MAY 21-22, 2018
BABBIO CENTER

MONDAY – May 21

8:15-9:00  Breakfast & Registration
9:00-9:15  Opening remarks: Dean Yehia Massoud

MORNING SESSION

9:15-9:35  Araceli Zavala - Supply Chain Resilience
9:35-9:55  Razieh Lotfalian Saremi - A Hybrid Simulation Model for Crowdsourced Software Development
9:55-10:15 Mehrnoosh Oghbaie - Aided Screening for protein interactions network

15 MINUTE BREAK

10:30-10:50  Jorge Buenfil - Architecture and Design of a School Security System
10:50-11:10  Peizhu Zhang - Automated Assessment of Systems Engineering Competencies
11:10-11:30  Saeed Vasebi - Automated vehicles provide opportunities to reduce fuel consumption and greenhouse gas emission
11:30-12:30 Lunch

AFTERNOON SESSION

1:45-2:05  Brian Chell - Benchmarking Multidisciplinary Design Analysis and Optimization Architectures with an Aircraft Case Study
2:05-2:25  Abdullah Khanfor - Decomposition of Crowdsourced Software Development Tasks
2:25-2:45  Antonio Pugliese - Development of Spectral Structural Complexity Metrics for Cyber-Physical Systems
2:45-3:05  Christine Edwards - Identification of Tipping Points in Supply Chain Dynamics using Effective Dimension and Resilience Index

15 MINUTE BREAK

3:40-4:00  John Comas - Mitigating Risk During Real-Time Deployment to Live Software Systems with the New DevOps Principles of Continuous Phase Transition & Continuous Risk Assessment
4:00-4:20  Brian Michael Gardner - Evaluation of Robustness of Space Exploration Logistics Network Subject to Uncertainty

15 MINUTE BREAK

4:35-4:55  Patrick O’Brien - Liquidation strategy for uninformed traders in the presence of Dark Pools
4:55 - 5:15  Christopher Kiesges - Mathematical Engineered Systems as Categorical Construction
6:00  Dinner - 4th floor lounge or 5th patio

TUESDAY – May 22

8:15-9:00  Breakfast

MORNING SESSION

9:00-9:20  Turki Nasser Aleyani - Obsolescence Management in COTS-Centric Cyber Physical Systems
9:20-9:40  James Enos - Theoretical Real System Age Calculation
9:40-10:00  Abbas Ehsanfar - Mechanism Design in Federated Networks
10:00 -10:20  Amineh Zadbood - Word-of-Mouth Recommendations in an Automobile Market System

15 MINUTE BREAK

10:35-10:55  David Forrest - Architecting for Adaptability in Development of Human Space Exploration Systems
10:55-11:15  Cinda Chullen - System Integration Approach to Carbon Dioxide Washout in an Advanced Extravehicular Mobility Unit
11:15-11:35  Stephanie Sharo Chiesi - Transformation to Digital Engineering: Exploring the systems engineering challenges in aerospace and defense
11:35-12:15 Lunch box
12:15-1:15  Invited Speaker: Alejandro Salado
Safe and effective operation of drones at commercial and consumer scale presents daunting communication and computational challenges. Most basic is the requirement for all stakeholders to have up to date awareness of the current operating picture in an area showing drones' locations relative to each other and to terrain. Second, a drone operator wishes to be able to securely command the drone from any distance rather than having to be within line-of-sight at all times as is required now. Beyond the drone's operator, however, other stakeholders, such as the FAA and law enforcement, need the capability to exert augmentative control over a drone in order to keep it away from prohibited flight areas and possibly force it to land or return to base. Finally, drones need to be able to avoid collisions with other drones and with static obstacles like buildings when flying in a highly congested area. This article overviews these challenges and describes a prototype system, the Geocast Air Operations Framework (GAOF), that combines novel communication and computational ideas into an architecture to address them.

Massoud’s research interests reside in leveraging innovations in modeling, design and signal processing techniques to automate the design process of efficient computing and sensing systems targeting applications in health, computer systems and energy. He has successfully collaborated with numerous companies and government organizations on research projects. He published more than 220 papers in leading journals and conference proceedings. He is known for having developed the world’s first realization of compressive sensing systems for signals, which is critical for the realization of highly complex biomedical implantable and wearable systems. Massoud has received many honors for his research and his service to the field. In 2009, he was elected to the IEEE Nanotechnology Council. In 2007, he was a recipient of the Rising Star of Texas Medal. Additional honors include the NSF CAREER Award in 2005, the Design Automation Conference Fellowship in 2005, the Synopsys Special Recognition Engineering Award in 2000 and two IEEE Best Paper awards. Massoud’s contributions to his profession beyond his university work are extensive. He was named Distinguished Lecturer by the IEEE Circuit and Systems Society. He is the editor of Mixed-Signal Letters—The Americas and has served as an associate editor of IEEE Transactions on Very Large Scale Integration Systems and IEEE Transactions on Circuits and Systems.

