ensures the integrity of data and computational results—as long as majority of the ledger nodes are secure—while allowing the complex computation to be performed by a set of redundant and efficient solvers. Five publications from this area are listed below.

1. Eisele, Scott, Eghtesad, Taha, Campanelli, Keegan, Agrawal, Prakhar, Laszka, Aron, and **Dubey, Abhishek**. **2020**. "Safe and Private Forward-Trading Platform for Transactive Microgrids". In: *Transactions on Cyber-Physical Systems* ()
2. Barreto, Carlos, Eghtesad, Taha, Eisele, Scott, Laszka, Aron, **Dubey, Abhishek**, and Koutsoukos, Xenofon. **2020**. "Cyber-Attacks and Mitigation in Blockchain Based Transactive Energy Systems". In: *3rd IEEE International Conference on Industrial Cyber-Physical Systems (ICPS 2020)*
3. Laszka, Aron, Eisele, Scott, **Dubey, Abhishek**, Karsai, Gabor, and Kvaternik, Karla. **2018**. "TRANSAX: A Blockchain-Based Decentralized Forward-Trading Energy Exchanged for Transactive Microgrids". In: *24th IEEE International Conference on Parallel and Distributed Systems, ICPADS 2018, Singapore, December 11-13, 2018*, pp. 918–927
4. Laszka, Aron, **Dubey, Abhishek**, Walker, Michael, and Schmidt, Douglas C. **2017**. "Providing privacy, safety, and security in IoT-based transactive energy systems using distributed ledgers". In: *Proceedings of the Seventh International Conference on the Internet of Things, IOT 2017, Linz, Austria, October 22-25, 2017*, 13:1–13:8
5. Bergquist, Jonatan, Laszka, Aron, Sturm, Monika, and **Dubey, Abhishek**. **2017**. "On the design of communication and transaction anonymity in blockchain-based transactive microgrids". In: *Proceedings of the 1st Workshop on Scalable and Resilient Infrastructures for Distributed Ledgers, SERIAL@Middleware 2017, Las Vegas, NV, USA, December 11-15, 2017*, 3:1–3:6

Research Projects and Grants

Active Grants (Current): $22,051,815

Completed Grants: $38,847,757

Total Grant Support: $60,899,572

Grants as PI (TT)

- Total as PI (TT): $7,997,709

2020–2024 National Science Foundation. **SCC-IRG Track 1: Mobility for all - Harnessing Emerging Transit Solutions for Underserved Communities**. Award Amount: $2,134,898.

2020–2024 Department of Energy. **AI-Engine for Optimizing Integrated Service Mixed Fleet Transit Operations**. Award Amount: $1,877,535.

2020–2021 National Science Foundation. **Collaborative Research: RAPID: Addressing Transit Accessibility and Public Health Challenges due to COVID-19**. Award Amount: $54,912.

2018–2021 Department of Energy. **High-dimensional Data-driven Energy optimization for Multi-Modal transit Agencies (HD-EMMA)**. Award Amount: $1,000,000.

2019–2020 Cisco Systems Foundation. **Spatio-Temporal AI Inference Engines for System-Level Reliability**. Award Amount: $100,000.

2018–2021 National Science Foundation. **III: Small: Collaborative Research: Summarizing Heterogeneous Crowdsourced & Web Streams Using Uncertain Concept Graphs**. Award Amount: $239,953.

2018–2021 National Science Foundation. **NeTS: JUNO2: Collaborative Research: STEAM: Secure and Trustworthy Framework for Integrated Energy and Mobility in Smart Connected Communities**. Award Amount: $209,992.

2017–2019 Marriott International. **Internet of Things (IoT) Immersion**. Award Amount: $29,999.

2017–2019 Siemens. **Blockchain as Middleware Services for Transactive Energy Applications**. Award Amount: $478,375.

2017–2018 MetaMorph. **MetaMorph Draper**. Award Amount: $84,201.

2017–2018 MetaMorph. **CAD Extensions for OpenMETA**. Award Amount: $88,127.

2016–2019 Siemens. **Industry Affiliate Program Grant**. Award Amount: $450,000.

2016–2020 National Science Foundation. **USIgnite: Collaborative Research: Social Computing Platform for Multi-Modal Transit**. Award Amount: $306,376.

2016–2019 U.S. Army. **Designing Resilient Data Processing Systems for Adversarial Environments**. Award Amount: $367,161.

2016–2017 Siemens, Inc.. **City-scale Extensible Smart Cyber-Physical Systems**. Award Amount: $49,886.

Grants as PI (Pre-TT)

- Total as PI (pre TT): - $526,294.00

2015–2017 National Science Foundation. **CPS-EAGER- Experiments with Smart City Hubs: Integration Platform for Human Cyber-Physical Systems In Smart Cities**. Award Amount: $197,556.

2014–2016 Siemens, Inc.. **Building Resilient Distributed Systems for Next Generation Mobile Adhoc Cyber Physical Systems**. Award Amount: $238,188.

2012–2013 ONR.. **Domain Specific Languages for Designing Electrical Ships**. Award Amount: $40,580.

2010–2012 NSF.. **Center for Autonomic Computing**. Award Amount: $49,970.

Grants as Co-Principle Investigator (as TT)

- Total as Co-PI (TT): $16,649,925

2020–2023 Defense Advanced Research Projects Agency. **Model-based Intent-Driven Adaptive Software (MIDAS)**. PI: Karsai, Gabor. Award Amount: $3,176,697.

2020–2023 Department of Defense. **Integrated Microgrid Control Platform**. PI: Karsai, Gabor. Award Amount: $933,392.

2019–2023 National Science Foundation. **Collaborative Research: An Interdisciplinary Approach to Prepare Undergraduates for Data Science Using Real-World Data from High Frequency Monitoring Systems**. PI: Biswas, Gautam. Award Amount: $631,435.

2018–2023 National Science Foundation. **FW-HTF Theme 1: Collaborative Research: Augmenting and Advancing Cognitive Performance of Control Room Operators for Power Grid Resiliency**. PI: Biswas, Gautam. Award Amount: $323,081.

2018–2022 Defense Advanced Research Projects Agency. **Assurance-based Learning-enabled Cyber-Physical Systems (ALC)**. PI: Karsai, Gabor. Award Amount: $7,196,463.

2018–2020 Tennessee Department of Transportation. **Collaborative Research Project To Coordinate The Data From the Crash Predictive Analytics Program Between TDOT and TDOSHS**. PI: Baroud, Hiba. Award Amount: $174,998.

2018–2019 General Dynamics Land systems. **GDLS-MBSE**. PI: Bapty, Ted. Award Amount: $120,000.

2016–2020 Department of Energy. **Resilient Information Architecture Platform for the Smart Grid (RIAPS)**. PI: Karsai, Gabor. Award Amount: $3,998,459.

2016–2017 Air Force Office of Scientific Research. **SCOPE Laboratory: Experimental Test bed for Evaluating Secure Cyber Operations in Physical Environments**. PI: Gokhale, Aniruddha. Award Amount: $95,400.

Grants as Senior Person (as TT)

2018–2021 National Security Agency. **Science of Security for Cyber-Physical Systems Lablet**. PI: Koutsoukos, Xenofon. Award Amount: $14,750,776.

2009–2012 Department of Energy. **Optimization of Fault Mitigation for Large Commodity Clusters**. PI: Ted Bapty. Award Amount: $340,974.

Grants as Co-PI (pre TT)

- Total as Co-PI (Pre TT)- $11,013,728.00

2014–2016 Defense Advanced Research Projects Agency. **Support for System of Systems Integration Technology and Experimentation (SoSITE)**. PI: Karsai,Gabor. Award Amount: $96,146.

2013–2016 National Science Foundation. **CPS: Synergy: Collaborative Research: Diagnostics and Prognostics Using Temporal Causal Models for Cyber Physical Systems- A case of Smart Electric Grid**. PI: Karsai,Gabor. Award Amount: $399,951.

2012–2014 Air Force Research Laboratory. **Resilient Software Systems**. PI: Karsai,Gabor. Award Amount: $699,570.

2012–2013 Department of Defense. **Future Airborne Capability Environment (FACE 5)**. PI: Bapty, Ted. Award Amount: $3,573,021.

2011–2014 Defense Advanced Research Projects Agency. **DARPA - F6 Model-driven Development Kit (F6MDK)**. PI: Karsai,Gabor. Award Amount: $6,245,040.

Patents

- Method and system for secure and private forward trading platform in transactive microgrids (Provisional)

- Method and System for Data-Driven Forecasting of Cascading Effects in Networked Systems (applied)
- Decentralized Method and System for Real Time Anomaly Detection In Transportation Networks (applied)

Journals

2020-2016 As Assistant Professor (under review)

J1. Ramakrishna, Shreyas, Rahiminasab, Zahra, Karsai, Gabor, Easwaran, Arvind, and **Dubey, Abhishek**. **2020**. "Efficient Out-of-Distribution Detection and Diagnosis using Disentangled Latent Representations". In: *ACM Transactions on Cyber Physical Systems* ().*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.***[under review]**

J2. Chen, Yuche, Wu, Guoyuan, Sun, Ruixiao, **Dubey, Abhishek**, Laszka, Aron, and Pugliese, Philip. **2020**. "A Review and Outlook of Energy Consumption Estimation Models for Electric Vehicles". In: *Renewable and Sustainable Energy Reviews* ().*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.***[under review]**

J3. Ayman, Afiya, Sivagnanam, Amutheezan, Wilbur, Michael, Pugliese, Philip, **Dubey, Abhishek**, and Laszka, Aron. **2020**. "Data-Driven Prediction and Optimization of Energy Use for Transit Fleets of Electric and ICE Vehicles". In: *ACM Transactions on Internet of Things* ().*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.***[under review]**

J4. Eisele, Scott, Laszka, Aron, Schmidt, Doug, and **Dubey, Abhishek**. **2020**. "The Role of Blockchains in Multi-Stakeholder Transactive Energy Systems". In: *Frontiers in Blockchains* ().*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.***[under review]**

2020-2016 As Assistant Professor (Published: 21 papers)

J5. Eisele, Scott, Barreto, Carlos, **Dubey, Abhishek**, Koutsoukos, Xenofon, Eghtesad, Taha, Laszka, Aron, and Mavridou, Anastasia. **2020**. "Blockchains for Transactive Energy Systems: Opportunities, Challenges, and Approaches". In: *IEEE Computer* ().*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

Abstract The emergence of blockchains and smart contracts have renewed interest in electrical cyber-physical systems, especially in the area of transactive energy systems. However, despite recent advances, there remain significant challenges that impede the practical adoption of blockchains in transactive energy systems, which include implementing complex market mechanisms in smart contracts, ensuring safety of the power system, and protecting residential consumers' privacy. To address these challenges, we present TRANSAX, a blockchain-based transactive energy system that provides an efficient, safe, and privacy-preserving market built on smart contracts. Implementation and deployment of TRANSAX in a verifiably correct and efficient way is based on VeriSolid, a framework for the correct-by-construction development of smart contracts, and RIAPS, a middleware for resilient distributed power systems

J6. Eisele, Scott, Eghtesad, Taha, Campanelli, Keegan, Agrawal, Prakhar, Laszka, Aron, and **Dubey, Abhishek**. **2020**. "Safe and Private Forward-Trading Platform for Transactive Microgrids". In: *Transactions on Cyber-Physical Systems* ().*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

Abstract Building a decentralized market for transactive microgrids is challenging because even though a decentralized system provides resilience, it also must satisfy requirements like privacy, efficiency, safety, and security, which are often in conflict with each other. As such, existing implementations of decentralized markets often focus on resilience and safety but compromise on privacy. In this paper, we describe our platform, called TRANSAX, which enables participants to trade in an energy futures market, which improves efficiency by finding feasible matches for energy trades, enabling DSOs to plan their energy needs better. TRANSAX provides privacy to participants by anonymizing their trading activity using a distributed mixing service, while also enforcing constraints that limit trading activity based on safety requirements, such as keeping planned energy flow below line capacity. We show that TRANSAX can satisfy the seemingly conflicting requirements of efficiency, safety, and privacy. We also provide an analysis of how much trading efficiency is lost. Trading efficiency is improved through the problem formulation which accounts for temporal flexibility, and system efficiency is improved using a hybrid-solver architecture. Finally, we describe a testbed to run experiments and demonstrate its performance using simulation results.

J7. Ghosh, Purboday, Eisele, Scott, **Dubey, Abhishek**, Metelko, Mary, Madari, Istvan, Volgyesi, Peter, and Karsai, Gabor. **2020**. "Designing a decentralized fault-tolerant software framework for smart grids and its applications". In: *Journal of Systems Architecture* 109 (), p. 101759. ISSN: 1383-7621.*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

Abstract The vision of the 'Smart Grid' anticipates a distributed real-time embedded system that implements various monitoring and control functions. As the reliability of the power grid is critical to modern society, the software supporting the grid must support fault tolerance and resilience of the resulting cyber-physical system. This paper describes the fault-tolerance features of a software framework called Resilient Information Architecture Platform for Smart Grid (RIAPS). The framework supports various mechanisms for fault detection and mitigation and works in concert with the applications that implement the grid-specific functions. The paper discusses the design philosophy for and the implementation of the fault tolerance features and presents an application example to show how it can be used to build highly resilient systems.

J8. Nannapaneni, Saideep, Mahadevan, Sankaran, **Dubey, Abhishek**, and Lee, Yung-Tsun Tina. **2020**. "Online monitoring and control of a cyber-physical manufacturing process under uncertainty". In: *Journal of Intelligent Manufacturing* (), pp. 1–16.*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

Abstract Recent technological advancements in computing, sensing and communication have led to the development of cyber-physical manufacturing processes, where a computing subsystem monitors the manufacturing process performance in real-time by analyzing sensor data and implements the necessary control to improve the product quality. This paper develops a predictive control framework where control actions are implemented after predicting the state of the manufacturing process or product quality at a future time using process models. In a cyber-physical manufacturing process, the product quality predictions may be affected by uncertainty sources from the computing subsystem (resource and communication uncertainty), manufacturing process (input uncertainty, process variability and modeling errors), and sensors (measurement uncertainty). In addition, due to the continuous interactions between the computing subsystem and the manufacturing process, these uncertainty sources may aggregate and compound over time. In some cases, some process parameters needed for model predictions may not be precisely known and may need to be derived from real time sensor data. This paper develops a dynamic Bayesian network approach, which enables the aggregation of multiple uncertainty sources, parameter estimation and robust prediction for online control. As the number of process parameters increase, their estimation using sensor data in real-time can be computationally expensive. To facilitate real-time analysis, variance-based global sensitivity analysis is used for dimension reduction. The proposed methodology of online monitoring and control under uncertainty, and dimension reduction, are illustrated for a cyber-physical turning process.

J9. Tu, H., Du, Y., Yu, H., **Dubey, Abhishek**, Lukic, S., and Karsai, G. **2020**. "Resilient Information Architecture Platform for the Smart Grid: A Novel Open-Source Platform for Microgrid Control". In: *IEEE Transactions on Industrial Electronics* 67.11 (), pp. 9393–9404 .*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

Abstract Microgrids are seen as an effective way to achieve reliable, resilient, and efficient operation of the power distribution system. Core functions of the microgrid control system are defined by the IEEE Standard 2030.7; however, the algorithms that realize these functions are not standardized, and are a topic of research. Furthermore, the corresponding controller hardware, operating system, and communication system to implement these functions vary significantly from one implementation to the next. In this article, we introduce an open-source platform, resilient information architecture platform for the smart grid (RIAPS), ideally suited for implementing and deploying distributed microgrid control algorithms. RIAPS provides a design-time tool suite for development and deployment of distributed microgrid control algorithms. With support from a number of run-time platform services, developed algorithms can be easily implemented and deployed into real microgrids. To demonstrate the unique features of RIAPS, we propose and implement a distributed microgrid secondary control algorithm capable of synchronized and proportional compensation of voltage unbalance using distributed generators. Test results show the effectiveness of the proposed control and the salient features of the RIAPS platform.

J10. Ramakrishna, Shreyas, Harstell, Charles, Burruss, Matthew P., Karsai, Gabor, and **Dubey, Abhishek**. **2020**. "Dynamic-weighted simplex strategy for learning enabled cyber physical systems". In: *Journal of Systems Architecture* 111 (), p. 101760. ISSN: 1383-7621 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

Abstract Cyber Physical Systems (CPS) have increasingly started using Learning Enabled Components (LECs) for performing perception-based control tasks. The simple design approach, and their capability to continuously learn has led to their widespread use in different autonomous applications. Despite their simplicity and impressive capabilities, these components are difficult to assure, which makes their use challenging. The problem of assuring CPS with untrusted controllers has been achieved using the Simplex Architecture. This architecture integrates the system to be assured with a safe controller and provides a decision logic to switch between the decisions of these controllers. However, the key challenges in using the Simplex Architecture are: (1) designing an effective decision logic, and (2) sudden transitions between controller decisions lead to inconsistent system performance. To address these research challenges, we make three key contributions: (1) dynamic-weighted simplex strategy – we introduce "weighted simplex strategy" as the weighted ensemble extension of the classical Simplex Architecture. We then provide a reinforcement learning based mechanism to find dynamic ensemble weights, (2) middleware framework – we design a framework that allows the use of the dynamic-weighted simplex strategy, and provides a resource manager to monitor the computational resources, and (3) hardware testbed – we design a remote-controlled car testbed called DeepNNCar to test and demonstrate the aforementioned key concepts. Using the hardware, we show that the dynamic-weighted simplex strategy has 60% fewer out-of-track occurrences (soft constraint violations), while demonstrating higher optimized speed (performance) of 0.4 m/s during indoor driving than the original LEC driven system.

