

2016-2017

# Understanding Complexities in Modern Systems

An overview of our research

STEVENS.EDU/SSE/RESEARCH

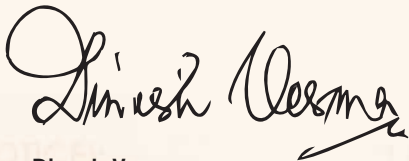


# Message from the Dean

Dr. Dinesh Verma

The research undertaken within the School of Systems & Enterprises (SSE) addresses some of the most pressing issues faced by our increasingly connected global society. It is an honor to be part of this team of faculty. In this, our first school research review, we talk about our research priorities and thrusts over the course of the next two to five years. Additionally, we summarize the work of our research centers across multiple domains: financial systems, national security, healthcare delivery and coastal urban resilience. This research review also gives us an opportunity to profile our faculty.

Research at SSE: together with our students, sponsors and partners in government and industry, we are on a journey to great new discoveries. I invite you to explore our 2016 / 2017 research review. As you read through it, I hope you find something that piques your interest. And I welcome your suggestions as to how future editions of our research review might be improved both in content and presentation.



Dinesh Verma

Ph.D., Dean of the School of Systems & Enterprises

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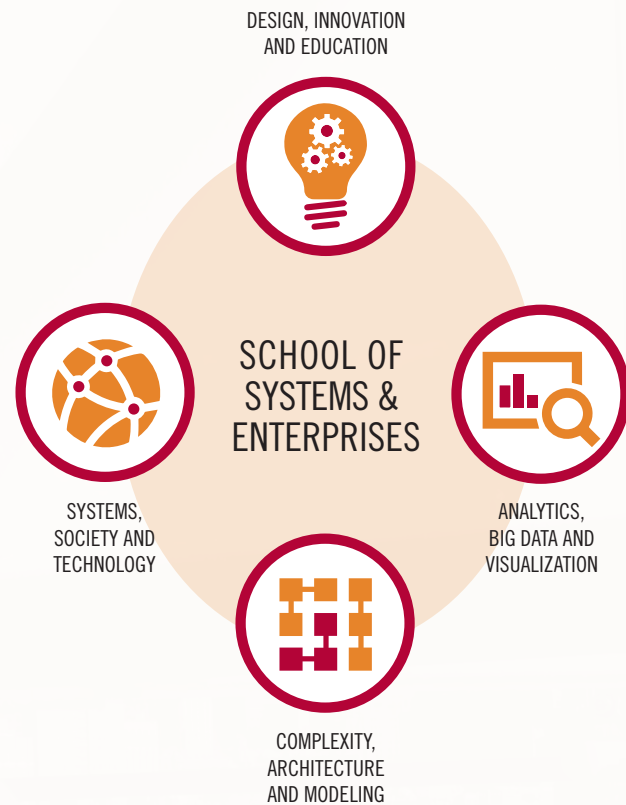
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# Core Research Areas

Understanding complexity in modern systems is the critical challenge of this century

Research at SSE is structured to help us better understand the forces that drive complexity, determine risks and benefits to society, design and architect appropriate systemic solutions, and provide analytical tools to continually improve and evolve these systems. SSE has defined four research vectors to more fully address complexity in modern large-scale interconnected systems and enterprises.

Our four research vectors serve as a foundation for these capabilities by understanding the behavior of people actually working with systems, determining how to design human-centric complex systems and educate the designers, create architecture and models of these systems, and leverage system and simulation data to enable informed risk and critical decisions. Our research is decidedly broad-based and has significant interplay with other disciplines and domains such as economics, healthcare, financial services, computational social sciences and public policy.



## 1. Systems, Society and Technology

Social systems – healthcare, aerospace, finance, marine, military and telecommunications to name a few – are grappling with the challenge of modernizing their technology. At the same time, the technologies needed to support these systems are growing increasingly complex. SSE research takes a deeper look at the interplay between complex systems and human enterprise, revealing insights about the nature of socio-technical interactions and its impact on society. SSE research is backed by rigorous analytical thinking and considers policy, individual rights, and organizational and ethical issues at points where people and technology intersect.

Insights from our research expand our understanding of how people and technology interact, with a bent toward human behavior and community. Thus, it enables systems thinkers to design effective complex systems and improve human interaction with these systems.

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## 2. Design, Innovation and Education

The empathetic, human-centric characteristics of design thinking, and the deep understanding of systems-level behavior enabled by systems thinking are critical for the success of human-based, complex systems. In addition, the integration of systems and software engineering facilitates the translations of these designs into reality throughout the life cycle. SSE researchers are investigating the future of design and systems and software engineering to determine the principles and approaches necessary for success, and the means by which to instill these capabilities into our future systems decision makers, designers and engineers. Educational challenges are not limited to post-secondary and graduate education, but also are examined K-12.

This area of research evaluates systems and design thinking. It includes reviewing the principles and state of the art in parallel disciplines, determining overlap and gaps in design, and conducting anthropological studies, to go “native” with rapid design organizations to understand behavior, and determine issues and improvements. Another aspect of this research is to improve the effectiveness of the education process, providing “experience acceleration” – through experiential learning, case studies, flight simulations, game-based learning and other methods.

Insights from this research narrow the gap between industry and academia and provide innovators and problem solvers with the systems and design thinking background needed to effectively address the challenges of complex systems.

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## 3. Complexity, Architecture and Modeling

As today's large-scale systems become more complex, discovery of effective modeling methods to structure and optimize complex systems architecture becomes increasingly relevant. SSE research has revealed that complexity and systems are about transformation, communication of information and how information is being used by decision-makers.

This area of research investigates methods for measuring complexity. Through innovative approaches, unique systems perspectives and thorough complexity analysis methods, researchers enable accurate measurement of complexity and systemic risks, and facilitate proper system architecture synthesis and assessment. To do this, SSE research leverages model interoperability and classification, stochastic modeling, the theory of modularity and collaborative design, among other methods.

Insights from this research help to specify system architectures that lower risk and reduce complexity. Thus, it enables systems thinkers to assess the level of complexity of a system and develop effective models to build successful systems.