Dr. Robert J. Hall earned the PhD and MS degrees in Electrical Engineering and Computer Science from the Massachusetts Institute of Technology and his Bachelor’s degree in E.E.C.S at the University of California, Berkeley. Since then he has been a Principal Investigator at AT&T Laboratories Research, working in the areas of automated software engineering, requirements engineering, modeling and simulation, scalable wireless network protocols, active smartphone games and sports of the future, cloud engineering, and edge/fog/IoT research. He is a Fellow of Automated Software Engineering and member of the Steering Committee of the IEEE/ACM International Conferences on Automated Software Engineering. He serves as Editor in Chief of Automated Software Engineering, an international journal, and is an ACM Distinguished Scientist.
Balancing Job and Stevens. Chapter 3: How to get a PhD in 4-1 years and still keep your job … and your family … and what comes next.

In this talk, I will share some insights from my own PhD journey, with the perspective of being now an assistant professor. I will talk about things that worked for me and things that did not work. Habits that helped, and habits that did not. Things that I would do again and things that I wished I had done differently. I cannot guarantee that these insights will work for every PhD student, but it helped me completing an award-winning PhD in 4 – 1 years while having a full-time job, enjoying (every) bit of it, and still finding the time to have a life (or sort of) beyond papers, which helped me land an (unexpected) job at top-ranked institution.

Dr. Alejandro Salado is an assistant professor of systems engineering with the Grado Department of Industrial & Systems Engineering at Virginia Tech. His research focuses on applying decision analysis to improve the practice of engineering. He is pioneering research in the area of verification and validation, for which he is investigating how engineers generate and evaluate evidence and how they build trust. His approach in this endeavor is transdisciplinary and intersects mathematical foundations, decision analysis and methods, and behavioral and cognitive models. In addition, Dr. Salado is engaged in developing disruptive educational approaches to smooth the transition of students to engineering work, as well as to build up capabilities to operationalize engineering ethic responsibility. Before joining academia, Alejandro spent over ten years as a systems engineer in the space industry, developing and leading space systems of up to $1b. He has published over 40 scientific publications, has received several paper awards, and his work has received federal funding. He is a recipient of the Fabrycky-Blanchard Award for Systems Engineering Research, the international Omega Alpha Association’s Exemplary Dissertation Award, and the Fulbright International Science and Technology Award. Dr. Salado holds a BSc/MSc in electrical engineering from Polytechnic University of Valencia, an MSc in project management and a MSc in electronics engineering from Polytechnic University of Catalonia, the SpaceTech MEng in space systems engineering from Delft University of Technology, and a PhD in systems engineering from the Stevens Institute of Technology.

MONDAY I MORNING SESSION

Araceli Zavala / azavala(at)stevens.edu

Supply Chain Resilience

The growth of global supply chains has allowed trading partners to experience collaboration, economic expansion, and increase their competitive success. At the same time, reliance on global supply chains exposes its trading partners to unforeseen disruptions. While the economic benefits are tremendous, they are not without risk as global supply chains are by their very nature susceptible to a wide array of disruptions. Thus, supply chains must increase their resilience to meet customers’ demands and, at the same time, ensure the economic benefits for the company. In this research, two types of supply chain disruptions are analyzed: 1) supply chains that lost a complete node within its network, and 2) product recalls. In the first case, the model is presented in the context of a multi-echelon, post-production support network of a sustainment-dominated system such as those found in the aerospace, defense, utilities, and construction industries. The model demonstrates the post-disruption resilience at each supply chain node along with the investment necessary to restore the network. The second case proposes a visualization model capable of providing a manager a visual description of the users’ daily negative sentiments in social media, through which companies can identify possible product recalls. Thus, managers can react in time and lessen the negative effects.

Araceli is finalizing her third year of doctoral studies in Engineering Management at the School of Systems and Enterprises. She works under the supervision of Dr. Jose Ramirez-Marquez on supply chain resilience. She holds a Bachelor’s in Industrial Engineering from the Instituto Tecnologico de Morelia in Mexico and a Master of Science degree in Quality and Productivity from the Tecnologico de Monterrey in Mexico. Araceli has worked since 2005 at the Industrial Engineering department at Tecnologico de Monterrey Campus Guadalajara as a full-time professor. She has been a consultant for several small and big companies in Mexico like Hershey’s, Pernord Ricard, Arca Continental, and others.
A Hybrid Simulation Model for Crowdsourced Software Development

Crowdsourcing as a new emerging software development method contains crowdsourced mini-tasks as demand and online workers as suppliers. The major counter-argument in such systems is that suppliers are volunteers and are not bound by any contract, also, the size of available suppliers varies wildly throughout the day. Such uncertainty about the receiving service may cause inefficiency and task failure. This research presents a hybrid simulation model to address the risk of task failure in crowdsourcing platforms. The simulation model is composed of three components: the discrete event simulation which represents the task life cycle, the agent-based simulation which illustrates the crowd workers’ decision-making process and the systems dynamic simulation which displays the platform.