J11. Hasan, Saqib, **Dubey, Abhishek**, Karsai, Gabor, and Koutsoukos, Xenofon. **2020**. "A game-theoretic approach for power systems defense against dynamic cyber-attacks". In: *International Journal of Electrical Power & Energy Systems* 115 (). ISSN: 0142-0615 .*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

Abstract Technological advancements in today's electrical grids give rise to new vulnerabilities and increase the potential attack surface for cyber-attacks that can severely affect the resilience of the grid. Cyber-attacks are increasing both in number as well as sophistication and these attacks can be strategically organized in chronological order (dynamic attacks), where they can be instantiated at different time instants. The chronological order of attacks enables us to uncover those attack combinations that can cause severe system damage but this concept remained unexplored due to the lack of dynamic attack models. Motivated by the idea, we consider a game-theoretic approach to design a new attacker-defender model for power systems. Here, the attacker can strategically identify the chronological order in which the critical substations and their protection assemblies can be attacked in order to maximize the overall system damage. However, the defender can intelligently identify the critical substations to protect such that the system damage can be minimized. We apply the developed algorithms to the IEEE-39 and 57 bus systems with finite attacker/defender budgets. Our results show the effectiveness of these models in improving the system resilience under dynamic attacks.

J12. Shekhar, Shashank, Chhokra, Ajay, Sun, Hongyang, Gokhale, Aniruddha, **Dubey, Abhishek**, Koutsoukos, Xenofon, and Karsai, Gabor. **2020**. "URMILA: Dynamically Trading-off Fog and Edge Resources for Performance and Mobility-Aware IoT Services". In: *Journal of Systems Architecture* (). ISSN: 1383-7621.*Contributions: Collaboratively developed the research ideas and wrote/edited a minor portion of the paper.*

Abstract The fog/edge computing paradigm is increasingly being adopted to support a range of latency-sensitive IoT services due to its ability to assure the latency requirements of these services while supporting the elastic properties of cloud computing. IoT services that cater to user mobility, however, face a number of challenges in this context. First, since user mobility can incur wireless connectivity issues, executing these services entirely on edge resources, such as smartphones, will result in a rapid drain in the battery charge. In contrast, executing these services entirely on fog resources, such as cloudlets or micro data centers, will incur higher communication costs and increased latencies in the face of fluctuating wireless connectivity and signal strength. Second, a high degree of multi-tenancy on fog resources involving different IoT services can lead to performance interference issues due to resource contention. In order to address these challenges, this paper describes URMILA, which makes dynamic resource management decisions to achieve effective trade-offs between using the fog and edge resources yet ensuring that the latency requirements of the IoT services are met. We evaluate URMILA's capabilities in the context of a real-world use case on an emulated but realistic IoT testbed.

J13. Sun, Fangzhou, **Dubey, Abhishek**, White, Jules, and Gokhale, Aniruddha. **Jan. 2019**. "Transit-hub: a smart public transportation decision support system with multi-timescale analytical services". In: *Cluster Computing* 22.Suppl 1 (), pp. 2239–2254.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

Abstract Public transit is a critical component of a smart and connected community. As such, citizens expect and require accurate information about real-time arrival/departures of transportation assets. As transit agencies enable large-scale integration of real-time sensors and support back-end data-driven decision support systems, the dynamic data-driven applications systems (DDDAS) paradigm becomes a promising approach to make the system smarter by providing online model learning and multi-time scale analytics as part of the decision support system that is used in the DDDAS feedback loop. In this paper, we describe a system in use in Nashville and illustrate the analytic methods developed by our team. These methods use both historical as well as real-time streaming data for online bus arrival prediction. The historical data is used to build classifiers that enable us to create expected performance models as well as identify anomalies. These classifiers can be used to provide schedule adjustment feedback to the metro transit authority. We also show how these analytics services can be packaged into modular, distributed and resilient micro-services that can be deployed on both cloud back ends as well as edge computing resources.

J14. Tu, H., Du, Y., Yu, H., **Dubey, Abhishek**, Lukic, S., and Karsai, G. **2019**. "Resilient Information Architecture Platform for the Smart Grid (RIAPS): A Novel Open-Source Platform for Microgrid Control". In: *IEEE Transactions on Industrial Electronics* (), pp. 1–1. ISSN: 1557-9948.*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

Abstract Microgrids are seen as an effective way to achieve reliable, resilient, and efficient operation of the power distribution system. Core functions of the microgrid control system are defined by the IEEE standard 2030.7; however, the algorithms that realize these functions are not standardized, and are a topic of research. Furthermore, the corresponding controller hardware, operating system, and communication system to implement these functions vary significantly from one implementation to the next. In this paper, we introduce an open-source platform, Resilient Information Architecture Platform for the Smart Grid (RIAPS), ideally suited for implementing and deploying distributed microgrid control algorithms. RIAPS provides a design-time tool suite for development and deployment of distributed microgrid control algorithms. With support from a number of run-time platform services, developed algorithms can be easily implemented and deployed into real microgrids. To demonstrate the unique features of RIAPS, we propose and implement a distributed microgrid secondary control algorithm capable of synchronized and proportional compensation of voltage unbalance using distributed generators. Test results show the effectiveness of the proposed control and the salient features of the RIAPS platform.

J15. **Dubey, Abhishek**, Emfinger, W., Gokhale, A., Kumar, P., McDermet, D., Bapty, T., and Karsai, G. **July 2019**. "Enabling Strong Isolation for Distributed Real-Time Applications in Edge Computing Scenarios". In: *IEEE Aerospace and Electronic Systems Magazine* 34.7 (), pp. 32–45. ISSN: 1557-959X.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

Abstract Distributed coexisting applications found in the military and space domains, which operate over managed but shared computing resources at the edge require strong isolation from each other. The state of the art for computation sharing at the edge is traditionally based on Docker and similar pseudovirtualization features. Our team has been working on an end-to-end architecture that provides strong spatial and temporal isolation similar to what has become standard in avionics communities. In this paper, we describe an open-source extension to Linux that we have designed and implemented for our distributed real-time embedded managed systems (DREMS) architecture. The key concepts are the partitioning scheduler, strong security design, and a health management interface.

J16. Eisele, Scott, Eghtesad, Taha, Campanelli, Keegan, Agrawal, Prakhar, Laszka, Aron, and **Dubey, Abhishek**. **2019**. "Safe and Private Forward-Trading Platform for Transactive Microgrids". In: *Transactions of Cyber Physical systems* abs/1910.12579 (). To Appear.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

Abstract Transactive microgrids have emerged as a transformative solution for the problems faced by distribution system operators due to an increase in the use of distributed energy resources and rapid growth in renewable energy generation. Transactive microgrids are tightly coupled cyber and physical systems, which require resilient and robust financial markets where transactions can be submitted and cleared, while ensuring that erroneous or malicious transactions cannot destabilize the grid. In this paper, we introduce TRANSAX, a novel decentralized platform for transactive microgrids. TRANSAX enables participants to trade in an energy futures market, which improves efficiency by finding feasible matches for energy trades, reducing the load on the distribution system operator. TRANSAX provides privacy to participants by anonymizing their trading activity using a distributed mixing service, while also enforcing constraints that limit trading activity based on safety requirements, such as keeping power flow below line capacity. We show that TRANSAX can satisfy the seemingly conflicting requirements of efficiency, safety, and privacy, and we demonstrate its performance using simulation results.

J17. **Dubey, Abhishek**, Karsai, Gabor, Volgyesi, Peter, Metelko, Mary, Madari, Istvan, Tu, Hao, Du, Yuhua, and Lukic, Srdjan. **2019**. "Device Access Abstractions for Resilient Information Architecture Platform for Smart Grid". In: *Embedded Systems Letters* 11.2 (), pp. 34–37.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

Abstract This paper presents an overview of design mechanisms to abstract device access protocols in the resilient information architecture platform for smart grid, a middleware for developing distributed smart grid applications. These mechanisms are required to decouple the application functionality from the specifics of the device mechanisms built by the device vendors.

J18. Chhokra, Ajay, **Dubey, Abhishek**, Mahadevan, Nagabhushan, Karsai, Gabor, Balasubramanian, Daniel, and Hasan, Saqib. **Feb. 2018**. "Hierarchical Reasoning about Faults in Cyber-Physical Energy Systems using Temporal Causal Diagrams". In: *International Journal of Prognostics and Health Management* 9.1 ().*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

Abstract The resiliency and reliability of critical cyber physical systems like electrical power grids are of paramount importance. These systems are often equipped with specialized protection devices to detect anomalies and isolate faults in order to arrest failure propagation and protect the healthy parts of the system. However, due to the limited situational awareness and hidden failures the protection devices themselves, through their operation (or mis-operation) may cause overloading and the disconnection of parts of an otherwise healthy system. This can result in cascading failures that lead to a blackout. Diagnosis of failures in such systems is extremely challenging because of the need to account for faults in both the physical systems as well as the protection devices, and the failure-effect propagation across the system. Our approach for diagnosing such cyber-physical systems is based on the concept of Temporal Causal Diagrams (TCD-s) that capture the timed discrete models of protection devices and their interactions with a system failure propagation graph. In this paper we present a refinement of the TCD language with a layer of independent local observers that aid in diagnosis. We describe a hierarchical two-tier failure diagnosis approach and showcase the results for 4 different scenarios involving both cyber and physical faults in a standard Western System Coordinating Council (WSCC) 9 bus system.

J19. Valls, Marisol Garcia, **Dubey, Abhishek**, and Botti, Vicent J. **2018**. "Introducing the new paradigm of Social Dispersed Computing: Applications, Technologies and Challenges". In: *Journal of Systems Architecture - Embedded Systems Design* 91 (), pp. 83–102.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

Abstract If last decade viewed computational services as a utilitythen surely this decade has transformed computation into a commodity. Computation is now progressively integrated into the physical networks in a seamless way that enables cyber-physical systems (CPS) and the Internet of Things (IoT) meet their latency requirements. Similar to the concept of "platform as a service" or "software as a service", both cloudlets and fog computing have found their own use cases. Edge devices (that we call end or user devices for disambiguation) play the role of personal computers, dedicated to a user and to a set of correlated applications. In this new scenario, the boundaries between the network node, the sensor, and the actuator are blurring, driven primarily by the computation power of IoT nodes like single board computers and the smartphones. The bigger data generated in this type of networks needs clever, scalable, and possibly decentralized computing solutions that can scale independently as required. Any node can be seen as part of a graph, with the capacity to serve as a computing or network router node, or both. Complex applications can possibly be distributed over this graph or network of nodes to improve the overall performance like the amount of data processed over time. In this paper, we identify this new computing paradigm that we call Social Dispersed Computing, analyzing key themes in it that includes a new outlook on its relation to agent based applications. We architect this new paradigm by providing supportive application examples that include next generation electrical energy distribution networks, next generation mobility services for transportation, and applications for distributed analysis and identification of non-recurring traffic congestion in cities. The paper analyzes the existing computing paradigms (e.g., cloud, fog, edge, mobile edge, social, etc.), solving the ambiguity of their definitions; and analyzes and discusses the relevant foundational software technologies, the remaining challenges, and research opportunities.

J20. Pradhan, Subhav, **Dubey, Abhishek**, Khare, Shweta, Nannapaneni, Saideep, Gokhale, Aniruddha S., Mahadevan, Sankaran, Schmidt, Douglas C., and Lehofer, Martin. **2018**. "CHARIOT: Goal-Driven Orchestration Middleware for Resilient IoT Systems". In: *Transactions of Cyber Physical Systems* 2.3 (), 16:1–16:37.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

Abstract An emerging trend in Internet of Things (IoT) applications is to move the computation (cyber) closer to the source of the data (physical). This paradigm is often referred to as edge computing. If edge resources are pooled together they can be used as decentralized shared resources for IoT applications, providing increased capacity to scale up computations and minimize end-to-end latency. Managing applications on these edge resources is hard, however, due to their remote, distributed, and (possibly) dynamic nature, which necessitates autonomous management mechanisms that facilitate application deployment, failure avoidance, failure management, and incremental updates. To address these needs, we present CHARIOT, which is orchestration middleware capable of autonomously managing IoT systems consisting of edge resources and applications. CHARIOT implements a three-layer architecture. The topmost layer comprises a system description language, the middle layer comprises a persistent data storage layer and the corresponding schema to store system information, and the bottom layer comprises a management engine that uses information stored persistently to formulate constraints that encode system properties and requirements, thereby enabling the use of Satisfiability Modulo Theories (SMT) solvers to compute optimal system (re)configurations dynamically at runtime. This paper describes the structure and functionality of CHARIOT and evaluates its efficacy as the basis for a smart parking system case study that uses sensors to manage parking spaces.

J21. Nannapaneni, S., Mahadevan, S., Dubey, A., Lechevalier, D., Narayanan, A., and Rachuri, S. **2017**. "Automated Uncertainty Quantification Through Information Fusion in Manufacturing Processes". eng. In: *Smart and Sustainable Manufacturing Systems* 1.1 (), pp. 153–177. ISSN: 25206478.*Contributions: Collaboratively developed the research ideas and wrote/edited a minor portion of the paper.*

Abstract Evaluation of key performance indicators (KPIs) such as energy consumption is essential for decision-making during the design and operation of smart manufacturing systems. The measurements of KPIs are strongly affected by several uncertainty sources such as input material uncertainty, the inherent variability in the manufacturing process, model uncertainty, and the uncertainty in the sensor measurements of operational data. A comprehensive understanding of the uncertainty sources and their effect on the KPIs is required to make the manufacturing processes more efficient. Towards this objective, this paper proposed an automated methodology to generate a hierarchical Bayesian network (HBN) for a manufacturing system from semantic system models, physics-based models, and available data in an automated manner, which can be used to perform uncertainty quantification (UQ) analysis. The semantic system model, which is a high-level model describing the system along with its parameters, is assumed to be available in the generic modeling environment (GME) platform. Apart from semantic description, physics-based models, if available, are assumed to be available in model libraries. The proposed methodology was divided into two tasks: (1) automated hierarchical Bayesian network construction using the semantic system model, available models and data, and (2) automated uncertainty quantification (UQ) analysis. A metamodel of an HBN was developed using the GME, along with a syntax representation for the associated conditional probability tables/distributions. The constructed HBN corresponding to a system was represented as an instance model of the HBN metamodel. On the metamodel, a model interpreter was written to be able to carry out the UQ analysis in an automated manner for any HBN instance model conforming to the HBN metamodel. The proposed methodologies are demonstrated using an injection molding process.

J22. Pradhan, Subhav, **Dubey, Abhishek**, Levendovszky, Tihamer, Kumar, Pranav Srinivas, Emfinger, William, Balasubramanian, Daniel, Otte, William, and Karsai, Gabor. **2016**. "Achieving resilience in distributed software systems via self-reconfiguration". In: *Journal of Systems and Software* 122 (), pp. 344–363.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

Abstract Improvements in mobile networking combined with the ubiquitous availability and adoption of low-cost development boards have enabled the vision of mobile platforms of Cyber-Physical Systems (CPS), such as fractionated spacecraft and UAV swarms. Computation and communication resources, sensors, and actuators that are shared among different applications characterize these systems. The cyber-physical nature of these systems means that physical environments can affect both the resource availability and software applications that depend on resource availability. While many application development and management challenges associated with such systems have been described in existing literature, resilient operation and execution have received less attention. This paper describes our work on improving runtime support for resilience in mobile CPS, with a special focus on our runtime infrastructure that provides autonomous resilience via self-reconfiguration. We also describe the interplay between this runtime infrastructure and our design-time tools, as the later is used to statically determine the resilience properties of the former. Finally, we present a use case study to demonstrate and evaluate our design-time resilience analysis and runtime self-reconfiguration infrastructure.

J23. Martins, Gonçalo, Moondra, Arul, **Dubey, Abhishek**, Bhattacharjee, Anirban, and Koutsoukos, Xenofon D. **2016**. "Computation and Communication Evaluation of an Authentication Mechanism for Time-Triggered Networked Control Systems". In: *Sensors* 16.8 (), p. 1166.*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

Abstract In modern networked control applications, confidentiality and integrity are important features to address in order to prevent against attacks. Moreover, network control systems are a fundamental part of the communication components of current cyber-physical systems (e.g., automotive communications). Many networked control systems employ Time-Triggered (TT) architectures that provide mechanisms enabling the exchange of precise and synchronous messages. TT systems have computation and communication constraints, and with the aim to enable secure communications in the network, it is important to evaluate the computational and communication overhead of implementing secure communication mechanisms. This paper presents a comprehensive analysis and evaluation of the effects of adding a Hash-based Message Authentication (HMAC) to TT networked control systems. The contributions of the paper include (1) the analysis and experimental validation of the communication overhead, as well as a scalability analysis that utilizes the experimental result for both wired and wireless platforms and (2) an experimental evaluation of the computational overhead of HMAC based on a kernel-level Linux implementation. An automotive application is used as an example, and the results show that it is feasible to implement a secure communication mechanism without interfering with the existing automotive controller execution times. The methods and results of the paper can be used for evaluating the performance impact of security mechanisms and, thus, for the design of secure wired and wireless TT networked control systems.

J24. Biswas, Gautam, Khorasgani, Hamed, Stanje, Gerald, **Dubey, Abhishek**, Deb, Somnath, and Ghoshal, Sudipto. **2016**. "An approach to mode and anomaly detection with spacecraft telemetry data". In: *International Journal of Prognostics and Health Management* ().*Contributions: Collaboratively developed the research ideas and wrote/edited a minor portion of the paper.*

Abstract This paper discusses a mixed method that combines unsupervised learning methods and human expert input for analyzing telemetry data from long-duration robotic space missions. Our goal is to develop more automated methods detecting anomalies in time series data. Once anomalies are identified using unsupervised learning methods we use feature selection methods followed by expert input to derive the knowledge required for building on-line detectors. These detectors can be used in later phases of the current mission and in future missions for improving operations and overall safety of the mission. Whereas the primary focus in this paper is on developing data-driven anomaly detection methods, we also present a computational platform for data mining and analytics that can operate on historical data offline, as well as incoming telemetry data on-line.