## 4. Analytics, Big Data and Visualization

Governments and industry have much to gain from applying analytics and visualization to improve communities. SSE researchers are conducting analytics research with a view on citizen, behavior and community.

This area of research assesses the urban perspective of real systems. From a citizen science perspective, this research looks at human systems in the community. It combines computational methods and visualization, and social media analytics to identify conversations and assess how communities behave and respond to different events during certain times.

Insights from this research enable leaders in government and industry to make informed decisions and determine community risk. Through analytics, this research also assesses community resilience and identifies ways to “sense” the community; for example, identifying depression or proxies for depression.

### Conclusion:

#### At the intersection of technology and people

Society is in the midst of a period of greatly accelerating complexity. As a result of the exponential increase in the interaction between people, technology and the natural world, a deeper understanding of complexity in our largest socio-technical systems is essential to design and develop effective, sustainable solutions that improve the lives of billions of people in an unpredictable world. Through collaboration with members of the social sciences and industry, systems researchers at SSE are developing new approaches, investigating novel models and deepening our understanding of complexity, which is fundamental to the success of our society, nation and global community.

## Numbers:

**Number of Tenure Stream Faculty Members: 15**

**Number of Joint Appointments: 2**

**2016: Total Research Expenditures in SSE: \$8,973,519**

**2016: Research Expenditures per TT Faculty Member: \$640,965**

**2015: Total Research Expenditures in SSE: \$10,395,408**

**2015: Research Expenditures per TT Faculty Member: \$742,529**

*Numbers do not reflect research expenses related to faculty with joint appointments.*

# Research Centers

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## Systems Engineering Research Center

*The Systems Engineering Research Center (SERC) provides broad systems research, and through the development of new methods, processes and tools, advances the practice of systems engineering in the defense and intelligence communities to address challenges posed by massive complexity, rapid pace of innovation, and increasing technological and operational change.*



## Center for Complex Systems and Enterprises

*The Center for Complex Systems and Enterprises (CCSE) addresses the growing complexity of socio-technical systems, adjoining wide-ranging disciplines – engineering, economics, finance, management, and behavioral and social sciences – to find solutions that improve public-private systems of great importance to society.*



## Hanlon Financial Systems Center

*The Hanlon Financial Systems Center (HFSC) is a world-class financial systems research and teaching center that was formed to provide thought leadership in finance and financial engineering.*



## Davidson Laboratory

*Led by Dr. Alan Blumberg, the Davidson Laboratory is one of the nation's largest and most renowned hydrodynamic and ocean engineering research facilities dedicated to solving problems that improve our ability to anticipate, detect, understand, predict and respond to extreme natural events.*



## Institute for Cognitive Networking

*The Institute for Cognitive Networking (iCON) researches dynamic spectrum access/sharing/management techniques that exploit spectrum (e.g., T.V.) white spaces to provide expanded broadband access to traditionally underserved populations.*

# Systems Engineering Research Center

Today's critical defense and intelligence systems are increasingly adaptive, resilient, secure and complex. Part of the work of systems engineers is to understand what is needed to develop cost effective solutions and ensure that these defense systems effectively work together. They achieve this aim by integrating disciplines, fostering cross-collaboration, balancing conflicting characteristics, affordably delivering capabilities, and facilitating cross-disciplinary collaboration. However, while systems engineers are in prime position to tackle these issues, they have often been constrained by the limitations of existing and classical systems methods, models and tools.

Designated a University Affiliated Research Center (UARC) by the United States Department of Defense (DoD), the SERC, led by Stevens Institute of Technology and principal collaborator, University of Southern California (USC), conducts research to help solve the aforementioned challenges.

SERC facilitates collaborative dialogue between academia, government and industry to understand and formulate interesting and relevant research questions. More than 400 researchers with diverse interests and from domains such as finance, telecommunications, computing and transportation have engaged on SERC projects since its establishment by the DoD in 2008.

The **SERC** research portfolio is structured into four research thrusts: enterprises and systems of systems, trusted systems, systems engineering and management transformation, and human capital development.

The emphasis in each of these research areas vary, but they all aim to provide the DoD with an overwhelming competitive advantage over adversaries in regards to increasingly complex, dynamic, cyber-physical-human net-centric systems and systems of systems of the future.

SERC enables the DoD to achieve this aim through the application of a systems approach; development of systems engineering principles, methods, processes and tools; and accelerated professional development of highly capable systems engineers and technical leaders in DoD and the defense industrial base.

For more information, visit [sercuarc.org](http://sercuarc.org)



*SERC research advances the design and development of complex defense and intelligence systems across all DoD domains.*

# Center for Complex Systems and Enterprises



*The CCSE Immersion Lab literally immerses problem-solvers and decision-makers in the exploration of real or computationally imagined complex systems.*

Most complex organizational systems involve phenomena at multiple levels. At the bottom level are human activities and work -- assembling components, delivering services or combating adversaries. At the next higher level, processes deliver the physical resources and information that enable human activity and work. At the next level, there are organizations, often-independent businesses, which own processes or elements of processes, which they operate in pursuit of their own market objectives. At the highest level is society with its objectives, values and norms.

Regardless of domain – healthcare delivery, financial systems, urban resilience and national security – these systems rely on expanding levels of networked connectivity and feedback loops, making prediction and control of these systems far more challenging than in the past. As such, the whole enterprise system associated with any of these domains must be characterized as a large-scale public-private enterprise.

An understanding of the limitations and challenges highlighted above is essential to generating and delivering knowledge and expertise that contributes to fundamental transformation of complex systems. Working together with partners in academia and industry, CCSE is mobilizing transdisciplinary research vision, experience, talent, creativity and capabilities to find human solutions for our increasingly complex world.

**CCSE** focuses its research on four key domains: healthcare delivery, financial systems, urban resilience and national security.

CCSE has found that a powerful mechanism that combines multi-level computational models of complex systems and enterprises with an immersive and interactive visualizations environment is essential to addressing complexity.

CCSE is enabling rapid conceptualization, development and validation of multi-level computational models with associated interactive visualizations, with a paradigm that facilitates modeling any complex enterprise. The innovative CCSE research environment, combined with educational programs at Stevens, develops skilled people who can create and deploy high value, affordable solutions in a wide range of complex systems and enterprises.

For more information, visit [stevens.edu/CCSE](https://stevens.edu/CCSE)



# Hanlon Financial Systems Center

Heightened interconnectedness in finance creates opportunities, but also increases complexity. New threats to traditional franchises include model risk, execution risk, business process risk, software systems integrity and cybersecurity dangers. In addition to these issues, expanded connectivity of financial systems increase the risks of contagion throughout global finance markets.

HFSC research addresses the complexity in instrumentation, information transmission, regulation and multi-scale finance in technology-driven big-data evolving financial systems. HFSC responds to the many challenges in financial systems risks and connects the latest research in academia to professionals in today's financial industry, thus providing Stevens students a superb venue to foster new thinking.

Corporate partners in a variety of industries turn to HFSC to help uncover solutions. Using its vast resources – powerful hardware and leading-edge software tools that replicate the look and feel of the technologies in place at real-world finance companies – HFSC provides the kind of cutting-edge research demanded by industry. HFSC also directly supports academic programs, preparing students with in-demand skill sets that translate to immediate impact and success in the workplace.

**HFSC** systematically applies mathematical, statistical and big-data computational sciences to analyze, approximate and provide practical solutions to emerging challenges in the complex global financial systems.

HFSC research spans wide-ranging areas, from financial engineering, statistics and econometrics to electrical engineering, artificial intelligence and neuromorphic computing. Master's and doctoral students perform research in areas such as financial networks, systemic risk, stochastic volatility models, rare events, liquidity measures of stock markets, portfolio optimization, robotics and artificial intelligence via neuronal networks and agent-based modeling.

The Center is named after Stevens alumnus Sean Hanlon, chairman, CEO and chief investment officer of Hanlon Investment Management, who through his generosity, made this world-class facility possible.

For more information, visit [stevens.edu/hanlon](https://stevens.edu/hanlon)



*A key component of HFSC, the Hanlon Financial Systems Lab (HFSL), provides support and computational resources for students and faculty, and allows for research and instruction into how finance is evolving in response to changing technology.*

# Davidson Laboratory



*Founded in 1935, the Davidson Laboratory's unique facilities and special expertise are utilized daily by more than 4,000 marine, aerospace and defense industry leaders, federal and municipal agencies, and a host of private and academic research groups.*

Never before have researchers been faced with a more urgent need to prepare coastal communities for extreme weather events that produce intense storm surges, conditions that lead to powerful surface waves, monsoon rains and ever-increasing sea levels. These catastrophic events affect not only U.S. citizens, but also the 136 port cities around the world that have more than one million inhabitants, a total population of 400 million.

The Davidson Laboratory innovates the science serving this growing global urban population, applying its expertise in coastal ocean physics and forecasting to problems that affect the 20 million residents of the New York metropolitan area.

Modeling by the Davidson Laboratory CURES team was highlighted in NYC's 2013 flood mitigation plan, showing that if the wind-blown storm surge caused by Hurricane Sandy had occurred 7-10 hours earlier—when the tide was high for regional waterways—the consequences would have been even more catastrophic, including inundation of the region's central food distribution port facilities.\*

Davidson Laboratory experts created and maintain the New York Harbor Observing and Prediction System (NYHOPS), a vital forecasting resource for emergency preparedness. Its experts also create novel infrastructure and coastline rebuilding solutions, and assess the effectiveness of urban shore protection initiatives, beach erosion mitigation plans and zoning laws to prepare for future natural disasters.

Davidson Laboratory experts also create innovative infrastructure and coastline rebuilding solutions, and assess the effectiveness of municipal shore protection initiatives, beach erosion mitigation plans and zoning laws to prepare for future natural disasters.

The Davidson Laboratory supports academics in areas such as naval architecture, marine hydrodynamics and coastal observing systems.

\*("The Impact of Tidal Phase on Hurricane Sandy's Flooding Around New York City and Long Island Sound", Georgas, N., P. Orton, A. Blumberg, L. Cohen, D. Zarrilli, and L. Yin, Journal of Extreme Events, DOI: 10.1142/S2345737614500067, 2014)

For more information, visit [stevens.edu/davidson](http://stevens.edu/davidson)

# Institute for Cognitive Networking

The world is more connected than ever, but underserved communities throughout various regions across the globe still lag behind. High-tech innovations in broadband have the potential to connect more populations where wireless access is limited or non-existent.

Funded by the U.S. National Science Foundation (NSF), iCON brings together researchers from the U.S. and South Africa with the aim of addressing the fundamental challenges related to low cost, reliable wireless broadband access technologies for traditionally underserved areas.

Specifically, iCON aims to facilitate new collaboration on R&D for appropriate white space wireless technology-centric solutions and 5G; enable knowledge sharing and cross-fertilization among the participants, including learnings from various past projects in Africa; enable sharing of emerging experimental hardware test-beds and associated software to support new trials; and promote interaction with industry and government agencies with a view to impacting spectrum policies and standards.

**iCON** supports international research collaborations in the U.S. and South Africa focused on accelerating wireless access research, with future plans to expand to other countries in Africa and beyond.

To achieve its aim, iCON leverages shared resources between universities and industry in the U.S. and South Africa – wireless testbeds, online resources, physical and virtual meetings, summer school and a graduate student exchange program.

In addition to its research activities, the Institute provides an environment for creative international collaboration to accelerate the rate of development of research innovations and the development of talent and workforce capable of excelling in a new highly interconnected world.



*iCON organizes wireless spectrum related educational/training programs, workshops and summer schools to benefit the academic community, industry and governments.*

For more information, visit [cognitive-networking.org](http://cognitive-networking.org)



**Dr. Mark  
Blackburn**

*Research Associate  
Professor, Systems  
Engineering*

Professor Blackburn's research is focused on methods and automated tools for reasoning about computer-based systems. His research combines tools, formal methods, modeling, simulation, visualization and computation in support of design, architecting and testing. His current interests include investigating the use of semantic web technologies and ontologies for cross-domain model integration of complex and cyber physical systems, and Bayesian networks for prediction, estimation and decision-making. He has received over \$10 million dollars from industry primarily focused on applied research in formal method-based modeling, analysis, simulation and test generation tools and methods.