J25. Nannapaneni, Saideep, **Dubey, Abhishek**, Abdelwahed, Sherif, Mahadevan, Sankaran, Neema, Sandeep, and Bapty, Ted. **2016**. "Mission-based reliability prediction in component-based systems". In: *International Journal of Prognostics and Health Management* 7.001 ().*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

Abstract This paper develops a framework for the extraction of a reliability block diagram in component-based systems for reliability prediction with respect to specific missions. A mission is defined as a composition of several high-level functions occurring at different stages and for a specific time during the mission. The high-level functions are decomposed into lower-level functions, which are then mapped to their corresponding components or component assemblies. The reliability block diagram is obtained using functional decomposition and function-component association. Using the reliability block diagram and the reliability information on the components such as failure rates, the reliability of the system carrying out a mission can be estimated. The reliability block diagram is evaluated by converting it into a logic (Boolean) expression. A modeling language created using the Generic Modeling Environment (GME) platform is used, which enables modeling of a system and captures the functional decomposition and function-component association in the system. This framework also allows for real-time monitoring of the system performance where the reliability of the mission can be computed over time as the mission progresses. The uncertainties in the failure rates and operational time of each high-level function are also considered which are quantified through probability distributions using the Bayesian framework. The dependence between failures of components are also considered and are quantified through a Bayesian network (BN). Other quantities of interest such as mission feasibility and function availability can also be assessed using this framework. Mission feasibility analysis determines if the mission can be accomplished given the current state of components in the system, and function availability provides information whether the function will be available in the future given the current state of the system. The proposed methodology is demonstrated using a radio-controlled (RC) car to carry out a simple surveillance mission.

2015-2009 <u>As Research Scientist</u> (7 papers)

J26. Balasubramanian, Daniel, **Dubey, Abhishek**, Otte, William, Levendovszky, Tihamer, Gokhale, Aniruddha S., Kumar, Pranav Srinivas, Emfinger, William, and Karsai, Gabor. **2015**. "DREMS ML: A wide spectrum architecture design language for distributed computing platforms". In: *Sci. Comput. Program.* 106 (), pp. 3–29.*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

Abstract Complex sensing, processing and control applications running on distributed platforms are difficult to design, develop, analyze, integrate, deploy and operate, especially if resource constraints, fault tolerance and security issues are to be addressed. While technology exists today for engineering distributed, real-time component-based applications, many problems remain unsolved by existing tools. Model-driven development techniques are powerful, but there are very few existing and complete tool chains that offer an end-to-end solution to developers, from design to deployment. There is a need for an integrated model-driven development environment that addresses all phases of application lifecycle including design, development, verification, analysis, integration, deployment, operation and maintenance, with supporting automation in every phase. Arguably, a centerpiece of such a model-driven environment is the modeling language. To that end, this paper presents a wide-spectrum architecture design language called DREMS ML that itself is an integrated collection of individual domain-specific sub-languages. We claim that the language promotes "correct-by-construction" software development and integration by supporting each individual phase of the application lifecycle. Using a case study, we demonstrate how the design of DREMS ML impacts the development of embedded systems.

J27. Mahadevan, Nagabhushan, **Dubey, Abhishek**, Chhokra, Ajay, Guo, Huangcheng, and Karsai, Gabor. **2015**. "Using temporal causal models to isolate failures in power system protection devices". In: *IEEE Instrum. Meas. Mag.* 18.4 (), pp. 28–39.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

Abstract We introduced the modeling paradigm of Temporal Causal Diagrams (TCD) in this paper. TCDs capture fault propagation and behavior (nominal and faulty) of system components. An example model for the power transmission systems was also described. This TCD model was then used to develop an executable simulation model in Simulink/ Stateflow. Though this translation of TCD to an executable model is currently done manually, we are developing model templates and tools to automate this process. Simulations results (i.e., event traces) for a couple of single and multi-fault scenarios were also presented. As part of our future work, we wish to test and study the scalability of this approach towards a larger power transmission system taking into account a far richer set of protection elements. Further, we wish to consider more realistic event traces from the fault scenarios including missing, inconsistent and out-of-sequence alarms and events.

J28. Levendovszky, Tihamer, **Dubey, Abhishek**, Otte, William, Balasubramanian, Daniel, Coglio, Alessandro, Nyako, Sandor, Emfinger, William, Kumar, Pranav Srinivas, Gokhale, Aniruddha S., and Karsai, Gabor. **2014**. "Distributed Real-Time Managed Systems: A Model-Driven Distributed Secure Information Architecture Platform for Managed Embedded Systems". In: *IEEE Software* 31.2 (), pp. 62–69.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

Abstract Architecting software for a cloud computing platform built from mobile embedded devices incurs many challenges that aren't present in traditional cloud computing. Both effectively managing constrained resources and isolating applications without adverse performance effects are needed. A practical design- and runtime solution incorporates modern software development practices and technologies along with novel approaches to address these challenges. The patterns and principles manifested in this system can potentially serve as guidelines for current and future practitioners in this field.

J29. Mahadevan, Nagabhushan, **Dubey, Abhishek**, Balasubramanian, Daniel, and Karsai, Gabor. **2013**. "Deliberative, search-based mitigation strategies for model-based software health management". In: *ISSE* 9.4 (), pp. 293–318.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

Abstract Rising software complexity in aerospace systems makes them very difficult to analyze and prepare for all possible fault scenarios at design time; therefore, classical run-time fault tolerance techniques such as self-checking pairs and triple modular redundancy are used. However, several recent incidents have made it clear that existing software fault tolerance techniques alone are not sufficient. To improve system dependability, simpler, yet formally specified and verified run-time monitoring, diagnosis, and fault mitigation capabilities are needed. Such architectures are already in use for managing the health of vehicles and systems. Software health management is the application of these techniques to software systems. In this paper, we briefly describe the software health management techniques and architecture developed by our research group. The foundation of the architecture is a real-time component framework (built upon ARINC-653 platform services) that defines a model of computation for software components. Dedicated architectural elements: the Component Level Health Manager (CLHM) and System Level Health Manager (SLHM) provide the health management services: anomaly detection, fault source isolation, and fault mitigation. The SLHM includes a diagnosis engine that (1) uses a Timed Failure Propagation Graph (TFPG) model derived from the component assembly model, (2) reasons about cascading fault effects in the system, and (3) isolates the fault source component(s). Thereafter, the appropriate system-level mitigation action is taken. The main focus of this article is the description of the fault mitigation architecture that uses goal-based deliberative reasoning to determine the best mitigation actions for recovering the system from the identified failure mode.

J30. Pradhan, Subhav, Otte, William, **Dubey, Abhishek**, Gokhale, Aniruddha S., and Karsai, Gabor. **2013**. "Towards a resilient deployment and configuration infrastructure for fractionated spacecraft". In: *SIGBED Review* 10.4 (), pp. 29–32.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

Abstract Fractionated spacecraft are clusters of small, independent modules that interact wirelessly to realize the functionality of a traditional monolithic spacecraft. System F6 (F6 stands for Future, Fast, Flexible, Fractionated, Free-Flying spacecraft) is a DARPA program for fractionated spacecraft. Software applications in F6 are implemented in the context of the F6 Information Architecture Platform (IAP), which provides component-based abstractions for composing distributed applications. The lifecycle of these distributed applications must be managed autonomously by a deployment and configuration (D&C) infrastructure, which can redeploy and reconfigure the running applications in response to faults and other anomalies that may occur during system operation. Addressing these D&C requirements is hard due to the significant fluctuation in resource availabilities, constraints on resources, and safety and security concerns. This paper presents the key architectural ideas that are required in realizing such a D&C infrastructure.

J31. Chalfant, Julie, Langland, Blake, Abdelwahed, Sherif, Chryssostomidis, Chryssostomos, Dougal, Roger, **Dubey, Abhishek**, El Mezyani, Touria, Herbst, JD, Kiehne, Thomas, and Ordonez, Juan, et al. **2012**. "A collaborative early-stage ship design environment". In: .*Contributions: Collaboratively developed the research ideas and wrote/edited a minor portion of the paper.*

Abstract Recent advances in sensor and weapons systems are significantly increasing the electrical power that is required and the thermal loads that must be dissipated onboard US Navy ships. Thus, design tools and methods must bring detailed consideration of all disciplines early in the design process, including electrical, thermal and controls in addition to the traditional naval architecture and marine engineering. Effective interface of the multiple disciplines demands a collaborative design process. The Electric Ship Research and Development Consortium (ESRDC) has developed the backbone structure of a collaborative design environment with the goal of bringing together many disciplines early in the ship design process. This design environment brings many innovations, especially in the arena of simultaneous collaborative design. This paper describes the Smart Ship System Design (S3D) environment as developed to date, along with overall and discipline-specific visions of implementation of the environment in ship design.

J32. **Dubey, Abhishek**, Karsai, Gabor, and Mahadevan, Nagabhushan. **2011**. "A component model for hard real-time systems: CCM with ARINC-653". In: *Softw., Pract. Exper.* 41.12 (), pp. 1517–1550.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

Abstract Size and complexity of software in safety critical system is increasing at a rapid pace. One technology that can be used to mitigate this complexity is component-based software development. However, in spite of the apparent benefits of a component-based approach to development, little work has been done in applying these concepts to hard real time systems. This paper improves the state of the art by making three contributions: (1) we present a component model for hard real time systems and define the semantics of different types of component interactions; (2) we present an implementation of a middleware that supports this component model. This middleware combines an open source CORBA Component Model (CCM) implementation (MICO) with ARINC-653: a state of the art RTOS standard, (3) finally; we describe a modeling environment that enables design, analysis, and deployment of component assemblies. We conclude with a discussion of lessons learned during this exercise. Our experiences point towards extending both the CCM as well as revising the ARINC-653.

<2009 As PhD. Student (4 papers)

J33. Nordstrom, Steven, **Dubey, Abhishek**, Keskinpala, Turker, Neema, Sandeep, and Bapty, Theodore. **2011**. "Autonomic Healing of Model-Based Systems". In: *JACIC* 8.4 (), pp. 87–99.*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

J34. Piccoli, Luciano, **Dubey, Abhishek**, Simone, James N, and Kowalkowlski, James B. **Apr. 2010**. "LQCD workflow execution framework: Models, provenance and fault-tolerance". In: *Journal of Physics: Conference Series* 219.7 (), p. 072047.*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

J35. **Dubey, Abhishek**, Mehrotra, Rajat, Abdelwahed, Sherif, and Tantawi, Asser N. **2009**. "Performance modeling of distributed multi-tier enterprise systems". In: *SIGMETRICS Performance Evaluation Review* 37.2 (), pp. 9–11.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

J36. **Dubey, Abhishek**, Nordstrom, Steven, Keskinpala, Turker, Neema, Sandeep, Bapty, Ted, and Karsai, Gabor. **2007**. "Towards a verifiable real-time, autonomic, fault mitigation framework for large scale real-time systems". In: *ISSE* 3.1 (), pp. 33–52.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

Abstract Designing autonomic fault responses is difficult, particularly in large-scale systems, as there is no single 'perfect' fault mitigation response to a given failure. The design of appropriate mitigation actions depend upon the goals and state of the application and environment. Strict time deadlines in real-time systems further exacerbate this problem. Any autonomic behavior in such systems must not only be functionally correct but should also conform to properties of liveness, safety and bounded time responsiveness. This paper details a real-time fault-tolerant framework, which uses a reflex and healing architecture to provide fault mitigation capabilities for large-scale real-time systems. At the heart of this architecture is a real-time reflex engine, which has a state-based failure management logic that can respond to both event- and time-based triggers. We also present a semantic domain for verifying properties of systems, which use this framework of real-time reflex engines. Lastly, a case study, which examines the details of such an approach, is presented.

Book Chapters

2020-2016 As Assistant Professor (7 Chapters)

B1. Bapty, Ted, **Dubey, Abhishek**, and Sztipanovits, Janos. **2020**. "Cyber-Physical Vulnerability Analysis of IoT Applications Using Multi-Modeling". In: *Modeling and Design of Secure Internet of Things*. John Wiley and Sons. Chap. 8, pp. 161–184. ISBN: 9781119593386.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

B2. Ramakrishna, Shreyas, Hartsell, Charles, **Dubey, Abhishek**, Pal, Partha, and Karsai, Gabor. **2020**. "A Methodology for Automating Assurance Case Generation". In: *Thirteenth International Tools and Methods of Competitive Engineering Symposium (TMCE 2020).Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

B3. Zhang, Peng, Schmidt, Douglas C., White, Jules, and **Dubey, Abhishek**. **2019**. "Chapter Seven - Consensus mechanisms and information security technologies". In: *Advances in Computers*. Vol. 115. Oreilly, pp. 181–209.*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

B4. Walker, Michael A., Schmidt, Douglas C., and **Dubey, Abhishek**. **2019**. "Chapter Six - Testing at scale of IoT blockchain applications". In: *Advances in Computers*. Vol. 115. Oreilly, pp. 155–179.*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

B5. Chhokra, Ajay, **Dubey, Abhishek**, Mahadevan, Nagabhushan, Hasan, Saqib, and Karsai, Gabor. **2018**. "Diagnosis in Cyber-Physical Systems with Fault Protection Assemblies". In: *Diagnosability, Security and Safety of Hybrid Dynamic and Cyber-Physical Systems*. Ed. by Moamar Sayed-Mouchaweh. Cham: Springer International Publishing. Chap. Chapter 8, pp. 201–225. ISBN: 978-3-319-74962-4.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

B6. Shekhar, Shashank, Sun, Fangzhou, **Dubey, Abhishek**, Gokhale, Aniruddha, Neema, Himanshu, Lehofer, Martin, and Freudberg, Dan. **2016**. "A Smart Decision Support System for Public Transit Operations". In: *Internet of Things and Data Analytics Handbook*.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

B7. Pradhan, Subhav, **Dubey, Abhishek**, and Gokhale, Aniruddha S. **2016**. "Designing a Resilient Deployment and Reconfiguration Infrastructure for Remotely Managed Cyber-Physical Systems". In: *Software Engineering for Resilient Systems - 8th International Workshop, SERENE 2016, Gothenburg, Sweden, September 5-6, 2016, Proceedings*, pp. 88–104.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

2015-2009 As Research Scientist (3 Chapters)

B8. **Dubey, Abhishek**, Karsai, Gabor, and Mahadevan, Nagabhushan. **2013**. "Fault-Adaptivity in Hard Real-Time Component-Based Software Systems". In: *Software Engineering for Self-Adaptive Systems II: International Seminar, Dagstuhl Castle, Germany, October 24-29, 2010 Revised Selected and Invited Papers*. Ed. by Rogério de Lemos, Holger Giese, Hausi A. Müller, and Mary Shaw. Berlin, Heidelberg: Springer Berlin Heidelberg, pp. 294–323. ISBN: 978-3-642-35813-5.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

B9. Mehrotra, Rajat, **Dubey, Abhishek**, Abdelwahed, Sherif, and Tantawi, Asser N. **2012**. "Power-Aware Modeling and Autonomic Management Framework for Distributed Computing Systems". In: *Handbook of Energy-Aware and Green Computing - Two Volume Set*. CRC Press, pp. 621–648.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

B10. Abdelwahed, Sherif, **Dubey, Abhishek**, Karsai, Gabor, and Mahadevan, Nagabhushan. **2011**. "Model-based Tools and Techniques for Real-Time System and Software Health Management". In: *Machine Learning and Knowledge Discovery for Engineering Systems Health Management*. CRC Press. Chap. Chapter 9, p. 285.*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

Highly Selective Conference Publications (Refereed).

2020-2016 As Assistant Professor (43 papers)

C1. Eisele, Scott, Eghtesad, Taha, Troutman, Nicholas, Laszka, Aron, and **Dubey, Abhishek**. **2020**. "Mechanisms for Outsourcing Computation via a Decentralized Market". In: *14TH ACM International Conference on Distributed and Event Based Systems .Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*[Acceptance Rate: 26 %.]

Abstract As the number of personal computing and IoT devices grows rapidly, so does the amount of computational power that is available at the edge. Since many of these devices are often idle, there is a vast amount of computational power that is currently untapped, and which could be used for outsourcing computation. Existing solutions for harnessing this power, such as volunteer computing (e.g., BOINC), are centralized platforms in which a single organization or company can control participation and pricing. By contrast, an open market of computational resources, where resource owners and resource users trade directly with each other, could lead to greater participation and more competitive pricing. To provide an open market, we introduce MODiCuM, a decentralized system for outsourcing computation. MODiCuM deters participants from misbehaving-which is a key problem in decentralized systems-by resolving disputes via dedicated mediators and by imposing enforceable fines. However, unlike other decentralized outsourcing solutions, MODiCuM minimizes computational overhead since it does not require global trust in mediation results. We provide analytical results proving that MODiCuM can deter misbehavior, and we evaluate the overhead of MODiCuM using experimental results based on an implementation of our platform.

C2. Wilbur, Michael, Samal, Chinmaya, Talusan, Jose Paolo, Yasumoto, Keiichi, and **Dubey, Abhishek**. **2020**. "Time-dependent Decentralized Routing using Federated Learning". In: *2020 IEEE 23nd International Symposium on Real-Time Distributed Computing (ISORC)*. IEEE.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*[Acceptance Rate: 44 %.]