As the principal investigator (PI) on four SERC research tasks sponsored by Naval Air Systems Command (NAVAIR), Professor Blackburn is investigating the most advanced and holistic approaches to model-centric engineering. Additionally, he is co-PI on a related task for quantitative risk. Prior PI experience includes conducting research tasks for the National Science Foundation (NSF), Federal Aviation Administration (FAA) and National Institute of Standards and Technology (NIST).

Professor Blackburn received his B.S. in mathematics from Arizona State University and M.S. in mathematics from Florida Atlantic University; both programs with an emphasis in computer science. He received his Ph.D. from George Mason University. •



**Dr. Alan Blumberg**

*George Meade  
Bond Professor;  
Director of  
Davidson Laboratory*

Professor Blumberg is renowned for his research in urban oceanography, predictive modeling and ocean physics with particular focus on the mutual dependent interactions between coastal waters and urban environments. His research has contributed to understanding the physical dynamics of estuarine and coastal ocean circulation, and to the creation of ocean observing and forecasting systems which are used for environmental studies, surface vessel operations, and as a basis for maritime security. General numerical models have been developed such as the Princeton Ocean Model (POM) and its shallow water derivative, the Estuarine and Coastal Ocean Model (ECOM) - which are now adapted by over 3,000 research groups worldwide. Long-term research interests address new perspectives on the evolution of urban-environment interactions to create sustainable and resilient 21st century coastal city regions.

He is the recipient of multi-year funding and grant awards and is a member of professional societies such as the American Meteorological Society, American Geophysical Union, American Society of Civil Engineering, Estuarine Research Federation, and Oceanography Society. He is a fellow of the American Society of Civil Engineers and a fellow of the American Meteorological Society.

After receiving his B.S. from Fairleigh Dickinson University, Professor Blumberg received his M.A. and Ph.D. from The Johns Hopkins University, and his Post-Doctoral degree from Princeton University. •

Professor Chandramouli is the Thomas Hattrick Chair Professor of Information Systems in Electrical and Computer Engineering and a professor in the School of Systems and Enterprises. Prior to joining Stevens he was on the ECE faculty at Iowa State University. His research covers cognitive radio networking, text analytics and forensics, social media analytics and prototyping/experimental systems research in these areas. His research and technology commercialization projects are funded by the National Science Foundation (including the CAREER award), National Institute of Justice, Department of Defense and the industry.

He has been an IEEE COMSOC Distinguished Lecturer, invited member to the U.S. Office of Science and Technology Policy roundtable discussion on Collaborating on Public Safety Broadband, editor of *IEEE Journal on Selected Areas in Communications (JSAC)--Cognitive Radio Series*, founding chair of the IEEE COMSOC Technical Committee on Cognitive Networks (TCCN), and a member of the IEEE COMSOC Standards Board.

He is a recipient of the Provost's Award for Academic Entrepreneurship and Enterprise Development (2012), New Jersey Inventors Hall of Fame Innovator Award (2012) and the Master of Engineering Honoris Causa (2014) from Stevens Institute of Technology. •



**Dr. Rajarathnam Chandramouli**

*Thomas Hattrick  
Chair Professor;  
Founding Director,  
NSF SAVI:  
Institute for Cognitive  
Networking*

Professor Chatterjee has more than 15 years of experience as a quantitative analyst working for various top-tier Wall Street firms. His last role before returning to academia was as director of the Multi-Asset Hybrid Derivatives Quantitative Research group at Citigroup in New York. He was also the global Basel III coordinator for all modeling efforts needed to satisfy the new regulatory risk requirements imposed on banks. Previously, he was a quantitative analyst at Barclays Capital, a vice president at Credit Suisse and a senior vice president at HSBC.

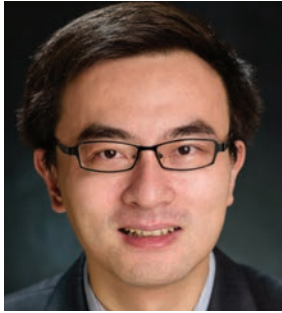
His educational background is in theoretical physics where he studied at Stony Brook University and the University of Chicago. His recent book, *Practical Methods of Financial Engineering and Risk Management*, Stevens Series on Quantitative Finance, Apress-Springer, was published in August 2014.

Professor Chatterjee received his M.Math from the University of Waterloo and Ph.D. in theoretical physics from Stony Brook University. He was a research fellow at the University of Chicago. •



**Dr. Rupak Chatterjee**

*Research Associate  
Professor;  
Deputy Director,  
Financial Engineering  
Division*



## Dr. Zhenyu Cui

*Assistant Professor,  
Financial Engineering*

Professor Cui's research interests are in financial derivatives pricing, stochastic processes and applied probability, stochastic simulation, and financial systemic risk. His current research includes working with new randomized unbiased Monte Carlo simulation schemes, which have broad applications in operations research and financial options pricing. As part of his active research activity, he is studying the effect of leverage ratio in the implied volatility surface generated from leveraged exchange-traded funds (LETF), in particular in stochastic volatility models.

He is also involved in a joint project on the study of the optimal portfolio selection problem with proportional transaction cost and jump risks, and of the optimal fee structure for the central clearing counterparty (CCP) and its effects on the overall systemic risk measures. His research appears in several scholarly journals including *Mathematical Finance*, *Finance and Stochastics*, and *Journal of Economic Theory*.

Professor Cui holds a B.S. in actuarial science from the University of Hong Kong. He attended the University of Waterloo where he received his M.S. in quantitative finance and Ph.D. in statistics. •



## Dr. Ionut Florescu

*Research Associate  
Professor;  
Director, Hanlon Financial  
Systems Lab (HFSL)*

Professor Florescu's expertise lies in developing stochastic models and using them for real-life applications. He is the recipient of several grants from the National Science Foundation (NSF), Nvidia and CME foundation. Additionally, he serves as the editor in chief for a new journal dedicated to study data sampled with high frequency as well as a reviewer for over 30 journals. His experience in organizing conferences includes the Modeling High Frequency Data in Finance conference series at Stevens. Professor Florescu has developed and introduced multiple courses in the Financial Engineering (FE) division, as well as two certificates and a new master's degree.

Dr. Florescu is the author of three books, editor of four more, has authored 35 refereed articles, and owns a patent. His work is applied in finance, computer vision, cryptography, environmental studies, geophysics and transformative learning. One large project he is leading is the Stevens High Frequency Trading (SHIFT) Simulation System which is the first model of its kind to test the behavior of modern high frequency financial markets using live, real-time market data. Other applications include the ABCShift, a patented computer vision algorithm that allows tracking of objects in videos when the background is changing, ROI the cloud robotics application, liquidity studies in finance, and stochastic volatility modeling.

Professor Florescu is a graduate of the Mathematics Division at the University of Bucharest. He received his Ph.D. in statistics from Purdue University. •

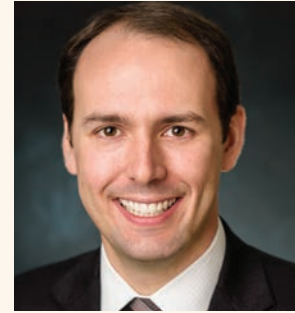
Professor Grogan is researching and developing information-based tools for engineering design in domains with distributed system architectures such as aerospace, defense and critical infrastructure. His current research falls into three general categories: interoperable modeling frameworks for systems-of-systems, collaborative design experiments and interactive simulation for federated systems.

His research of future engineered systems involves investigating the challenges in overcoming the limited capacity of human organizations to understand and anticipate long-term and inter-disciplinary effects of design decisions. He recently developed interoperable simulation gaming as a design method – an approach which combines the capability of simulation models to share technical information with an interactive design session and live participants to communicate non-technical information and topics out of scope of the technical model. This method builds on tools and techniques developed for military war-gaming and concurrent engineering. Past projects consider diverse application cases such as space exploration campaigns, fractionated and federated satellite systems, and local- and national-scale infrastructure planning.

Professor Grogan received his B.S. in engineering mechanics and astronautics from the University of Wisconsin–Madison. He then attended MIT where he received his S.M. in aeronautics and astronautics and Ph.D. in engineering systems. •

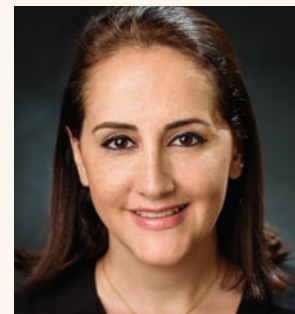
Professor Hayeri’s research focuses on transportation systems, connected and automated vehicles, and infrastructure, climate and energy security. As part of the project, *Connected and Autonomous Vehicles 2040 Vision*, she studied the impacts of autonomous and connected vehicles on infrastructure, design, communications, investment decisions, freight, driver licensing, real time data usage and workforce training. In another recent project, *Energy Impacts of Autonomous Vehicles*, she examines potential energy impacts of autonomous vehicles for various levels of automation defined by the National Highway Traffic Safety Administration (NHTSA).

Professor Hayeri attended the University of Nebraska-Lincoln where she received her B.Sc. in civil and environmental engineering and University of California, Berkeley where she received her M.Eng. in transportation engineering - civil and environmental engineering. She received her dual Ph.D. (civil and environmental engineering / engineering and public policy) from Carnegie Mellon University, where she was also a researcher with the T-SET UTC (Technologies for Safe and Efficient Transportation) program from the U.S. Department of Transportation (USDOT). She completed her post-doctorate research fellow at the University of Pennsylvania, working with the GRASP lab (General Robotics, Automation, Sensing and Perception). •



**Dr. Paul Grogan**

*Assistant Professor,  
Systems Engineering*



**Dr. Yeganeh M.  
Hayeri**

*Assistant Professor,  
Systems Engineering*



**Dr. Babak Heydari**

*Assistant Professor,  
Systems Engineering*

Professor Heydari, director of Complex Evolving Network Systems (CENS) lab, has published over 50 papers in peer-reviewed journals and conferences. His interdisciplinary research falls at the intersection of engineering, economics and systems sciences. He received the NSF CAREER award in 2016 and his research is funded by DARPA and several private corporations.

His research interests include: systems science, socio-technical systems, computational social sciences, resilience, data-driven policy analysis and system architecture. Active projects include impact of product/systems architecture on dynamics of innovation and competition in the product ecosystem; coordination dynamics in hybrid teams, composed of human and autonomous agents; spatial diffusion of behavioral risk; and resource sharing mechanisms for sharing economy.

Before joining Stevens, Professor Heydari was a leading researcher in the area of wireless and silicon-based high frequency systems, and a Silicon Valley entrepreneur. His doctoral project resulted in the first ever set of building blocks for wireless systems above 100GHz. He received his B.Sc. in electrical engineering and chemistry from the Sharif University of Technology, and his M.Sc and Ph.D. in electrical engineering (Ph.D. minor in economics) from the University of California at Berkeley, where he also received his management of technology graduate certificate from the HAAS Business School. •



**Dr. Steven Hoffenson**

*Assistant Professor,  
Systems Engineering*

Professor Hoffenson's research focuses on sustainable design, systems thinking, policy and design, design optimization, uncertainty analysis, variation simulation and vehicle safety. His research looks into the ways that people design products, drawing from different disciplines to understand product development and design optimization as a multi-stakeholder system that accounts for how designers' decisions interact with those of consumers, corporations and policy-makers.

This work combines engineering models, decision theory models, economic models and a systems framework to build an understanding of how different decisions with respect to product development and adoption will affect the economic, environmental and social sustainability of the surrounding world. His research is published in several journals.