Abstract Recent advancements in cloud computing have driven rapid development in data-intensive smart city applications by providing near real time processing and storage scalability. This has resulted in efficient centralized route planning services such as Google Maps, upon which millions of users rely. Route planning algorithms have progressed in line with the cloud environments in which they run. Current state of the art solutions assume a shared memory model, hence deployment is limited to multi-processing environments in data centers. By centralizing these services, latency has become the limiting parameter in the technologies of the future, such as autonomous cars. Additionally, these services require access to outside networks, raising availability concerns in disaster scenarios. Therefore, this paper provides a decentralized route planning approach for private fog networks. We leverage recent advances in federated learning to collaboratively learn shared prediction models online and investigate our approach with a simulated case study from a mid-size U.S. city.

C3. Barreto, Carlos, Eghtesad, Taha, Eisele, Scott, Laszka, Aron, **Dubey, Abhishek**, and Koutsoukos, Xenofon. **2020**. "Cyber-Attacks and Mitigation in Blockchain Based Transactive Energy Systems". In: *3rd IEEE International Conference on Industrial Cyber-Physical Systems (ICPS 2020).Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*[Acceptance Rate Unknown.]

Abstract Power grids are undergoing major changes due to the rapid adoption of intermittent renewable energy resources and the increased availability of energy storage devices. These trends drive smart-grid operators to envision a future where peer-to-peer energy trading occurs within microgrids, leading to the development of Transactive Energy Systems. Blockchains have garnered significant interest from both academia and industry for their potential application in decentralized TES, in large part due to their high level of resilience. In this paper, we introduce a novel class of attacks against blockchain based TES, which target the gateways that connect market participants to the system. We introduce a general model of blockchain based TES and study multiple threat models and attack strategies. We also demonstrate the impact of these attacks using a testbed based on GridLAB-D and a private Ethereum network. Finally, we study how to mitigate these attack.

C4. Potteiger, B., Cai, F., Dubey, A., Koutsoukos, X., and Zhang, Z. **2020**. "Security in Mixed Time and Event Triggered Cyber-Physical Systems using Moving Target Defense". In: *2020 IEEE 23rd International Symposium on Real-Time Distributed Computing (ISORC)*, pp. 89–97.*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*[Acceptance Rate: 44 %.] **[Best Paper Award Nominee]**

Abstract Memory corruption attacks such as code injection, code reuse, and non-control data attacks have become widely popular for compromising safety-critical Cyber-Physical Systems (CPS). Moving target defense (MTD) techniques such as instruction set randomization (ISR), address space randomization (ASR), and data space randomization (DSR) can be used to protect systems against such attacks. CPS often use time-triggered architectures to guarantee predictable and reliable operation. MTD techniques can cause time delays with unpredictable behavior. To protect CPS against memory corruption attacks, MTD techniques can be implemented in a mixed time and event-triggered architecture that provides capabilities for maintaining safety and availability during an attack. This paper presents a mixed time and event-triggered MTD security approach based on the ARINC 653 architecture that provides predictable and reliable operation during normal operation and rapid detection and reconfiguration upon detection of attacks. We leverage a hardware-in-the-loop testbed and an advanced emergency braking system (AEBS) case study to show the effectiveness of our approach.

C5. Ayman, Afiya, Wilbur, Michael, Sivagnanam, Amutheezan, Pugliese, Philip, **Dubey, Abhishek**, and Laszka, Aron. **June 2020**. "Data-Driven Prediction of Route-Level Energy Use for Mixed-Vehicle Transit Fleets". In: *2020 IEEE International Conference on Smart Computing (SMARTCOMP) (SMARTCOMP 2020)*. Bologna, Italy.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

Abstract Due to increasing concerns about environmental impact, operating costs, and energy security, public transit agencies are seeking to reduce their fuel use by employing electric vehicles (EVs). However, because of the high upfront cost of EVs, most agencies can afford only mixed fleets of internal-combustion and electric vehicles. Making the best use of these mixed fleets presents a challenge for agencies since optimizing the assignment of vehicles to transit routes, scheduling charging, etc. require accurate predictions of electricity and fuel use. Recent advances in sensor-based technologies, data analytics, and machine learning enable remedying this situation; however, to the best of our knowledge, there exists no framework that would integrate all relevant data into a route-level prediction model for public transit. In this paper, we present a novel framework for the data-driven prediction of route-level energy use for mixed-vehicle transit fleets, which we evaluate using data collected from the bus fleet of CARTA, the public transit authority of Chattanooga, TN. We present a data collection and storage framework, which we use to capture system-level data, including traffic and weather conditions, and high-frequency vehicle-level data, including location traces, fuel or electricity use, etc. We present domain-specific methods and algorithms for integrating and cleansing data from various sources, including street and elevation maps. Finally, we train and evaluate machine learning models, including deep neural networks, decision trees, and linear regression, on our integrated dataset. Our results show that neural networks provide accurate estimates, while other models can help us discover relations between energy use and factors such as road and weather conditions.

C6. Talusan, Jose Paolo, Wilbur, Michael, **Dubey, Abhishek**, and Yasumoto, Keiichi. **2020**. "On Decentralized Route Planning Using the Road Side Units as Computing Resources". In: *2020 IEEE International Conference on Fog Computing (ICFC)*. IEEE.*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

Abstract Residents in cities typically use third-party platforms such as Google Maps for route planning services. While providing near real-time processing, these state of the art centralized deployments are limited to multiprocessing environments in data centers. This raises privacy concerns, increases risk for critical data and causes vulnerability to network failure. In this paper, we propose to use decentralized road side units (RSU) (owned by the city) to perform route planning. We divide the city road network into grids, each assigned an RSU where traffic data is kept locally, increasing security and resiliency such that the system can perform even if some RSUs fail. Route generation is done in two steps. First, an optimal grid sequence is generated, prioritizing shortest path calculation accuracy but not RSU load. Second, we assign route planning tasks to the grids in the sequence. Keeping in mind RSU load and constraints, tasks can be allocated and executed in any non-optimal grid but with lower accuracy. We evaluate this system using Metropolitan Nashville road traffic data. We divided the area into 500 grids, configuring load and neighborhood sizes to meet delay constraints while maximizing model accuracy. The results show that there is a 30 percent decrease in processing time with a decrease in model accuracy of 99 percent to 92.3 percent, by simply increasing the search area to the optimal grid's immediate neighborhood.

C7. Bhattacharjee, Anirban, Chhokra, Ajay Dev, Sun, Hongyang, Shekhar, Shashank, Gokhale, Aniruddha, Karsai, Gabor, and **Dubey, Abhishek**. **May 2020**. "Deep-Edge: An Efficient Framework for Deep Learning Model Update on Heterogeneous Edge". In: *2020 IEEE 4th International Conference on Fog and Edge Computing (ICFEC)*. IEEE. ISBN: 9781728173054.*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

Abstract Deep Learning (DL) model-based AI services are increasingly offered in a variety of predictive analytics services such as computer vision, natural language processing, speech recognition. However, the quality of the DL models can degrade over time due to changes in the input data distribution, thereby requiring periodic model updates. Although cloud data-centers can meet the computational requirements of the resource-intensive and time-consuming model update task, transferring data from the edge devices to the cloud incurs a significant cost in terms of network bandwidth and are prone to data privacy issues. With the advent of GPU-enabled edge devices, the DL model update can be performed at the edge in a distributed manner using multiple connected edge devices. However, efficiently utilizing the edge resources for the model update is a hard problem due to the heterogeneity among the edge devices and the resource interference caused by the co-location of the DL model update task with latency-critical tasks running in the background. To overcome these challenges, we present Deep-Edge, a load- and interference-aware, fault-tolerant resource management framework for performing model update at the edge that uses distributed training. This paper makes the following contributions. First, it provides a unified framework for monitoring, profiling, and deploying the DL model update tasks on heterogeneous edge devices. Second, it presents a scheduler that reduces the total re-training time by appropriately selecting the edge devices and distributing data among them such that no latency-critical applications experience deadline violations. Finally, we present empirical results to validate the efficacy of the framework using a real-world DL model update case-study based on the Caltech dataset and an edge AI cluster testbed.

C8. Chhokra, Ajay, Hasan, Saqib, **Dubey, Abhishek**, and Karsai, Gabor. **2020**. "A Binary Decision Diagram Based Cascade Prognostics Scheme For Power Systems". In: *2020 American control conference*. accepted for publication. IEEE.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

Abstract Cascading outages in power systems is a rare, but important phenomenon with huge social and economic implications. Due to the inherent complexity and heterogeneity of components in power system, analysis and prediction of the current and future states of the system is a challenging task. In this paper, we address prognosis of cascading outages in power systems by employing a novel approach based on reduced ordered binary decision diagrams. We present a systemic way of synthesizing these decision diagrams based on a simple cascade model. We also describe a workflow for finding the emergency load curtailment actions as a part of the mitigation strategy. In the end, we show the applicability of our approach using the standard IEEE 14 bus system.

C9. Pettet, Geoffrey, Mukhopadhyay, Ayan, Kochenderfer, Mykel, Vorobeychik, Yevgeniy, and **Dubey, Abhishek**. **2020**. "On Algorithmic Decision Procedures in Emergency Response Systems in Smart and Connected Communities". In: *Proceedings of the 19th Conference on Autonomous Agents and MultiAgent Systems, AAMAS 2020, Auckland, New Zealand*.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*[Acceptance Rate: 23 %.]

Abstract Emergency Response Management (ERM) is a critical problem faced by communities across the globe. Despite its importance, it is common for ERM systems to follow myopic and straight-forward decision policies in the real world. Principled approaches to aid decision-making under uncertainty have been explored in this context but have failed to be accepted into real systems. We identify a key issue impeding their adoption — algorithmic approaches to emergency response focus on reactive, post-incident dispatching actions, i.e. optimally dispatching a responder after incidents occur. However, the critical nature of emergency response dictates that when an incident occurs, first responders always dispatch the closest available responder to the incident. We argue that the crucial period of planning for ERM systems is not post-incident, but between incidents. However, this is not a trivial planning problem - a major challenge with dynamically balancing the spatial distribution of responders is the complexity of the problem. An orthogonal problem in ERM systems is to plan under limited communication, which is particularly important in disaster scenarios that affect communication networks. We address both the problems by proposing two partially decentralized multi-agent planning algorithms that utilize heuristics and the structure of the dispatch problem. We evaluate our proposed approach using real-world data, and find that in several contexts, dynamic re-balancing the spatial distribution of emergency responders reduces both the average response time as well as its variance.

C10. Shekhar, Shashank, Chhokra, Ajay, Sun, Hongyang, Gokhale, Aniruddha, **Dubey, Abhishek**, and Koutsoukos, Xenofon D. **2019**. "URMILA: A Performance and Mobility-Aware Fog/Edge Resource Management Middleware". In: *IEEE 22nd International Symposium on Real-Time Distributed Computing, ISORC 2019, Valencia, Spain, May 7-9, 2019*, pp. 118–125.*Contributions: Collaboratively developed the research ideas and wrote/edited a minor portion of the paper.*

C11. Krentz, Timothy, **Dubey, Abhishek**, and Karsai, Gabor. **2019**. "Short Paper: Towards An Edge-Located Time-Series Database". In: *IEEE 22nd International Symposium on Real-Time Distributed Computing, ISORC 2019, Valencia, Spain, May 7-9, 2019*, pp. 151–154.*Contributions: Collaboratively developed the research ideas and wrote/edited a minor portion of the paper.*

C12. Hartsell, Charles, Mahadevan, Nagabhushan, Ramakrishna, Shreyas, **Dubey, Abhishek**, Bapty, Theodore, Johnson, Taylor T., Koutsoukos, Xenofon D., Sztipanovits, Janos, and Karsai, Gabor. **2019**. "CPS Design with Learning-Enabled Components: A Case Study". In: *Proceedings of the 30th International Workshop on Rapid System Prototyping, RSP 2019, New York, NY, USA, October 17-18, 2019*, pp. 57–63.*Contributions: Collaboratively developed the research ideas and wrote/edited a minor portion of the paper.*

C13. Basak, Sanchita, Sengupta, Saptarshi, and **Dubey, Abhishek**. **June 2019**. "Mechanisms for Integrated Feature Normalization and Remaining Useful Life Estimation Using LSTMs Applied to Hard-Disks". In: *IEEE International Conference on Smart Computing, SMARTCOMP 2019, Washington, DC, USA*, pp. 208–216 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.***[Best Paper Award]**

C14. Wilbur, Michael, **Dubey, Abhishek**, Leão, Bruno, and Bhattacharjee, Shameek. **June 2019**. "A Decentralized Approach for Real Time Anomaly Detection in Transportation Networks". In: *IEEE International Conference on Smart Computing, SMARTCOMP 2019, Washington, DC, USA*, pp. 274–282.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C15. Samal, Chinmaya, **Dubey, Abhishek**, and Ratliff, Lillian J. **June 2019**. "MobilyticsGym: A Simulation Framework for Analyzing Urban Mobility Decision Strategies". In: *IEEE International Conference on Smart Computing, SMARTCOMP 2019, Washington, DC, USA*, pp. 283–291.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C16. Basak, Sanchita, **Dubey, Abhishek**, and Leao, Bruno P. **2019**. "Analyzing the Cascading Effect of Traffic Congestion Using LSTM Networks". In: *2019 IEEE International Conference on Big Data (Big Data)*, pp. 2144–2153.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C17. Basak, Sanchita, Sun, Fangzhou, Sengupta, Saptarshi, and **Dubey, Abhishek**. **2019**. "Data-Driven Optimization of Public Transit Schedule". In: *Big Data Analytics - 7th International Conference, BDA 2019, Ahmedabad, India*, pp. 265–284.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C18. Mukhopadhyay, Ayan, Pettet, Geoffrey, Samal, Chinmaya, **Dubey, Abhishek**, and Vorobeychik, Yevgeniy. **2019**. "An online decision-theoretic pipeline for responder dispatch". In: *Proceedings of the 10th ACM/IEEE International Conference on Cyber-Physical Systems, ICCPS 2019, Montreal, QC, Canada*, pp. 185–196.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C19. Mavridou, Anastasia, Laszka, Aron, Stachtiari, Emmanouela, and **Dubey, Abhishek**. **2019**. "VeriSolid: Correct-by-Design Smart Contracts for Ethereum". In: *Financial Cryptography and Data Security - 23rd International Conference, FC 2019, Frigate Bay, St. Kitts and Nevis, Revised Selected Papers*, pp. 446–465.*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

C20. Ghosh, Purboday, Eisele, Scott, **Dubey, Abhishek**, Metelko, Mary, Madari, István, Völgyesi, Péter, and Karsai, Gabor. **2019**. "On the Design of Fault-Tolerance in a Decentralized Software Platform for Power Systems". In: *IEEE 22nd International Symposium on Real-Time Distributed Computing, ISORC 2019, Valencia, Spain*, pp. 52–60.*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

C21. Ramakrishna, Shreyas, **Dubey, Abhishek**, Burruss, Matthew P., Hartsell, Charles, Mahadevan, Nagabhushan, Nannapaneni, Saideep, Laszka, Aron, and Karsai, Gabor. **2019**. "Augmenting Learning Components for Safety in Resource Constrained Autonomous Robots". In: *IEEE 22nd International Symposium on Real-Time Distributed Computing, ISORC 2019, Valencia, Spain, May 7-9, 2019*, pp. 108–117.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C22. Du, Y., Tu, H., Lukic, S., Lubkeman, D., **Dubey, Abhishek**, and Karsai, G. **Nov. 2018**. "Development of a Controller Hardware-in-the-Loop Platform for Microgrid Distributed Control Applications". In: *2018 IEEE Electronic Power Grid (eGrid)*, pp. 1–6.*Contributions: Collaboratively developed the research ideas and wrote/edited a minor portion of the paper.*

C23. Laszka, Aron, Eisele, Scott, **Dubey, Abhishek**, Karsai, Gabor, and Kvaternik, Karla. **2018**. "TRANSAX: A Blockchain-Based Decentralized Forward-Trading Energy Exchanged for Transactive Microgrids". In: *24th IEEE International Conference on Parallel and Distributed Systems, ICPADS 2018, Singapore, December 11-13, 2018*, pp. 918–927.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C24. Hasan, Saqib, Ghafouri, Amin, **Dubey, Abhishek**, Karsai, Gabor, and Koutsoukos, Xenofon D. **2018**. "Vulnerability analysis of power systems based on cyber-attack and defense models". In: *2018 IEEE Power & Energy Society Innovative Smart Grid Technologies Conference, ISGT 2018, Washington, DC, USA, February 19-22, 2018*, pp. 1–5.*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

C25. Eisele, Scott, Laszka, Aron, Mavridou, Anastasia, and **Dubey, Abhishek**. **2018**. "SolidWorx: A Resilient and Trustworthy Transactive Platform for Smart and Connected Communities". In: *IEEE International Conference on Internet of Things and Blockchains*, pp. 1263–1272.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C26. Barbour, William, Samal, Chinmaya, Kuppa, Shankara, **Dubey, Abhishek**, and Work, Daniel B. **2018**. "On the Data-Driven Prediction of Arrival Times for Freight Trains on U.S. Railroads". In: *21st International Conference on Intelligent Transportation Systems, ITSC 2018, Maui, HI, USA, November 4-7, 2018*, pp. 2289–2296.*Contributions: Collaboratively developed the research ideas and wrote/edited a minor portion of the paper.*