Professor Hoffenson attended the University of Michigan, earning his M.S.E. and Ph.D. in mechanical engineering, where his research focused on design optimization of vehicles for safety accounting for uncertainty, human factors and market considerations. In his postdoctoral position in the Department of Product and Production Development at Chalmers University of Technology in Gothenburg, Sweden, he researched interdisciplinary product design for quality and sustainability. Recently, he served as a Congressional Science & Engineering Fellow sponsored by the American Association for the Advancement of Science (AAAS) in Washington, D.C. •



Professor Khashanah's most recent research efforts are dedicated to financial networks, systemic risk, complex adaptive systems, heterogeneous agent-based modeling, meta-models and complexity theory, wavelets and dynamic neural networks, high-frequency finance, and relativity computing. Examples of his research projects include Algorithmic Contract Type Unified Standards (ACTUS), funded by The Alfred P. Sloan Foundation; Modeling Systemic Risk in an International Financial System of Systems Using Clustering Techniques and Minimum Spanning Tree Methodology, copula CoVaR; and Predictive Analytics for Large Complex Networks, funded by the Stevens Accenture alliance. Other active projects are funded by IRRCi, NSF and NASA. He is the founder of the financial engineering (FE) program at Stevens; the FE division is one of the largest in the U.S.

His research is featured in over 25 publications, several conference papers, and multiple white papers and books. His affiliation with professional societies includes the American Finance Association (AFA), International Association of Quantitative Finance (IAQF), Committee to Establish the National Institute of Finance (CE-NIF), International Council on Systems Engineering NASA Systems Engineering Consortium (INCOSE), and IEEE Computational Intelligence Society. Professor Khashanah attended the University of Petroleum and Minerals. He received his M.S. in applied mathematics from the University of Cincinnati and Ph.D. in applied mathematics from the University of Delaware. •



**Dr. Khaldoun Khashanah**

*Professor;  
Financial Engineering  
Division Director*

Professor Lipizzi's research interests include data mining, text mining and network analysis with a focus on social media and its use as a backchannel for real life activities, extracting semantic and topological metrics to analyze virtual conversations. His research has been published in diverse publications, including the *International Journal of Information Management* and *Technological Forecasting & Social Change*.

In addition to his current role as industry assistant professor at Stevens, where he teaches engineering management students the major techniques and solutions to discover knowledge in data and text, Professor Lipizzi is the principal at a boutique data consulting firm. He specializes in providing behavior analysis, predictive modeling, analytics, data and text mining for industry in Europe and the U.S.

Professor Lipizzi received his Laurea in mathematics from Università La Sapienza in Rome, Italy, Executive MBA in management from IMD Business School and Ph.D. in system engineering from Stevens Institute of Technology. •



**Dr. Carlo Lipizzi**

*Industry Assistant  
Professor;  
Graduate Engineering  
Management  
Program Lead*



## Dr. Mo Mansouri

*Research Associate Professor;  
Program Lead for Systems Engineering and Socio-technical Systems*

Professor Mansouri has various research interests with a focus on designing resilience in infrastructure systems and governance of networked systems. His research of governance frameworks for complex adaptive sociotechnical systems includes the development of frameworks, models, mechanisms and methods for influencing desired behavioral patterns, as well as performance output of complex adaptive sociotechnical systems through quantifying, estimating and optimizing methodologies. Other areas of research include governing patterns of human behavior in online social networks, and designing resilience, decision-making under uncertainties, and policymaking in networked systems. His research is published in various scientific journals including *IEEE Systems Journal*, *IEEE Transactions on SMC: Systems*, *International Journal of System of Systems Engineering*, *Journal of Transportation Research Board*, *Marine Policy*, *Maritime Policy and Management*, *International Journal of Industrial and Systems Engineering*, *Enterprise Information Systems*, among many others.

His industry experiences include working as research fellow and scientist to evaluate the effectiveness of operations systems and create systemic tools and methods to assist decision-making processes for the World Bank, HAND Foundation, NIAC and other non-profit entities.

After receiving his B.S. from Sharif University of Technology and M.S. from the University of Tehran both in industrial engineering, he received his Ph.D. in engineering management from The George Washington University. •



## Dr. Somayeh Moazeni

*Assistant Professor,  
Engineering Management*

Professor Moazeni's research interests lie broadly in operations research and machine learning. She has focused on theory and applications of stochastic optimal control, approximate dynamic programming, information collection, stochastic modeling, risk management and numerical optimization. The application areas of her interest include computational finance and algorithmic trading, electricity market, energy systems risk management, data-driven business analytics particularly marketing analytics and call center analytics, and systems design.

Her research has appeared in multiple journals: *INFORMS Journal on Computing*, *SIAM Journal on Optimization*, *Journal of Computational Finance*, *Computational Optimization and Applications*, *Quantitative Finance*, and others. She is a frequent speaker at conferences organized by Institute for Operations Research and the Management Science, Mathematical Optimization Society, Society for Industrial and Applied Mathematics, and others.

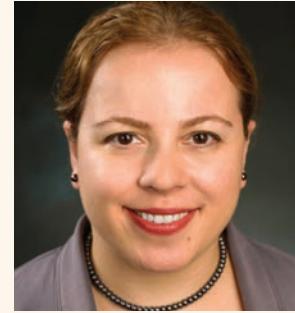
National Science Foundation (NSF), Accenture and Travelers Insurance fund her current research. She also received a Microsoft Research Award and a postdoctoral fellowship from the Natural Sciences and Engineering Research Council of Canada (NSERC).

She completed her postdoctoral study at Princeton University, her Ph.D. in computer science and M.Math in combinatorics and optimization from the University of Waterloo, Canada. Her industry experiences include serving in quantitative and risk analysis roles for the Royal Bank of Canada (RBC) and Bank of Montreal (BMO) Financial Group. •

Professor Nilchiani has researched various dimensions of complex systems response to change and uncertainty. Her three research tracks include: flexible and adaptive systems designs and measuring the quantitative value of various systemilities such as adaptability, flexibility, evolvability, agility and resilience; quantifying, measuring and embedding resilience and sustainability in large-scale critical infrastructure systems; and inherent and perceived complexity of systems and various measures and characterizations of complexity as well as their correlation to the vulnerability and fragility of the system.

She received her Ph.D. in aerospace systems from MIT, where she focused on designing, embedding and measuring flexibility in space systems and spacecrafts, sponsored by DARPA's Orbital Express Program. She has used various decision-making tools, uncertainty modeling, options and decision analysis tools and integrated them into her models for measuring the value of flexibility.

Dr. Nilchiani's research has been funded by the Department of Homeland Security (DHS) Center of Excellence, DARPA's Fractionated Systems Program (F6), SERC Research and ONR/Naval Postgraduate School. She has authored over 40 refereed journals and conference articles, and is an associate member of American Institute of Aeronautics and Astronautics (AIAA) and Society of Women Engineers. •



**Dr. Roshanak Nilchiani**

*Associate Professor,  
Systems Engineering*

Professor Pennock is associate director of the Center for Complex Systems and Enterprises (CCSE). His research interests involve modeling of enterprise systems and systems of systems, multi-scale modeling, and model uncertainty. His research application domains include health care, national security and finance. His research has been published in *Applied Ergonomics* and *Systems Engineering*. Additionally, he has presented his research at conferences including *IEEE Systems, Man, Cybernetics*, *IEEE Systems* and *CESUN*.

His industry experience includes working as a senior systems engineer in various lead technical roles for Northrop Grumman Corporation where he specialized in system architecture, model based systems engineering and requirements development.

Professor Pennock attended the University of Virginia and received both his B.S. and M.S. in systems engineering. He received his Ph.D. in industrial engineering from Georgia Tech. •



**Dr. Michael Pennock**

*Assistant Professor,  
Systems Engineering*



**Dr. Jose Emmanuel Ramirez-Marquez**

*Enterprise Science and Engineering Division Director; Associate Professor*

Professor Ramirez-Marquez focuses his research on the development of mathematical models for the analysis and computation of system operational effectiveness, and reliability and vulnerability analysis as the basis for designing system resilience. He also works at the intersection of evolutionary computation for the optimization of complex problems associated with system performance and design.

His recent work has explored how visualization of data can be used for decision-making purposes at the community level. In these areas, Professor Ramirez-Marquez has conducted funded research for both private industry and government, and has published over 100 refereed manuscripts in technical journals, book chapters and industry reports. He has presented his research findings nationally and internationally in conferences such as INFORMS, ISERC, INCOSE, CESUN and ESREL. Additionally, he has served as the president of the Quality Control and Reliability division board of the Institute of Industrial Engineers. Currently, he is a member of the Technical Committee on System Reliability for the European Safety and Reliability Association.

Professor Ramirez-Marquez is a former Fulbright Scholar. He holds degrees from Rutgers University in industrial engineering (Ph.D. and M.Sc.) and statistics (M.Sc.), and from Universidad Nacional Autonoma de Mexico in actuarial science. •



**Dr. William Rouse**

*Alexander Crombie Humphreys Professor; Director, Center for Complex Systems & Enterprises (CCSE)*

Professor Rouse's research and development interests focus on understanding and managing complex public-private systems such as healthcare delivery, urban systems and national security, with emphasis on mathematical and computational modeling of these systems for the purpose of policy design and analysis. His research in human-centered design methodology has resulted in successful training and aiding systems spanning multiple functions in public and private enterprises. He is professor emeritus, and former chair, of the School of Industrial and Systems Engineering at the Georgia Institute of Technology.

The author of hundreds of articles and book chapters, and many books, including most recently *Universities as Complex Enterprises* (Wiley, 2016), *Modeling and Visualization of Complex Systems and Enterprises* (Wiley, 2015), and *Understanding and Managing the Complexity of Healthcare* (MIT Press, 2014), Professor Rouse is well-known for his systems-oriented research, with particular regard to the roles and performance of people and organizations in relation to complex systems.

Previous roles include chair of the Committee on Human Factors (now Board on Human Systems Integration) of the National Research Council, member of the U.S. Air Force Scientific Advisory Board, and member of the DoD Senior Advisory Group on Modeling and Simulation. He is a lifetime national associate of the National Research Council and National Academies. He was elected to the National Academy of Engineering in 1991, as well as elected a fellow of four professional societies: IEEE, INCOSE, INFORMS and HFES.

Rouse received his B.S. from the University of Rhode Island, and his S.M. and Ph.D. from MIT. •

Professor Verma's professional and research activities emphasize systems engineering and design with a focus on conceptual design evaluation, preliminary design and system architecture, design decision-making, life cycle costing, and supportability engineering. Previous experience includes technical director at Lockheed Martin Undersea Systems in the area of adapted systems and supportability engineering processes, methods and tools for complex system development and integration; and research scientist at Virginia Tech, where he managed the University's Systems Engineering Design Laboratory. In addition to serving many companies in a consulting capacity throughout his career, he was an invited lecturer at the University of Exeter, United Kingdom from 1995 through 2000, and an external advisor to the Scientific Director of the Embedded Systems Institute in Eindhoven, Netherlands, from 2003 to 2008.

He has authored over 100 technical papers, book reviews, technical monographs, and co-authored three textbooks. In addition to his publications, Professor Verma has received three patents in the areas of life-cycle costing and fuzzy logic techniques for evaluating design concepts.

Professor Verma received his Ph.D. and M.S. in industrial and systems engineering design from Virginia Tech. He is a fellow of the International Council on Systems Engineering (INCOSE). He sits on the Inaugural Board of Advisors for the Jim McNatt Logistic Systems Institute at the University of North Texas. He was recognized with an honorary doctoral degree (honoris causa) from Linnaeus University (Sweden) in 2008. •

Professor Vesonder's current research interests include: software engineering and system development, cyber-physical and socio-technical systems, Smart Cities, human computer interaction, and evolvability. He has over 35 years of industry experience, including serving as executive director of the Cloud Platforms Research Department at AT&T Labs Research, which focused both on cloud platforms and mobile and pervasive systems. Today, he is both a Bell Labs and an AT&T Fellow.