C27. Sun, Fangzhou, **Dubey, Abhishek**, Samal, Chinmaya, Baroud, Hiba, and Kulkarni, Chetan. **2018**. "Short-Term Transit Decision Support System Using Multi-task Deep Neural Networks". In: *2018 IEEE International Conference on Smart Computing, SMARTCOMP 2018, Taormina, Sicily, Italy, June 18-20, 2018*, pp. 155–162.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C28. Samal, Chinmaya, **Dubey, Abhishek**, and Ratliff, Lillian J. **2018**. "Mobilytics- An Extensible, Modular and Resilient Mobility Platform". In: *2018 IEEE International Conference on Smart Computing, SMARTCOMP 2018, Taormina, Sicily, Italy, June 18-20, 2018*, pp. 356–361.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C29. Du, Y., Tu, H., Lukic, S., Lubkeman, D., **Dubey, Abhishek**, and Karsai, G. **Apr. 2018**. "Resilient Information Architecture Platform for Smart Systems (RIAPS): Case Study for Distributed Apparent Power Control". In: *2018 IEEE/PES Transmission and Distribution Conference and Exposition (T D)*, pp. 1–5.*Contributions: Collaboratively developed the research ideas and wrote/edited a minor portion of the paper.*

C30. Hasan, Saqib, Chhokra, Ajay, **Dubey, Abhishek**, Mahadevan, Nagabhushan, Karsai, Gabor, Jain, Rishabh, and Lukic, Srdjan. **2017**. "A simulation testbed for cascade analysis". In: *IEEE Power & Energy Society Innovative Smart Grid Technologies Conference, ISGT 2017, Washington, DC, USA, April 23-26, 2017*, pp. 1–5.*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

C31. Khare, Shweta Prabhat, Sallai, János, **Dubey, Abhishek**, and Gokhale, Aniruddha S. **2017**. "Short Paper: Towards Low-Cost Indoor Localization Using Edge Computing Resources". In: *20th IEEE International Symposium on Real-Time Distributed Computing, ISORC 2017, Toronto, ON, Canada, May 16-18, 2017*, pp. 28–31.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C32. Nannapaneni, Saideep, **Dubey, Abhishek**, and Mahadevan, Sankaran. **2017**. "Performance evaluation of smart systems under uncertainty". In: *2017 IEEE SmartWorld*, pp. 1–8.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C33. Eisele, Scott, Madari, István, **Dubey, Abhishek**, and Karsai, Gabor. **2017**. "RIAPS: Resilient Information Architecture Platform for Decentralized Smart Systems". In: *20th IEEE International Symposium on Real-Time Distributed Computing, ISORC 2017, Toronto, ON, Canada, May 16-18, 2017*, pp. 125–132.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C34. Völgyesi, Péter, **Dubey, Abhishek**, Krentz, Timothy, Madari, István, Metelko, Mary, and Karsai, Gabor. **2017**. "Time synchronization services for low-cost fog computing applications". In: *International Symposium on Rapid System Prototyping, RSP 2017, Shortening the Path from Specification to Prototype, October 19-20, 2017, Seoul, South Korea*, pp. 57–63.*Contributions: Collaboratively developed the research ideas and wrote/edited a minor portion of the paper.*

C35. Sun, Fangzhou, Samal, Chinmaya, White, Jules, and **Dubey, Abhishek**. **2017**. "Unsupervised Mechanisms for Optimizing On-Time Performance of Fixed Schedule Transit Vehicles". In: *2017 IEEE International Conference on Smart Computing, SMARTCOMP 2017, Hong Kong, China, May 29-31, 2017*, pp. 1–8.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C36. Pettet, Geoffrey, Nannapaneni, Saideep, Stadnick, Benjamin, **Dubey, Abhishek**, and Biswas, Gautam. **2017**. "Incident analysis and prediction using clustering and Bayesian network". In: *2017 IEEE SmartWorld*, pp. 1–8.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C37. **Dubey, Abhishek**, Karsai, Gabor, and Pradhan, Subhav. **2017**. "Resilience at the edge in cyber-physical systems". In: *Second International Conference on Fog and Mobile Edge Computing, FMEC 2017, Valencia, Spain, May 8-11, 2017*, pp. 139–146.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C38. Sun, Fangzhou, **Dubey, Abhishek**, and White, Jules. **2017**. "DxNAT - Deep neural networks for explaining non-recurring traffic congestion". In: *2017 IEEE International Conference on Big Data, BigData 2017, Boston, MA, USA, December 11-14, 2017*, pp. 2141–2150.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C39. Mukhopadhyay, Ayan, Vorobeychik, Yevgeniy, **Dubey, Abhishek**, and Biswas, Gautam. **2017**. "Prioritized Allocation of Emergency Responders based on a Continuous-Time Incident Prediction Model". In: *Proceedings of the 16th Conference on Autonomous Agents and MultiAgent Systems, AAMAS 2017, São Paulo, Brazil, May 8-12, 2017*, pp. 168–177.*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

C40. Du, Y., Tu, H., Lukic, S., Lubkeman, D., **Dubey, Abhishek**, and Karsai, G. **Sept. 2017**. "Implementation of a distributed microgrid controller on the Resilient Information Architecture Platform for Smart Systems (RIAPS)". in: *2017 North American Power Symposium (NAPS)*, pp. 1–6.*Contributions: Collaboratively developed the research ideas and wrote/edited a minor portion of the paper.*

C41. Laszka, Aron, **Dubey, Abhishek**, Walker, Michael, and Schmidt, Douglas C. **2017**. "Providing privacy, safety, and security in IoT-based transactive energy systems using distributed ledgers". In: *Proceedings of the Seventh International Conference on the Internet of Things, IOT 2017, Linz, Austria, October 22-25, 2017*, 13:1–13:8.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C42. Oruganti, Aparna, Sun, Fangzhou, Baroud, Hiba, and **Dubey, Abhishek**. **2016**. "DelayRadar: A multivariate predictive model for transit systems". In: *2016 IEEE International Conference on Big Data, BigData 2016, Washington DC, USA, December 5-8, 2016*, pp. 1799–1806.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C43. Sun, Fangzhou, Pan, Yao, White, Jules, and **Dubey, Abhishek**. **2016**. "Real-Time and Predictive Analytics for Smart Public Transportation Decision Support System". In: *2016 IEEE International Conference on Smart Computing, SMARTCOMP 2016, St Louis, MO, USA, May 18-20, 2016*, pp. 1–8.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

2015-2009 As Research Scientist (13 papers)

C44. Jain, R., Lukic, S. M., Chhokra, A., Mahadevan, N., **Dubey, Abhishek**, and Karsai, G. **Oct. 2015**. "An improved distance relay model with directional element, and memory polarization for TCD based fault propagation studies". In: *2015 North American Power Symposium (NAPS)*, pp. 1–6.*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

C45. Balasubramanian, Daniel, **Dubey, Abhishek**, Otte, William R., Emfinger, William, Kumar, Pranav Srinivas, and Karsai, Gabor. **2014**. "A Rapid Testing Framework for a Mobile Cloud". In: *25nd IEEE International Symposium on Rapid System Prototyping, RSP 2014, New Delhi, India, October 16-17, 2014*, pp. 128–134.*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

C46. Karsai, Gabor, Balasubramanian, Daniel, **Dubey, Abhishek**, and Otte, William. **2014**. "Distributed and Managed: Research Challenges and Opportunities of the Next Generation Cyber-Physical Systems". In: *17th IEEE International Symposium on Object/Component/Service-Oriented Real-Time Distributed Computing, ISORC 2014, Reno, NV, USA, June 10-12, 2014*, pp. 1–8.*Contributions: Collaboratively developed the research ideas and wrote/edited a minor portion of the paper.*

C47. Otte, William, **Dubey, Abhishek**, Pradhan, Subhav, Patil, Prithviraj, Gokhale, Aniruddha S., Karsai, Gabor, and Willemsen, Johnny. **2013**. "F6COM: A component model for resource-constrained and dynamic space-based computing environments". In: *16th IEEE International Symposium on Object/Component/Service-Oriented Real-Time Distributed Computing, ISORC 2013, Paderborn, Germany, June 19-21, 2013*, pp. 1–8.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C48. Mahadevan, Nagabhushan, **Dubey, Abhishek**, and Karsai, Gabor. **2012**. "Architecting Health Management into Software Component Assemblies: Lessons Learned from the ARINC-653 Component Mode". In: *15th IEEE International Symposium on Object/Component/Service-Oriented Real-Time Distributed Computing, ISORC 2012, Shenzhen, China, April 11-13, 2012*, pp. 79–86.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C49. Dabholkar, Akshay, **Dubey, Abhishek**, Gokhale, Aniruddha S., Karsai, Gabor, and Mahadevan, Nagabhushan. **2012**. "Reliable Distributed Real-Time and Embedded Systems through Safe Middleware Adaptation". In: *IEEE 31st Symposium on Reliable Distributed Systems, SRDS 2012, Irvine, CA, USA, October 8-11, 2012*, pp. 362–371.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C50. Mehrotra, Rajat, **Dubey, Abhishek**, Abdelwahed, Sherif, and Rowland, Krisa W. **2012**. "RFDMon: A Real-time and Fault-tolerant Distributed System Monitoring Approach". In: *The 8th International Conference on Autonomic and Autonomous Systems ICAS 2012*.*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C51. **Dubey, Abhishek**, Mahadevan, Nagabhushan, and Karsai, Gabor. **2012**. "A deliberative reasoner for model-based software health management". In: *The Eighth International Conference on Autonomic and Autonomous Systems*, pp. 86–92 [Best paper award] .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C52. Roy, Nilabja, **Dubey, Abhishek**, and Gokhale, Aniruddha S. **2011**. "Efficient Autoscaling in the Cloud Using Predictive Models for Workload Forecasting". In: *IEEE International Conference on Cloud Computing, CLOUD 2011, Washington, DC, USA, 4-9 July, 2011*, pp. 500–507 .*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

C53. Roy, Nilabja, **Dubey, Abhishek**, Gokhale, Aniruddha S., and Dowdy, Larry W. **2011**. "A Capacity Planning Process for Performance Assurance of Component-based Distributed Systems". In: *ICPE'11 - Second Joint WOSP/SIPEW International Conference on Performance Engineering, Karlsruhe, Germany, March 14-16, 2011*, pp. 259–270 .*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

C54. Mahadevan, Nagabhushan, **Dubey, Abhishek**, and Karsai, Gabor. **2011**. "Application of software health management techniques". In: *2011 ICSE Symposium on Software Engineering for Adaptive and Self-Managing Systems, SEAMS 2011, Waikiki, Honolulu , HI, USA, May 23-24, 2011*, pp. 1–10 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C55. Balasubramanian, Jaiganesh, Gokhale, Aniruddha S., **Dubey, Abhishek**, Wolf, Friedhelm, Lu, Chenyang, Gill, Christopher D., and Schmidt, Douglas C. **2010**. "Middleware for Resource-Aware Deployment and Configuration of Fault-Tolerant Real-time Systems". In: *16th IEEE Real-Time and Embedded Technology and Applications Symposium, RTAS 2010, Stockholm, Sweden, April 12-15, 2010*, pp. 69–78 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C56. **Dubey, Abhishek**, Karsai, Gabor, Kereskényi, Róbert, and Mahadevan, Nagabhushan. **2010**. "A Real-Time Component Framework: Experience with CCM and ARINC-653". In: *13th IEEE International Symposium on Object/Component/Service-Oriented Real-Time Distributed Computing, ISORC 2010, Carmona, Sevilla, Spain, 5-6 May 2010*, pp. 143–150 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

<2009 As PhD. Student (2 papers)

C57. **Dubey, Abhishek**, Karsai, Gabor, and Abdelwahed, Sherif. **2009**. "Compensating for Timing Jitter in Computing Systems with General-Purpose Operating Systems". In: *2009 IEEE International Symposium on Object/Component/Service-Oriented Real-Time Distributed Computing, ISORC 2009, Tokyo, Japan, 17-20 March 2009*, pp. 55–62 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C58. **Dubey, Abhishek**, Wu, X., Su, H., and Koo, T. J. **2005**. "Computation Platform for Automatic Analysis of Embedded Software Systems Using Model Based Approach". In: *Automated Technology for Verification and Analysis*. Ed. by Doron A. Peled and Yih-Kuen Tsay. Berlin, Heidelberg: Springer Berlin Heidelberg, pp. 114–128. ISBN: 978-3-540-31969-6 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

Other Selective Conference Publications (Refereed)

2020-2016 As Assistant Professor (12 papers)

C59. Barbour, William, Wilbur, Michael, Sandoval, Ricardo, Geffen, Caleb Van, Hall, Brandon, **Dubey, Abhishek**, and Work, Dan. **2020**. "Data Driven Methods for Effective Micromobility Parking". In: *Proceedings of the Transportation Research Board Annual Meeting .Contributions: Collaboratively developed the research ideas and wrote/edited a minor portion of the paper.*

C60. Basak, Sanchita, Aman, Afiya, Laszka, Aron, **Dubey, Abhishek**, and Leao, Bruno. **Oct. 2019**. "Data-Driven Detection of Anomalies and Cascading Failures in Traffic Networks". In: *Proceedings of the 11th Annual Conference of the Prognostics and Health Management Society (PHM) .Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C61. Oruganti, Aparna, Basak, Sanchita, Sun, Fangzhou, Baroud, Hiba, and **Dubey, Abhishek**. **2019**. "Modeling and Predicting the Cascading Effects of Delay in Transit Systems". In: *Transportation Research Board Annual Meeting .Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C62. Tu, H., Du, Y., Yu, H., Lukic, S., Volgyesi, P., Metelko, M., **Dubey, Abhishek**, and Karsai, G. **June 2018**. "An Adaptive Interleaving Algorithm for Multi-Converter Systems". In: *2018 9th IEEE International Symposium on Power Electronics for Distributed Generation Systems (PEDG)*, pp. 1–7 .*Contributions: Collaboratively developed the research ideas and wrote/edited a minor portion of the paper.*

C63. Nannapaneni, Saideep, Mahadevan, Sankaran, and **Dubey, Abhishek**. **June 2018**. "Real-Time Control of Cyber-Physical Manufacturing Process Under Uncertainty". In: *Proceedings of ASME 2018 13th International Manufacturing Science and Engineering Conference*. Vol. Volume 3: Manufacturing Equipment and Systems. International Manufacturing Science and Engineering Conference. V003T02A001 .*Contributions: Collaboratively developed the research ideas and wrote/edited a minor portion of the paper.*

C64. Nannapaneni, Saideep, **Dubey, Abhishek**, and Mahadevan, Sankaran. **2018**. "Automated aircraft separation safety assurance using Bayesian networks". In: *2018 Aviation Technology, Integration, and Operations Conference*, p. 3199 .*Contributions: Collaboratively developed the research ideas and wrote/edited a minor portion of the paper.*

C65. Tu, H., Du, Y., Yu, H., Lukic, S., Metelko, M., Volgyesi, P., **Dubey, Abhishek**, and Karsai, G. **Sept. 2018**. "A Hardware-in-the-Loop Real-Time Testbed for Microgrid Hierarchical Control". In: *2018 IEEE Energy Conversion Congress and Exposition (ECCE)*, pp. 2053–2059 .*Contributions: Collaboratively developed the research ideas and wrote/edited a minor portion of the paper.*

C66. Sun, Fangzhou, **Dubey, Abhishek**, Kulkarni, C, Mahadevan, Nagbhushan, and Luna, Ali Guarneros. **2018**. "A data driven health monitoring approach to extending small sats mission". In: *Conference Proceedings, Annual Conference of The Prognostics And Health Management Society .Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C67. Du, Y., Tu, H., Lukic, S., **Dubey, Abhishek**, and Karsai, G. **Sept. 2018**. "Distributed Microgrid Synchronization Strategy Using a Novel Information Architecture Platform". In: *2018 IEEE Energy Conversion Congress and Exposition (ECCE)*, pp. 2060–2066 .*Contributions: Collaboratively developed the research ideas and wrote/edited a minor portion of the paper.*

C68. Hasan, S., Ghafouri, A., **Dubey, Abhishek**, Karsai, G., and Koutsoukos, X. **Sept. 2017**. "Heuristics-based approach for identifying critical N-k contingencies in power systems". In: *2017 Resilience Week (RWS)*, pp. 191–197 .*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

C69. **Dubey, Abhishek**, Karsai, Gabor, Gokhale, Aniruddha, Emfinger, William, and Kumar, Pranav. **2017**. "Drems-os: An operating system for managed distributed real-time embedded systems". In: *2017 6th International Conference on Space Mission Challenges for Information Technology (SMC-IT)*. IEEE, pp. 114–119 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C70. Biswas, Gautam, Khorasgani, Hamed, Stanje, Gerald, **Dubey, Abhishek**, Deb, Somnath, and Ghoshal, Sudipto. **2016**. "An application of data driven anomaly identification to spacecraft telemetry data". In: *Prognostics and Health Management Conference .Contributions: Collaboratively developed the research ideas and wrote/edited a minor portion of the paper.*

2015-2009 As Research Scientist (13 papers)

C71. Chhokra, A., Abdelwahed, S., **Dubey, Abhishek**, Neema, S., and Karsai, G. **June 2015**. "From system modeling to formal verification". In: *2015 Electronic System Level Synthesis Conference (ESLsyn)*, pp. 41–46 .*Contributions: Collaboratively developed the research ideas and wrote/edited a minor portion of the paper.*

C72. Martins, G., Bhattacharjee, A., **Dubey, Abhishek**, and Koutsoukos, X. **Aug. 2014**. "Performance evaluation of an authentication mechanism in time-triggered networked control systems". In: *2014 7th International Symposium on Resilient Control Systems (ISRCS)*, pp. 1–6 .*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