His committee experience includes serving as member of the editorial board of the *International Journal of Information Quality* and the *International Journal of Computer Systems Science and Engineering*. A noted author of over 40 research papers, Professor Vesonder has experience serving as associate editor in charge of telecommunications and network management for the journal, *Intelligent Systems Review*. Additional experience includes guest editor of the *IEEE Communications Magazine*. With 4 patents to his name, he is noted for his early contributions to artificial intelligence (AI) when he developed a system for monitoring communications cables.

Professor Vesonder received his B.A. in cognitive psychology from the University of Notre Dame. He attended the University of Pittsburgh where he received both his M.S. and Ph.D. in cognitive psychology. •



**Dr. Dinesh Verma**

*Dean and Professor,  
School of Systems and  
Enterprises;  
Executive Director,  
Systems Engineering  
Research Center (SERC)*



**Dr. Gregg  
Vesonder**

*Industry Professor;  
Director, Research,  
Systems and  
Software Division*



## Dr. Jon Wade

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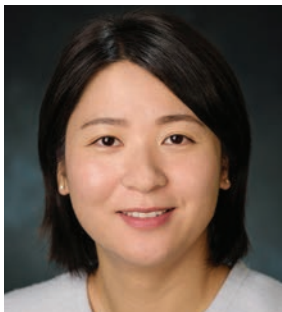
*Research Professor;  
Director, Systems and  
Software Division;  
Chief Technology Officer,  
Systems Engineering  
Research Center (SERC)*

Professor Wade's research falls within the areas of the use of technology in systems engineering and STEM education, and complex systems and complexity management.

His industry experience includes serving as executive vice president of engineering at International Game Technology (IGT) where he created corporate vision, led product development, championed the development of a corporate architecture and system development practices, and managed corporate wide research and development. His previous industry experience includes managing the development of the UltraSPARC V based Enterprise Server family at Sun Microsystems and leading supercomputer development at Thinking Machines Corporation.

In addition to his publications, Professor Wade is the recipient of 12 patents in the areas of integrated circuits, computer architecture, networked systems and internal combustion engines. He is an elected member of Sigma Xi, Tau Beta Pi and Eta Kappa Nu honorary societies. He has served on the boards of organizations such as Software and Systems Consortium, the Reno Philharmonic Association, DigiDeal Corporation and the Center for Excellence in Education.

Professor Wade attended MIT where he received his S.B., S.M., E.E. and Ph.D. degrees in electrical engineering and computer science. •



## Dr. Lu Xiao

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*Assistant Professor,  
Software Engineering*

Professor Xiao's research interests lie in software engineering, particularly in software architecture, software economics, cost estimation and software ecosystems. Throughout her career, she has focused her research on the relationship between software architecture and maintenance quality. She has presented at various conferences including the International Conference on Software Engineering (ICSE), International Symposium on the Foundations of Software Engineering (FSE), the International Symposium on Empirical Software Engineering and Measurement (ESEM), and Working IEEE/IFIP Conference on Software Architecture (WISCA). Her work has also appeared in the *Journal of Systems and Software* and in the book *Economics-Driven Software Architecture*. In her current project, she is evaluating the alignment between software architecture and the organizational structure of the respective software development team.

Prof. Xiao received her B.E. in computer science from Beijing University of Posts and Telecommunications, and Ph.D. in computer science from Drexel University, where she was the recipient of several awards including first prize at the ACM Student Research Competition in 2015. •

Professor Yang's research interests include behavioral finance, modeling algorithmic trading behavior, financial trading and information fraud detection, financial systemic risk, and agent based financial market simulation. He has worked with major federal financial regulators including the Securities and Exchange Commission (SEC), Commodity Futures Trading Commission (CFTC), and Treasury as either a research consultant or system architect. His research, which intersects XBRL technology, text analytics and finance, is recognized by the Securities and Exchange Commission (SEC), resulting in a recent nomination to their highly-selective Distinguished Visiting Scholars Program.

He has a number of high impact academic publications in the area of quantitative finance and financial engineering, and he is an active member of the Computational Finance and Economic Committee of the IEEE Computational Intelligence Society. As an expert in modeling High Frequency Trading strategies, he provides consulting services to the Chief Economist Office and the Division of Enforcement at the Commodity Futures Trading Commission in Washington DC. His industry experience includes working as a system architect and strategic thought-leader in financial information systems for 6 years at Northrop Grumman Corporation.

Professor Yang received his B.S. in aerospace engineering from Beijing Institute of Aeronautics and Astronautics and M.S. in computer science application from Virginia Polytechnic Institute and Virginia State University. He attended the University of Virginia where he received both his M.E. and Ph.D. in systems engineering. •

Professor Yang's current research which lies in the area of empirical software engineering includes: crowdsourced software engineering, software cost estimation, defect prediction, and software process modeling and simulation, as well as promoting the development and transferring of research prototype toolkits in software industry. Her research has been funded by a number of Chinese national research programs including the Ministry of Education, NSFC, 863/973, HeGaoJi, CAS Innovation Promotion Program, as well as industry collaborators. She is a member of the editorial board of *Journal of Cost Analysis and Parametrics* and *Journal of Software* (Chinese).

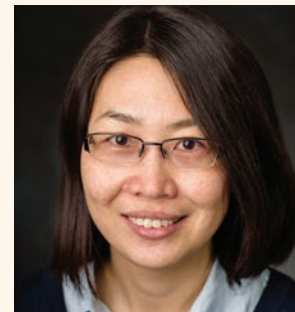
Her manuscript experience includes co-editing two conference proceedings and publishing over 60 research papers, including some which won awards at several international conferences. Additional previous experience includes serving as program co-chair for ICSP 2010, steering committee member for PROMISE 2012-2013, and program committee member for international conferences such as ASE, ICSE SEIP, ESEM and APSEC.

Professor Yang received her B.S. in computer science and economics from Peking University and M.E. in software engineering from the Institute of Software Chinese Academy of Sciences. She attended the University of Southern California where she received her Ph.D. in computer science. •



**Dr. Steve Yang**

*Assistant Professor,  
Financial Engineering*



**Dr. Ye Yang**

*Associate Professor,  
Software Engineering*

2016-2017

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