C73. Mahadevan, Nagabhushan, **Dubey, Abhishek**, Karsai, Gabor, Srivastava, Anurag, and Liu, Chen-Ching. **Jan. 2014**. "Temporal Causal Diagrams for diagnosing failures in cyber-physical systems". In: *Annual Conference of the Prognostics and Health Management Society .Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C74. Pradhan, S., Emfinger, W., **Dubey, Abhishek**, Otte, W. R., Balasubramanian, D., Gokhale, A., Karsai, G., and Coglio, A. **Sept. 2014**. "Establishing Secure Interactions across Distributed Applications in Satellite Clusters". In: *2014 IEEE International Conference on Space Mission Challenges for Information Technology*, pp. 67–74 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C75. Pradhan, Subhav, Otte, William, **Dubey, Abhishek**, Gokhale, Aniruddha, and Karsai, Gabor. **2014**. "Key Considerations for a Resilient and Autonomous Deployment and Configuration Infrastructure for Cyber-Physical Systems". In: *Proceedings of the 11th IEEE International Conference and Workshops on the Engineering of Autonomic and Autonomous Systems (EASe'14)*. Citeseer .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C76. Otte, William R., **Dubey, Abhishek**, and Karsai, Gabor. **2014**. "A resilient and secure software platform and architecture for distributed spacecraft". In: *Sensors and Systems for Space Applications VII*. ed. by Khanh D. Pham and Joseph L. Cox. Vol. 9085. International Society for Optics and Photonics. SPIE, pp. 121–130 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C77. Nannapaneni, Saideep, **Dubey, Abhishek**, Abdelwahed, Sherif, Mahadevan, Sankaran, and Neema, Sandeep. **Oct. 2014**. "A Model-Based Approach for Reliability Assessment in Component-Based Systems". In: *PHM 2014 - Proceedings of the Annual Conference of the Prognostics and Health Management Society 2014 .Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C78. Qian Chen, Mehrotra, R., **Dubey, Abhishek**, Abdelwahed, S., and Rowland, K. **Mar. 2012**. "On state of the art in virtual machine security". In: *2012 Proceedings of IEEE Southeastcon*, pp. 1–6 .*Contributions: Collaboratively developed the research ideas and wrote/edited a minor portion of the paper.*

C79. **Dubey, Abhishek**, Emfinger, W., Gokhale, A., Karsai, G., Otte, W. R., Parsons, J., Szabo, C., Coglio, A., Smith, E., and Bose, P. **Mar. 2012**. "A software platform for fractionated spacecraft". In: *2012 IEEE Aerospace Conference*, pp. 1–20 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C80. **Dubey, Abhishek**, Karsai, G., and Mahadevan, N. **Mar. 2011**. "Model-based software health management for real-time systems". In: *2011 Aerospace Conference*, pp. 1–18 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C81. Mehrotra, R., **Dubey, Abhishek**, Abdelwahed, S., and Monceaux, W. **Apr. 2011**. "Large Scale Monitoring and Online Analysis in a Distributed Virtualized Environment". In: *2011 Eighth IEEE International Conference and Workshops on Engineering of Autonomic and Autonomous Systems*, pp. 1–9 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C82. Pan, P., **Dubey, Abhishek**, and Piccoli, L. **Mar. 2010**. "Dynamic Workflow Management and Monitoring Using DDS". in: *2010 Seventh IEEE International Conference and Workshops on Engineering of Autonomic and Autonomous Systems*, pp. 20–29 .*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

C83. Saxena, Tripti, **Dubey, Abhishek**, Balasubramanian, Daniel, and Karsai, Gabor. **2010**. "Enabling self-management by using model-based design space exploration". In: *2010 Seventh IEEE International Conference and Workshops on Engineering of Autonomic and Autonomous Systems*. IEEE, pp. 137–144 .*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

Before 2009 As PhD. Student (9 papers)

C84. **Dubey, Abhishek**, Riley, Derek, Abdelwahed, Sherif, and Bapty, Ted. **2009**. "Modeling and Analysis of Probabilistic Timed Systems". In: *16th Annual IEEE International Conference and Workshop on the Engineering of Computer Based Systems, ECBS 2009, San Francisco, California, USA, 14-16 April 2009*, pp. 69–78 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C85. **Dubey, Abhishek**, Piccoli, L., Kowalkowski, J. B., Simone, J. N., Sun, X., Karsai, G., and Neema, S. **Apr. 2009**. "Using Runtime Verification to Design a Reliable Execution Framework for Scientific Workflows". In: *2009 Sixth IEEE Conference and Workshops on Engineering of Autonomic and Autonomous Systems*, pp. 87–96 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C86. **Dubey, Abhishek**. **2009**. "Algorithms for Synthesizing Safe Sets of Operation for Embedded Systems". In: *16th Annual IEEE International Conference and Workshop on the Engineering of Computer Based Systems, ECBS 2009, San Francisco, California, USA, 14-16 April 2009*, pp. 149–155 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C87. **Dubey, Abhishek**, Nordstrom, S., Keskinpala, T., Neema, S., Bapty, T., and Karsai, G. **Mar. 2008**. "Towards A Model-Based Autonomic Reliability Framework for Computing Clusters". In: *Fifth IEEE Workshop on Engineering of Autonomic and Autonomous Systems (ease 2008)*, pp. 75–85 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C88. Nordstrom, S., **Dubey, Abhishek**, Keskinpala, T., Datta, R., Neema, S., and Bapty, T. **Mar. 2007**. "Model Predictive Analysis for AutonomicWorkflow Management in Large-scale Scientific Computing Environments". In: *Fourth IEEE International Workshop on Engineering of Autonomic and Autonomous Systems (EASe'07)*, pp. 37–42 .*Contributions: Collaboratively developed the research ideas and wrote/edited a minor portion of the paper.*

C89. **Dubey, Abhishek**, Nordstrom, S., Keskinpala, T., Neema, S., and Bapty, T. **Mar. 2006**. "Verifying Autonomic Fault Mitigation Strategies in Large Scale Real-Time Systems". In: *Third IEEE International Workshop on Engineering of Autonomic Autonomous Systems (EASE'06)*, pp. 129–140 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

C90. Nordstrom, Steven, Bapty, Ted, Neema, Sandeep, **Dubey, Abhishek**, and Keskinpala, Turker. **July 2006**. "A Guided Explorative Approach for Autonomic Healing of Model-Based Systems". In: *Second IEEE conference on Space Mission Challenges for Information Technology (SMC-IT)*. Pasadena, CA .*Contributions: Collaboratively developed the research ideas and wrote/edited a minor portion of the paper.*

C91. Keskinpala, Turker, **Dubey, Abhishek**, Nordstrom, Steve, Bapty, Ted, and Neema, Sandeep. **2006**. "A Model Driven Tool for Automated System Level Testing of Middleware". In: *Systems Testing and Validation*, p. 19 .*Contributions: Collaboratively developed the research ideas and wrote/edited a minor portion of the paper.*

C92. Nordstrom, S., **Dubey, Abhishek**, Keskinpala, T., Neema, S., and Bapty, T. **Mar. 2006**. "GHOST: Guided Healing and Optimization Search Technique for Healing Large-Scale Embedded Systems". In: *Third IEEE International Workshop on Engineering of Autonomic Autonomous Systems (EASE'06)*, pp. 54–60 .*Contributions: Collaboratively developed the research ideas and wrote/edited a minor portion of the paper.*

Workshop Publications (Refereed)

2020-2016 As Assistant Professor (22 papers)

W1. Barbour, W., Wilbur, M., Sandoval, R., Dubey, A., and Work, D. B. **2020**. "Streaming computation algorithms for spatiotemporal micromobility service availability". In: *2020 IEEE Workshop on Design Automation for CPS and IoT (DESTION)*, pp. 32–38 .*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

W2. Sajan, Kaduvettykunnal, Bariya, Mohini, Basak, Sanchita, Srivastava, Anurag K., **Dubey, Abhishek**, von Meier, Alexandra, and Biswas, Gautam. **2020**. "Realistic Synchrophasor Data Generation for Anomaly Detection and Event Classification". In: *8th Workshop on Modeling and Simulation of Cyber-Physical Energy Systems, MSCPES@CPSIoTWeek .Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

W3. Sundar, Vijay Kumar, Ramakrishna, Shreyas, Rahiminasab, Zahra, Easwaran, Arvind, and **Dubey, Abhishek**. **2020**. "Out-of-Distribution Detection in Multi-Label Datasets using Latent Space of β-VAE". in: *2020 Workshop on Assured Autonomous Systems (WAAS)*. to appear. IEEE .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

W4. Nannapaneni, Saideep and **Dubey, Abhishek**. **2019**. "Towards demand-oriented flexible rerouting of public transit under uncertainty". In: *Proceedings of the Fourth Workshop on International Science of Smart City Operations and Platforms Engineering, SCOPE@CPSIoTWeek 2019, Montreal, QC, Canada*, pp. 35–40 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

W5. Pettet, Geoffrey, Sahoo, Saroj, and **Dubey, Abhishek**. **2019**. "Towards an Adaptive Multi-Modal Traffic Analytics Framework at the Edge". In: *IEEE International Conference on Pervasive Computing and Communications Workshops, PerCom Workshops 2019, Kyoto, Japan, March 11-15, 2019*, pp. 511–516 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

W6. Talusan, Jose Paolo, Tiausas, Francis, Yasumoto, Keiichi, Wilbur, Michael, Pettet, Geoffrey, **Dubey, Abhishek**, and Bhattacharjee, Shameek. **2019**. "Smart Transportation Delay and Resiliency Testbed Based on Information Flow of Things Middleware". In: *IEEE International Conference on Smart Computing, SMARTCOMP 2019, Washington, DC, USA, June 12-15, 2019*, pp. 13–18 .*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

W7. Zhang, Yue, Eisele, Scott, **Dubey, Abhishek**, Laszka, Aron, and Srivastava, Anurag K. **2019**. "Cyber-Physical Simulation Platform for Security Assessment of Transactive Energy Systems". In: *7th Workshop on Modeling and Simulation of Cyber-Physical Energy Systems, MSCPES@CPSIoTWeek 2019, Montreal, QC, Canada*, pp. 1–6 .*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

W8. Hartsell, Charles, Mahadevan, Nagabhushan, Ramakrishna, Shreyas, **Dubey, Abhishek**, Bapty, Theodore, Johnson, Taylor T., Koutsoukos, Xenofon D., Sztipanovits, Janos, and Karsai, Gabor. **Apr. 2019**. "Model-based design for CPS with learning-enabled components". In: *Proceedings of the Workshop on Design Automation for CPS and IoT, DESTION@CPSIoTWeek 2019, Montreal, QC, Canada*, pp. 1–9 .*Contributions: Collaboratively developed the research ideas and wrote/edited a minor portion of the paper.*

W9. Laszka, Aron, Mavridou, Anastasia, Eisele, Scott, Statchtiari, Emmanouela, and **Dubey, Abhishek**. **Sept. 2019**. "VeriSolid for TRANSAX: Correct-by-Design Ethereum Smart Contracts for Energy Trading". In: *First International Summer School on Security and Privacy for Blockchains and Distributed Ledger Technologies, BDLT 2019, Vienna, Austria .Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

W10. Laszka, Aron, Mavridou, Anastasia, and **Dubey, Abhishek**. **2018**. "Resilient and Trustworthy Transactive Platform for Smart and Connected Communities". In: *High Confidence Software and Systems Conference .Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

W11. Purohit, H., Nannapaneni, S., **Dubey, Abhishek**, Karuna, P., and Biswas, G. **Apr. 2018**. "Structured Summarization of Social Web for Smart Emergency Services by Uncertain Concept Graph". In: *2018 IEEE International Science of Smart City Operations and Platforms Engineering in Partnership with Global City Teams Challenge (SCOPE-GCTC)*, pp. 30–35 .*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

W12. Samal, Chinmaya, Sun, Fangzhou, and **Dubey, Abhishek**. **2017**. "SpeedPro: A Predictive Multi-Model Approach for Urban Traffic Speed Estimation". In: *2017 IEEE International Conference on Smart Computing, SMARTCOMP 2017, Hong Kong, China, May 29-31, 2017*, pp. 1–6 .*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

W13. Tan, Joshua, Kendrick, Christine, **Dubey, Abhishek**, and Rhee, Sokwoo. **2017**. "Indicator frameworks". In: *Proceedings of the 2nd International Workshop on Science of Smart City Operations and Platforms Engineering, SCOPE@CPSWeek 2017, Pittsburgh, PA, USA, April 21, 2017*, pp. 19–25 .*Contributions: Collaboratively developed the research ideas and wrote/edited a minor portion of the paper.*

W14. Ghafouri, Amin, Laszka, Aron, **Dubey, Abhishek**, and Koutsoukos, Xenofon D. **2017**. "Optimal detection of faulty traffic sensors used in route planning". In: *Proceedings of the 2nd International Workshop on Science of Smart City Operations and Platforms Engineering, SCOPE@CPSWeek 2017, Pittsburgh, PA, USA, April 21, 2017*, pp. 1–6 .*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

W15. Hasan, S., **Dubey, Abhishek**, Chhokra, A., Mahadevan, N., Karsai, G., and Koutsoukos, X. **Apr. 2017**. "A modeling framework to integrate exogenous tools for identifying critical components in power systems". In: *2017 Workshop on Modeling and Simulation of Cyber-Physical Energy Systems (MSCPES)*, pp. 1–6 .*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

W16. Chhokra, Ajay, Kulkarni, Amogh, Hasan, Saqib, **Dubey, Abhishek**, Mahadevan, Nagabhushan, and Karsai, Gabor. **2017**. "A Systematic Approach of Identifying Optimal Load Control Actions for Arresting Cascading Failures in Power Systems". In: *Proceedings of the 2nd Workshop on Cyber-Physical Security and Resilience in Smart Grids, SPSR-SG@CPSWeek 2017, Pittsburgh, PA, USA, April 21, 2017*, pp. 41–46 .*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

W17. Eisele, Scott, Pettet, Geoffrey, **Dubey, Abhishek**, and Karsai, Gabor. **2017**. "Towards an architecture for evaluating and analyzing decentralized Fog applications". In: *IEEE Fog World Congress, FWC 2017, Santa Clara, CA, USA, October 30 - Nov. 1, 2017*, pp. 1–6 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

W18. Bergquist, Jonatan, Laszka, Aron, Sturm, Monika, and **Dubey, Abhishek**. **2017**. "On the design of communication and transaction anonymity in blockchain-based transactive microgrids". In: *Proceedings of the 1st Workshop on Scalable and Resilient Infrastructures for Distributed Ledgers, SERIAL@Middleware 2017, Las Vegas, NV, USA, December 11-15, 2017*, 3:1–3:6 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

W19. Walker, Michael A., **Dubey, Abhishek**, Laszka, Aron, and Schmidt, Douglas C. **2017**. "PlaTIBART: a platform for transactive IoT blockchain applications with repeatable testing". In: *Proceedings of the 4th Workshop on Middleware and Applications for the Internet of Things, M4IoT@Middleware 2017, Las Vegas, NV, USA, December 11, 2017*, pp. 17–22 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

W20. Nannapaneni, Saideep, Mahadevan, Sankaran, Pradhan, Subhav, and **Dubey, Abhishek**. **2016**. "Towards Reliability-Based Decision Making in Cyber-Physical Systems". In: *2016 IEEE International Conference on Smart Computing, SMARTCOMP 2016, St Louis, MO, USA, May 18-20, 2016*, pp. 1–6 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

W21. **Dubey, Abhishek**, Pradhan, Subhav, Schmidt, Douglas C., Rusitschka, Sebnem, and Sturm, Monika. **2016**. "The Role of Context and Resilient Middleware in Next Generation Smart Grids". In: *Proceedings of the 3rd Workshop on Middleware for Context-Aware Applications in the IoT, M4IoT@Middleware 2016, Trento, Italy, December 12-13, 2016*, pp. 1–6 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

W22. Neema, Himanshu, Emfinger, William, and **Dubey, Abhishek**. **2016**. "A Reusable and Extensible Web-Based Co-Simulation Platform for Transactive Energy Systems". In: *Proceedings of the 3rd International Transactive Energy Systems, Portland, Oregon, USA*. vol. 12 .*Contributions: Collaboratively developed the research ideas and wrote/edited a minor portion of the paper.*

2015-2009 As Research Scientist (11 Papers)

W23. Pradhan, S., **Dubey, Abhishek**, Neema, S., and Gokhale, A. **Apr. 2016**. "Towards a generic computation model for smart city platforms". In: *2016 1st International Workshop on Science of Smart City Operations and Platforms Engineering (SCOPE) in partnership with Global City Teams Challenge (GCTC) (SCOPE - GCTC)*, pp. 1–6 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

W24. Chhokra, A., **Dubey, Abhishek**, Mahadevan, N., and Karsai, G. **Apr. 2015**. "A component-based approach for modeling failure propagations in power systems". In: *2015 Workshop on Modeling and Simulation of Cyber-Physical Energy Systems (MSCPES)*, pp. 1–6 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

W25. Pradhan, Subhav M., **Dubey, Abhishek**, Gokhale, Aniruddha S., and Lehofer, Martin. **2015**. "CHARIOT: a domain specific language for extensible cyber-physical systems". In: *Proceedings of the Workshop on Domain-Specific Modeling, DSM@SPLASH 2015, Pittsburgh, PA, USA, October 27, 2015*, pp. 9–16 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

W26. **Dubey, Abhishek**, Sturm, Monika, Lehofer, Martin, and Sztipanovits, Janos. **2015**. "Smart City Hubs: Opportunities for Integrating and Studying Human CPS at Scale". In: *Workshop on Big Data Analytics in CPS: Enabling the Move from IoT to Real-Time Control .Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

W27. Kumar, Pranav Srinivas, **Dubey, Abhishek**, and Karsai, Gabor. **2014**. "Colored Petri Net-based Modeling and Formal Analysis of Component-based Applications". In: *Proceedings of the 11th Workshop on Model-Driven Engineering, Verification and Validation co-located with 17th International Conference on Model Driven Engineering Languages and Systems, MoDeVVa@MODELS 2014, Valencia, Spain, September 30, 2014*, pp. 79–88 .*Contributions: Collaboratively developed the research ideas and wrote/edited a minor portion of the paper.*

W28. Balasubramanian, Daniel, Levendovszky, Tihamer, **Dubey, Abhishek**, and Karsai, Gabor. **2014**. "Taming Multi-Paradigm Integration in a Software Architecture Description Language". In: *Proceedings of the 8th Workshop on Multi-Paradigm Modeling co-located with the 17th International Conference on Model Driven Engineering Languages and Systems, MPM@MODELS 2014, Valencia, Spain, September 30, 2014*, pp. 67–76 .*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

W29. Emfinger, William, Karsai, Gabor, **Dubey, Abhishek**, and Gokhale, Aniruddha S. **2014**. "Analysis, verification, and management toolsuite for cyber-physical applications on time-varying networks". In: *Proceedings of the 4th ACM SIGBED International Workshop on Design, Modeling, and Evaluation of Cyber-Physical Systems, CyPhy 2014, Berlin, Germany, April 14-17, 2014*, pp. 44–47 .*Contributions: Collaboratively developed the research ideas and wrote/edited a minor portion of the paper.*

W30. Dubey, A, Karsai, G, Mahadevan, N, Srivastava, A, Liu, CC, and Lukic, S. **2013**. "Understanding Failure Dynamics in the Smart Electric Grid". In: *NSF Energy Cyber Physical System Workshop, Washington DC .Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

W31. **Dubey, Abhishek**, Gokhale, Aniruddha, Karsai, Gabor, Otte, W, and Willemsen, Johnny. **2013**. "A model-driven software component framework for fractionated spacecraft". In: *Proceedings of the 5th International Conference on Spacecraft Formation Flying Missions and Technologies (SFFMT)*. IEEE Munich, Germany .*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

W32. Shi, J., Amgai, R., Abdelwahed, S., **Dubey, Abhishek**, Humphreys, J., Alattar, M., and Jia, R. **Apr. 2013**. "Generic modeling and analysis framework for shipboard system design". In: *2013 IEEE Electric Ship Technologies Symposium (ESTS)*, pp. 420–428 .*Contributions: Collaboratively developed the research ideas and wrote/edited a minor portion of the paper.*

W33. **Dubey, Abhishek**, Mahadevan, Nagbhushan, and Kereskenyi, Robert. **2009**. "Reflex and healing architecture for software health management". In: *International workshop on software health management. IEEE conference on space mission challenges for information technology .Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

Posters and Demonstrations

2020-2016 As Assistant Professor (9 poster and demos)

D1. Pettet, Geoffrey, Mukhopadhyay, Ayan, Samal, Chinmaya, **Dubey, Abhishek**, and Vorobeychik, Yevgeniy. **2019**. "Incident management and analysis dashboard for fire departments: ICCPS demo". In: *Proceedings of the 10th ACM/IEEE International Conference on Cyber-Physical Systems, ICCPS 2019, Montreal, QC, Canada*, pp. 336–337 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

D2. Hartsell, Charles, Mahadevan, Nagabhushan, Ramakrishna, Shreyas, **Dubey, Abhishek**, Bapty, Theodore, and Karsai, Gabor. **2019**. "A CPS toolchain for learning-based systems: demo abstract". In: *Proceedings of the 10th ACM/IEEE International Conference on Cyber-Physical Systems, ICCPS 2019, Montreal, QC, Canada*, pp. 342–343 .*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

D3. Shekhar, Shashank, Chhokra, Ajay, Sun, Hongyang, Gokhale, Aniruddha, **Dubey, Abhishek**, and Koutsoukos, Xenofon D. **2019**. "Supporting fog/edge-based cognitive assistance IoT services for the visually impaired: poster abstract". In: *Proceedings of the International Conference on Internet of Things Design and Implementation, IoTDI 2019, Montreal, QC, Canada*, pp. 275–276 .*Contributions: Collaboratively developed the research ideas and wrote/edited a minor portion of the paper.*

D4. Eisele, Scott, Ghosh, Purboday, Campanelli, Keegan, **Dubey, Abhishek**, and Karsai, Gabor. **2019**. "Demo: Transactive Energy Application with RIAPS". in: *IEEE 22nd International Symposium on Real-Time Distributed Computing, ISORC 2019, Valencia, Spain, May 7-9, 2019*, pp. 85–86 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

D5. Burruss, Matthew P., Ramakrishna, Shreyas, Karsai, Gabor, and **Dubey, Abhishek**. **2019**. "DeepNNCar: A Testbed for Deploying and Testing Middleware Frameworks for Autonomous Robots". In: *IEEE 22nd International Symposium on Real-Time Distributed Computing, ISORC 2019, Valencia, Spain, May 7-9, 2019*, pp. 87–88 [undergraduate author] .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

D6. Chhokra, Ajay, Hasan, Saqib, **Dubey, Abhishek**, Mahadevan, Nagabhushan, and Karsai, Gabor. **2017**. "Diagnostics and prognostics using temporal causal models for cyber physical energy systems". In: *Proceedings of the 8th International Conference on Cyber-Physical Systems, ICCPS 2017, Pittsburgh, Pennsylvania, USA, April 18-20, 2017*, p. 87 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

D7. Eisele, Scott, **Dubey, Abhishek**, Karsai, Gabor, and Lukic, Srdjan. **2017**. "Transactive energy demo with RIAPS platform". In: *Proceedings of the 8th International Conference on Cyber-Physical Systems, ICCPS 2017, Pittsburgh, Pennsylvania, USA, April 18-20, 2017*, p. 91 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

D8. Pradhan, Subhav, **Dubey, Abhishek**, Khare, Shweta, Sun, Fangzhou, Sallai, János, Gokhale, Aniruddha S., Schmidt, Douglas C., Lehofer, Martin, and Sturm, Monika. **2016**. "Poster Abstract: A Distributed and Resilient Platform for City-Scale Smart Systems". In: *IEEE/ACM Symposium on Edge Computing, SEC 2016, Washington, DC, USA, October 27-28, 2016*, pp. 99–100 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

D9. Emfinger, William, **Dubey, Abhishek**, Völgyesi, Péter, Sallai, János, and Karsai, Gabor. **2016**. "Demo Abstract: RIAPS - A Resilient Information Architecture Platform for Edge Computing". In: *IEEE/ACM Symposium on Edge Computing, SEC 2016, Washington, DC, USA, October 27-28, 2016*, pp. 119–120 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

2015-2009 <u>As Research Scientist</u> (4 poster and demos)

D10. Chhokra, Ajay, **Dubey, Abhishek**, Mahadevan, Nagabhushan, and Karsai, Gabor. **2016**. "Poster Abstract: Distributed Reasoning for Diagnosing Cascading Outages in Cyber Physical Energy Systems". In: *7th ACM/IEEE International Conference on Cyber-Physical Systems, ICCPS 2016, Vienna, Austria, April 11-14, 2016*, 33:1 .*Contributions: Collaboratively developed the research ideas and wrote/edited a portion of the paper.*

D11. Pradhan, Subhav, **Dubey, Abhishek**, and Gokhale, Aniruddha S. **2016**. "WiP Abstract: Platform for Designing and Managing Resilient and Extensible CPS". in: *7th ACM/IEEE International Conference on Cyber-Physical Systems, ICCPS 2016, Vienna, Austria, April 11-14, 2016*, 39:1 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

D12. Emfinger, William, Kumar, Pranav, **Dubey, Abhishek**, Otte, William, Gokhale, Aniruddha, and Karsai, Gabor. **2013**. "Drems: A toolchain and platform for the rapid application development, integration, and deployment of managed distributed real-time embedded systems". In: *IEEE Real-time Systems Symposium .Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

D13. Mehrotra, Rajat, **Dubey, Abhishek**, Abdelwahed, Sherif, and Tantawi, Asser N. **2010**. "Integrated Monitoring and Control for Performance Management of Distributed Enterprise Systems". In: *MASCOTS 2010, 18th Annual IEEE/ACM International Symposium on Modeling, Analysis and Simulation of Computer and Telecommunication Systems, Miami, Florida, USA, August 17-19, 2010*, pp. 424–426 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

<2009 As PhD. Student (1 poster and demo)

D14. **Dubey, Abhishek**, Neema, Sandeep, Kowalkowski, Jim, and Singh, Amitoj. **2008**. "Scientific Computing Autonomic Reliability Framework". In: *Fourth International Conference on e-Science, e-Science 2008, 7-12 December 2008, Indianapolis, IN, USA*, pp. 352–353 .*Contributions: Devised and directed the main research ideas and wrote/edited a significant portion of the paper.*

Invited Talks

P1. **Dubey, Abhishek**. **2020**. "Building Principled Decision Procedures for Urban Transit and Emergency Response Services". In: *Invited Presentation at Berkley Institute of Transportation Studies*

P2. **Dubey, Abhishek**. **Oct. 2019**. "Resilient Cyber Physical Systems". In: *Invited Presentation at Princeton Workshop on Resilience in Smart Grid*

P3. **Dubey, Abhishek**. **Dec. 2019**. "Principled Approaches for Resilient Emergency Response Procedures". In: *NSF Workshop with JST In Tokyo Japan*

P4. **Dubey, Abhishek**. **2019**. "Principled Approaches for Resilient Decision Procedures in Smart and Connected communities". In: *Invited Presentation at George Mason University*

P5. **Dubey, Abhishek**. **Dec. 2019**. "Principled Approaches for Resilient Decision Procedures in Smart and Connected communities". In: *Adaptive Reflective Middleware Workshop Panel at Middleware Conference*

P6. **Dubey, Abhishek**. **2019**. "Predictive Smart Emergency Response". In: *NSF Workshop on Emergency Response at University of South Carolina*

P7. **Dubey, Abhishek**. **2019**. "Panel on AI in Smart Cities". In: *Metrolab Summit*

P8. **Dubey, Abhishek**. **2019**. "Optimal Anomaly Detection and Dispatch Response in Transportation Networks". In: *Freedm Research Symposium at NCSU (Invited)*

P9. **Dubey, Abhishek**. **May 2019**. "Internet of Things: Opportunities, Background and Challenges". In: *Tutorial and Presentation at Marriott International in Atlanta*

P10. **Dubey, Abhishek**. **May 2019**. "Model-based design for CPS with learning Enabled Components". In: *Invited Presentation at SMC-IT workshop on Autonomy*

P11. **Dubey, Abhishek**. **Dec. 2019**. "Blockchains and CPS". in: *New Directions in Software and Technology (NDIST)*

P12. **Dubey, Abhishek**. **May 2018**. "Resilient and Trustworthy Transactive Platform for Smart and Connected Communities". In: *Invited Talk at Nanyang Technological University, Singapore*

P13. **Dubey, Abhishek**. **Oct. 2018**. "Resilient Analytics for Smart and Connected Communities". In: *Invited Presentation at Oakridge National Lab, Knoxville*

P14. **Dubey, Abhishek**. **2018**. "Resilient Cyber Physical Systems". In: *Invited Presentation at Missouri Science and Technology*

P15. **Dubey, Abhishek**. **2017**. "Blockchain and IoT". in: *Keynote at M4IoT workshop at Middleware Conference*

P16. **Dubey, Abhishek**. **Dec. 2017**. "Communication Anonymity in Transactive Energy". In: *Serial 2017 Workshop*

P17. **Dubey, Abhishek**. **2017**. "Blockchains: Application to time-sensitive Systems". In: *Invited Presentation Hashed Health Summit, Nashville TN*

P18. **Dubey, Abhishek**. **2017**. "Reliable Distributed Systems in Smart and Connected Communities". In: *Invited Presentation at Missouri Science and Technology*

P19. **Dubey, Abhishek**. **2017**. "Drems-os: An operating system for managed distributed real-time embedded systems". In: *2017 6th International Conference on Space Mission Challenges for Information Technology (SMC-IT)*. IEEE

P20. **Dubey, Abhishek**. **Nov. 2017**. "Education and Immersion Opportunities in Smart Cities". In: *Education panel on Smart and connected communities*

P21. **Dubey, Abhishek**. **June 2017**. "Social Routing Algorithms for Efficient Mobility". In: *US-Ignite Summit on Smart Cities*

P22. **Dubey, Abhishek**. **2016**. "Digitalization disrupts traditional business". In: *Keynote at M4IoT workshop at Middleware Conference*

P23. **Dubey, Abhishek**. **2016**. "Resilient Information Architecture for Smart Systems". In: *Invited Talk at Siemens, CT, Munich*

Conference Presentations

P24. **Dubey, Abhishek**. **2019**. "Cyber-Physical Simulation Platform for Security Assessment of Transactive Energy Systems". In: *7th Workshop on Modeling and Simulation of Cyber-Physical Energy Systems, MSCPES@CPSIoTWeek 2019, Montreal, QC, Canada*

P25. **Dubey, Abhishek**. **2019**. "Smart Transportation Delay and Resiliency Testbed Based on Information Flow of Things Middleware". In: *IEEE International Conference on Smart Computing, SMARTCOMP 2019, Washington, DC, USA, June 12-15, 2019*

P26. **Dubey, Abhishek**. **June 2019**. "Mobilytics-Gym: A Simulation Framework for Analyzing Urban Mobility Decision Strategies". In: *IEEE International Conference on Smart Computing, SMARTCOMP 2019, Washington, DC, USA*

P27. **Dubey, Abhishek**. **2019**. "Towards an Adaptive Multi-Modal Traffic Analytics Framework at the Edge". In: *IEEE International Conference on Pervasive Computing and Communications Workshops, PerCom Workshops 2019, Kyoto, Japan, March 11-15, 2019*

P28. **Dubey, Abhishek**. **2019**. "Towards demand-oriented flexible rerouting of public transit under uncertainty". In: *Fourth Workshop on International Science of Smart City Operations and Platforms Engineering, SCOPE@CPSIoTWeek 2019, Montreal, QC, Canada*

P29. **Dubey, Abhishek**. **2019**. "Demo: Transactive Energy Application with RIAPS". in: *IEEE 22nd International Symposium on Real-Time Distributed Computing, ISORC 2019, Valencia, Spain, May 7-9, 2019*

P30. **Dubey, Abhishek**. **2018**. "TRANSAX: A Blockchain-Based Decentralized Forward-Trading Energy Exchanged for Transactive Microgrids". In: *24th IEEE International Conference on Parallel and Distributed Systems, ICPADS 2018, Singapore, December 11-13, 2018*

P31. **Dubey, Abhishek**. **2017**. "Role of Blockchains in Decentralized Cyber-Physical Systems". In: *Invited Talk at Siemens Blockchain Workshop, Erlangen, Germany*

P32. **Dubey, Abhishek**. **2017**. "DxNAT - Deep neural networks for explaining non-recurring traffic congestion". In: *2017 IEEE International Conference on Big Data, BigData 2017, Boston, MA, USA, December 11-14, 2017*

P33. **Dubey, Abhishek**. **2017**. "Incident analysis and prediction using clustering and Bayesian network". In: *2017 IEEE SmartWorld, San Francisco, CA, USA, August 4-8, 2017*

P34. **Dubey, Abhishek**. **2017**. "Performance evaluation of smart systems under uncertainty". In: *2017 IEEE SmartWorld, San Francisco, CA, USA, August 4-8, 2017*

P35. **Dubey, Abhishek**. **2017**. "Providing privacy, safety, and security in IoT-based transactive energy systems using distributed ledgers". In: *Seventh International Conference on the Internet of Things, IOT 2017, Linz, Austria, October 22-25, 2017*

P36. **Dubey, Abhishek**. **2017**. "Transactive energy demo with RIAPS platform". In: *8th International Conference on Cyber-Physical Systems, ICCPS 2017, Pittsburgh, Pennsylvania, USA, April 18-20, 2017*

P37. **Dubey, Abhishek**. **2016**. "A distributed and resilient platform for city-scale smart systems". In: *Conference presentation, IEEE/ACM Symposium on Edge Computing (SEC)*

P38. **Dubey, Abhishek**. **2016**. "Towards Reliability-Based Decision Making in Cyber-Physical Systems". In: *2016 IEEE International Conference on Smart Computing, SMARTCOMP 2016, St Louis, MO, USA, May 18-20, 2016*

P39. **Dubey, Abhishek**. **2016**. "The Role of Context and Resilient Middleware in Next Generation Smart Grids". In: *3rd Workshop on Middleware for Context-Aware Applications in the IoT, M4IoT@Middleware 2016, Trento, Italy*

P40. **Dubey, Abhishek**. **2015**. "Smart City Hubs: Opportunities for Integrating and Studying Human CPS at Scale". In: *Workshop on Big Data Analytics in CPS: Enabling the Move from IoT to Real-Time Control*

P41. **Dubey, Abhishek**. **2015**. "Challenges for Application Platforms for Integrated Cyber Physical Systems". In: *Workshop on Big Data Analytics in CPS: Enabling the Move from IoT to Real-Time Control*

P42. **Dubey, Abhishek**. **2015**. "Transit Hub - An Extensible and Smart Decision Support System for Public Transportation". In: *CPS Principal Investigators Meeting*

P43. **Dubey, Abhishek**. **2014**. "A Rapid Testing Framework for a Mobile Cloud". In: *25th IEEE International Symposium on Rapid System Prototyping, RSP 2014, New Delhi, India, October 16-17, 2014*

P44. **Dubey, Abhishek**. **2014**. "An Information Architecture Platform for Mobile, Secure, and Resilient Distributed Systems". In: *High Confidence Software and Systems Conference*

P45. **Dubey, Abhishek**. **2014**. "Using temporal causal models to isolate failures in Power System protection devices". In: *AUTOTESTCON*

P46. **Dubey, Abhishek**. **2014**. "Temporal causal diagrams for diagnosing failures in cyber-physical systems". In:

P47. **Dubey, Abhishek**. **2014**. "A Resilient and Secure Software Platform and Architecture for Distributed Spacecraft". In: *SPIE Defense, Security, and Sensing*

P48. **Dubey, Abhishek**. **2012**. "A Deliberative Reasoner for Model-Based Software Health Management". In: *The Eighth International Conference on Autonomic and Autonomous Systems*

P49. **Dubey, Abhishek**. **2012**. "RFDMon: A Real-time and Fault-tolerant Distributed System Monitoring Approach". In: *The Eighth International Conference on Autonomic and Autonomous Systems*

P50. **Dubey, Abhishek**. **Mar. 2012**. "A Software Platform for Fractionated Spacecraft". In: *IEEE Aerospace Conference, 2012*. Big Sky, MT, USA

P51. **Dubey, Abhishek**. **Mar. 2011**. "Model-based software health management for real-time systems". In: *Aerospace Conference, 2011 IEEE*

P52. **Dubey, Abhishek**. **2011**. "Application of Software Health Management Techniques". In: *6th International Symposium on Software Engineering for Adaptive and Self-Managing Systems*. SEAMS '11. Waikiki, Honolulu, HI, USA

P53. **Dubey, Abhishek**. **2010**. "A Real-Time Component Framework: Experience with CCM and ARINC-653". In: *IEEE International Symposium on Object-Oriented Real-Time Distributed Computing*. Los Alamitos, CA, USA

P54. **Dubey, Abhishek**. **2010**. "Integrated Monitoring and Control for Performance Management of Distributed Enterprise Systems". In: *International Symposium on Modeling, Analysis, and Simulation of Computer Systems*. Los Alamitos, CA, USA

P55. **Dubey, Abhishek**. **Mar. 2010**. "Dynamic Workflow Management and Monitoring Using DDS". in: *Engineering of Autonomic and Autonomous Systems (EASe), 2010 Seventh IEEE International Conference and Workshops on*

P56. **Dubey, Abhishek**. **2010**. "Model Based Design". In: *Talk at Fermi National Laboratory*

P57. **Dubey, Abhishek**. **2010**. "Distributed diagnosis of complex systems using timed failure propagation graph models". In: *AUTOTESTCON, 2010 IEEE*. IEEE

P58. **Dubey, Abhishek**. **2009**. "Modeling and Analysis of Probabilistic Timed Systems". In: *IEEE International Conference on the Engineering of Computer-Based Systems*. Los Alamitos, CA, USA

P59. **Dubey, Abhishek**. **2009**. "Compensating for Timing Jitter in Computing Systems with General-Purpose Operating Systems". In: *IEEE International Symposium on Object-Oriented Real-Time Distributed Computing*. Los Alamitos, CA, USA

P60. **Dubey, Abhishek**. **2009**. "Using Runtime Verification to Design a Reliable Execution Framework for Scientific Workflows". In: *EASE '09: 2009 Sixth IEEE Conference and Workshops on Engineering of Autonomic and Autonomous Systems*. Washington, DC, USA

P61. **Dubey, Abhishek**. **2009**. "Algorithms for Synthesizing Safe Sets of Operation for Embedded Systems". In: *ECBS '09: 2009 16th Annual IEEE International Conference and Workshop on the Engineering of Computer Based Systems*. Washington, DC, USA

P62. **Dubey, Abhishek**. **July 2009**. "Reflex and Healing Architecture for Software Health Management". In: *International Workshop on Software Health Management, IEEE conference on Space Mission Challenges for Information Technology*

P63. **Dubey, Abhishek**. **2008**. "Towards A Model-Based Autonomic Reliability Framework for Computing Clusters". In: *5th IEEE International Workshop on Engineering of Autonomic & Autonomous Systems (EASe)*

P64. **Dubey, Abhishek**. **2008**. "Scientific Computing Autonomic Reliability Framework". In: *ESCIENCE '08: 2008 Fourth IEEE International Conference on eScience*. Washington, DC, USA

P65. **Dubey, Abhishek**. **2007**. "Model Predictive Analysis for Autonomic Workflow Management in Large-scale Scientific Computing Environments". In: *4th IEEE International Workshop on Engineering of Autonomic & Autonomous Systems (EASe)*

P66. **Dubey, Abhishek**. **2006**. "Verifying autonomic fault mitigation strategies in large scale real-time systems". In: *3rd IEEE International Workshop on Engineering of Autonomic & Autonomous Systems (EASe)*

Professional Service

Grant Review Panels

2014-2020 I have participated in grant review panels for the NSF SCC, Civic Innovation Challenge, IIS Core, Big Data and CPS programs.

Editorial Activity

2019 Guest Editor: Special Issue of Journal of Systems and Software, ISORC 2018

2018 Guest Editor: Special Issue of Journal of Systems and Software, Elsevier on Adaptive Reflective Middleware

2013 Guest Editor: Special Issue on Software Health Management, Springer-Verlag

2016 International Workshop on Science of Smart City Operations and Platforms Engineering

2017 International Workshop on Science of Smart City Operations and Platforms Engineering

Conference and Workshop Organization

2020 Local Organization Chair for CPSWeek 2021.

2019 Finance Chair of 22nd IEEE International Symposium On Real-Time Computing (ISORC)

2019 General Chair of 22nd IEEE International Symposium On Real-Time Computing (ISORC)

2019,2020 Program Co-chair of 4th IEEE Workshop on Big Data and IoT Security in Smart Computing at SmartComp conference.

2020–2016 Chair - International Workshop on Science of Smart City Operations and Platforms Engineering at CPS Week

2018 Local organizer for Real-Time Systems and Symposium (RTSS)

2018 Program Chair of 21st IEEE International Symposium On Real-Time Computing (ISORC)

2018 Co-Chair - 1st International Workshop on Trustworthy and Real-Time Edge Computing for Cyber-Physical Systems (TREC4CPS)

2018 Program Chair of Smart and Connected Communities Workshop at International Conference on Distributed Computing and Networking.

2017 General Chair of the 16th Workshop on Adaptive and Reflective Middleware

2015 Chair, SPLC Conference, Tools and Demonstration Track

Technical Program Committees

2021 IEEE International Conference on Blockchain and Cryptocurrency

2021 5th IEEE International Conference on Fog and Edge Computing 2021

2021 22nd International Conference on Distributed Computing and Networking (ICDCN 2021)

2020 1st Workshop on Blockchain for Network Resource Sharing (BlockNet 2020

2020 7th International Workshop on Middleware and Applications for the Internet of Things (M4IoT 2020)

2020 COINS: IEEE International Conference on Omni-layer Intelligent systems

2020 IEEE International Conference on Blockchain and Cryptocurrency

2020 IEEE Workshop on Assured Autonomy

2018,2019 Destion Workshop at CPS Week

2019 SmartComp

2017 Smart World Congress

2017 Fog World Congress

2016-2018 SmartSys Workshop at SmartComp Conference

2018-2016 ACM MMSys, special session on smart cities

2020-2013 Program committee member for International Symposium on Object-oriented Real-time Distributed Computing

2015 Program committee member for Workshop on Wild and Crazy Ideas on the interplay between IoT and Big Data

2015 Program committee member for 31st ACM/SIGAPP Symposium on Applied Computing, Reliable Software Technologies and Communication Middleware Track

2012 Program Committee Member: 9th IEEE Workshop on Model-Based Development for Computer-Based Systems

2011 Co-Chair, Second International Workshop on Software Health Management

2011 Program committee member for 9th IEEE/IFIP International Conference on Embedded and Ubiquitous Computing

2011 Program committee member for International Symposium on Object-oriented Real-time Distributed Computing

Journals

I have frequently reviewed papers for the following journals.

- International Journal on Prognostics and Health Management
- IEEE Transactions on System Man and Cybernetics
- Future Generation Computer Systems
- IEEE Access
- IEEE Computer
- Elsivier Pervasive and Mobile Computing
- Innovations in System and Software
- IEEE Transactions on Smart Grid
- IEEE Transactions on Mobile Computing
- Journal on Cluster Computing
- ACM Transactions on Cyber Physical Systems
- Journal of Aerospace Computing, Information, and Communication
- Journal of Universal Computer Science
- IEEE Industrial Informatics
- Embdeded System Letters

- Journal of Systems and Software - Elsevier

Professional Societies

- Senior Member, IEEE
- Member, IEEE Power and Energy Society
- Member, IEEE Intelligent Transportation Society
- IEEE Computer Society Special Technical Community on Blockchains
- IEEE Computer Society Special Technical Community on Smartgrid
- IEEE Computer Society Special Technical Community on Real-time Systems
- IEEE Technical Committee on Autonomous and Autonomic Systems.

University Service

2017-2020	Advisor computer science class of 2019, 2021 and 2022.
2020	VU Summer Research Program Review Committee
2020	UPE Honors Society Faculty Advisor
2019	Goldwater Scholarship Review Committee
2019	Participated in 2U curriculum discussion.
2019,2020	Helping Metro Nashville with data management and data analytics for Mobility data. It includes scooter data and accident data.
2019	My research group participated along with the Wondry at the OZ art museum family day held on August 19th, 2019.
2018,2029	Actively Participating in MOVE VU committees
2017	Working with the mobility planning group in future vu to design a campus wayfinding system.
2017	Data Analytics for the Vanderbilt CMAQ Grant submitted.
2016	Directed undergraduate senior design project on smart home analytic.
2017	Selected to offer a university course on data science for smart communities
2017	Serving as a member of the Bluesky Advisory Committee
2017	Served in the transit committee of Future VU
2017,2018	Presented Transit Related Projects at FutureVU meetings
2018	Part of the Working Group on Energy and Natural Resources, lead: George Honberger (2017)
2017	Presented review of smart community research at Intro to Engineering Lectures (2017)
2018	Organized Multimodal Mobility Workshop for interaction between community, industry and academic partners. Details are available at `https://cps-vo.org/group/MultiModalMobility`
2017	Gulch Traffic Density Assessment Project in collaboration with Planning Department
2018	Air Quality Assessment Project in collaboration with the GNRC
2017-2018	Working closely with the Nashville Mayor's office and the Nashville Technology Council on Blockchain initiatives in metropolitan area
2017	Working closely with the Open Data initiative at the Metro ITS
2018	Active participant in the TennSmart program
2018	We are currently in the process of implementing the Transit Hub platform for Chattanooga Area Regional Transit Authority

2016-2017 Chair, Connected Nashville Technology Standards Committee convened by Mayor

2016 Helped develop the Nashville application for the Department of Transportation Challenge

2015-2017 Led Nashville projects at the Global Cities Team Challenge organized by NIST. The projects included collaborative work with Nashville MTA and Nashville Fire Department

Teaching

Courses Created or Significantly Redesigned

Topics in Big Data — The goal of this class is to cover topics in Big Data. The focus is on principles and practices of data storage, data modeling techniques, data processing and querying, data analytics and applications of machine learning using these systems. I revised the big data course to focus more on noSQL and smart cities data stores. Additionally, we are introducing students to cloud computing for big data and using Amazon Web Services for course assignments.

Data Science Applications for Smart Cities - Co-created with Gautam Biswas — The new university course introduces students to important challenges that arise from unprecedented growth in our cities and metropolitan areas making it hard to provide the infrastructure and resources needed for sustainable development and maintaining the needed quality of life for all citizens. To study solution approaches, the course adopts the notion of Smart Cities, an urban development vision that adopts an Internet of Things (IoT) framework to provide a technology-driven framework for integration of city infrastructure and resources, and thus provide mechanism to optimize their use and provide an efficient, informed, and equitable distribution of services.

Reliable Distributed Systems — I created course Univ 8395-02 in which students are introduced to various topics in this field including requirements analysis, reliability analysis, redundant architectures and mechanisms for fault avoidance.

Operating Systems — I significantly redesigned and enhanced CS 3281/5281, Introduction to Operating Systems course to focus more on the application of fundamental concepts of resource management and concurrency. The course always ends in a team project where students design new application and modules for operating systems. Additionally, the course delivery and assignments are managed over GitHub.

Courses Taught

Spring 2020 CS 4266/5266 - Topics in Big Data, 47 students

Spring 2020 Univ 3360/5360 - Data Sciences for Smart Cities, 23 Students

Spring 2019 CS 3281/5281 - Principles of Operating Systems I, 37 students

Fall 2019 Univ 3360/5360 - CS 5891 05, CS 3891 - Special topic - Reliable Distributed systems, 10 Students

Spring 2018 Univ 3360/5360 - Data Sciences for Smart Cities, 20 Students

Fall 2018 Univ 3360/5360 - CS 5891 05, CS 3891 - Special topic - Reliable Distributed systems, 26 Students

Spring 2018 Univ 3360/5360 - Data Sciences for Smart Cities, 20 Students

Spring 2018 CS 3281/5281 - Principles of Operating Systems I, 35 students

Fall 2017 CS 8395-02- Sp Topics: Fundamentals of Dependable and Resilient Distributed Computing, 11 students(Overall instructor rating 4.50/school average 4.05)

Spring 2017 CS 3281/5281 - Principles of Operating Systems I, 32 students (Overall instructor rating 3.92/department average 4.13)

Fall 2016 CS 3281/5281 - Principles of Operating Systems I, 42 students(Overall instructor rating 4.27/department average 4.00)

Spring 2016 CS 3281/5281 - Principles of Operating Systems I, 42 students(Overall instructor rating 4.21)

Fall 2015 CS 3281/5281 - Principles of Operating Systems I, 49 students

Spring 2015 CS 281 - Principles of Operating Systems I, 38 students(Overall instructor rating 4.05)

Fall 2014 CS 281 - Principles of Operating Systems I, 40 students

Spring 2014 CS 281 - Principles of Operating Systems I, 29 students(Overall instructor rating 3.84)

Students and Postdoc Scholars Advised

Thesis Supervised

2020 Matthew Buruss. Enhancing the Robustness of Deep Neural Networks Against Security Threats Using Radial Basis Functions (MS Thesis, Vanderbilt University).

2019 Chinmaya Samal. Time-dependent and Privacy- Preserving Decentralized Routing using Federated Learning (MS Thesis, Vanderbilt University).

2018 Fangzhou Sun. Algorithms for Context-Sensitive Prediction, Optimization and Anomaly Detection in Urban Mobility (Doctoral dissertation, Vanderbilt University).

2017 Pradhan, Subhav. Algorithms and Techniques for Managing Extensibility in Cyber-Physical Systems (Doctoral dissertation, Vanderbilt University).

Doctoral Thesis Program Committee

- Ajay Chhokra
- Anirban Bhattacharjee
- Yi Li
- Jian Lou
- Ayan Mukhopadhyay
- Amin Ghafouri
- Yao Pan
- Saideep Nannapaneni (Civil Engineering)

Postdoc Scholars

- Sayyed Vazirizade
- Saideep Nannapaneni
- William Emfinger

Graduate Students Advised

- Fangzhou Sun, CS (Graduated in 2018 with Ph.D)
- Subhav Pradhan, CS (Graduated in 2017 with Ph.D)
- Chinmaya Samal, CS (Graduated in 2019 with MS)
- Geoffrey Pettet, CS
- Michael Wilbur, CS
- Nithin Guruswamy, CS

- Sanchita Basak, EE
- Scott Eisele, EE
- Shreyas Ramakrishnan, EE
- Matthew Burruss, CS (Dual BS/MS)

Graduate Students partially supported as PI (other than direct advisees)

- Mike Walker, CS
- William Emfinger, EE
- Pranav S. Kumar, EE
- Akshay Dabholkar, CS
- Timothy Krentz, CS
- Zhuangwei Kang, CS
- Purboday Ghosh, CS
- Shweta Khare, CS
- Ajay Chokra, EE
- Saqib Hasan, EE
- Saideep Nannapaneni, Civil

Undergraduate Research Supervised

2020 Abhiram Vadali, CS - Big Data Analytics for Smart Transit Systems

2020 Riyan Kabir, CS - Big Data Analytics for Smart Transit Systems

2020 Teo Lee, CS - Predictive Models for Emergency Response Systems

2020 Anna Ouyang, Psychology - Predictive Models for Emergency Response Systems

2018, 2019 Matthew Buruss, CS - Assured Autonomy

2019,2020 Keegan Campanelli, EE - Transactive Energy and Electric Grid

2019 Li Haoyu, CS - Data Analytics for Emergency Response

2019 Brian Xu, CS - Data Analytics for Emergency Response

2017, 2018 Rounak Salim, CS - Indoor Localization

2017 Hoyos Juan Sebastian, CS - Secure Operating Systems

2017 Nicholas Lewis, CS - Internet of Things

2017 Aaron Smith, CS - Virtual Reality

2017 Anne Zou, CS - Mobility Application for Cities

2016-2017 Smart Home Analytics Team - Megan WoodRuff, John Carlton Jester, Morgan Fogel, Jianpeng Min (Senior Design)

Awards and Honors

- Best paper award Smartcomp 2019.
- Invited to present my work at the Arab American Frontiers organized by National Academy of Engineering in Cairo, Egypt in 2019.
- Promoted to Senior Member grade by IEEE in 2015.
- Best project finalist NTC 2017.
- Best paper award ICAS 2012.

- Received a letter of commendation from the Chancellor's Office for the Smart Cities work in Nashville

Selected Software Development Accomplishments

- Part of the team developing the Resilient Information Architecture Platform for Smart Grid. It is now a Linux Foundation Project.
- Co-created the transactive energy middleware called TRANSAX
- Supervised the software for edge clouds called MODICUM.
- Created the first open-source operating system implementation (COSMOS) for the Future Airborne Capability Environment
- Created the ARINC 653 Emulation Environment for Linux Operating system. This software is used by NASA JPL, FERMI National Lab in addition to the participants of FACE and System F6 program.
- Created the CHARIOT management environment. The system is now used internally by Siemens.
- Co-developed the F6MDK. The full stack implementation of a containerized application system was used for the DARPA System-F6 project.