Razieh is a research assistant in the Software Analytics Lab at SSE. Her research is mainly focused on tasks failure in Crowdsourced Software Development (CSD) platforms, and the possible reasons of this issue. Her goal is to develop an automated decision making tool to test different possible scenarios and provide deeper insights for CSD project managers.

Aided Screening for protein interactions network

For decades we have understood that the physical networks of protein-protein interactions (PPIs) that constitute the interactomes of cells determine molecular and cellular characteristics, including health and disease. While much progress has been made, contemporary analyses suggest that we may still be decades away from a comprehensive ‘first draft’ map of a human interactome. Hence, we are currently unable to thoroughly understand the physical basis of cellular function – making technologies that address this limitation of immense importance. Among the major bottlenecks to be addressed is how PPI data are processed and interpreted. Networks graphs constructed from collated PPI data are commonplace in biology; where these data are derived from experiments with different motives. Thus, the portrayal of PPIs is frequently affected by multiple type of biases including: 1) selection bias, 2) laboratory bias. The objective of this research is to aid molecular biologists in the analysis of collated PPI data and use the knowledge to better form hypotheses and improve the design of future experiment. Our approach weights data from automated databases, which include electronically inferred interactions and are understood to contain a high frequency of false-positive nodes, by comparing them to data from manually curated databases, which leverage human oversight and produce more expert-like decisions regarding bona fide physiological interactions networks. However, manually curated data are few and such databases grow very slowly. We believe that by appropriately merging the two resources, the false-positive prediction rate can be reduced, while promising new candidates can be effectively distinguished from noise, focusing downstream experimental strategies and improving biological understanding.

I’m a PhD candidate in School of Systems and Enterprises at Stevens Institute of Technology. I hold a M.S. in Management of Technology from NYU and a B.S. in Electrical Engineering from K.N.Toosi University of Technology. My thesis focuses on aiding for decision making in complex systems.

Architecture and Design of a School Security System

A system for automatic firearm and long knife detection with a man-in-the-loop for confirmation and selection of countermeasures is proposed to protect schools and other sensitive areas with minimal human interaction. The system architecture combines statistical analysis, pattern recognition and data visualization for human-machine interface, as well as adaptive mechanisms on the software side. For hardware, a mix of low cost cameras for visual and infrared wavelengths attached to micro-computers for visual preprocessing are included in the design of a basic prototype.

Jorge Buenfil is a Systems Engineering PhD candidate at Stevens Institute of Technology and a systems engineer lead with the U.S. Army Armament Research, Development and Engineering Center, Picatinny Arsenal, New Jersey.
Automated Assessment of Systems Engineering Competencies

Peizhu Zhang is a Ph.D. Candidate at Stevens Institute of Technology with a major in Systems Engineering. His research interests include systems engineering, competency assessment, software engineering, and serious games. He has over 10 years of experience in design and development of software systems. Zhang holds a B.S. in software engineering from Beijing University of Technology as well as an M.S. in Computer Science from Stevens Institute of Technology.

Saeed Vasebi / svasebi(at)stevens.edu

Automated vehicles provide opportunities to reduce fuel consumption and greenhouse gas emission

Gasoline is the main source of energy used for surface transportation in the United States. Reducing fuel consumption in light duty vehicles can significantly improve air quality, energy security, and greenhouse gas (GHG) emissions. Emerging automated vehicles could influence energy consumption and environmental concerns. This study examines the effect of automated vehicle technologies on fuel consumption and GHG emission, using stochastic modeling. Automated vehicle systems examined in this study include warning systems such as blind spot warning, control systems such as lane keeping assistance, and information systems such as dynamic route guidance. We have estimated fuel savings associated with reduction of accident and non-accident related congestion, aerodynamic force reduction, operation load, and traffic rebound. Results of this study show automated light duty vehicles could reduce 6% - 23% of fuel consumption in the U.S (i.e. equal to 30-117 gallons gas and 587-2,300 pounds CO2 per vehicle annually). Also, adoption of automated vehicles could benefit all road users (i.e. conventional vehicle drivers) up to 3% of fuel consumption (i.e. equal to 4.3 billion gallons gas and 84 billion pounds CO2 per year for all the vehicles). Keywords:
Automated vehicle, fuel consumption, automated vehicle technologies, Greenhouse gas emission, environmental impacts

I am a second-year PhD student in SSE. My research focus is transportation systems including autonomous vehicles, ride sharing, and drivers’ behavior.

MONDAY I AFTERNOON SESSION

Brian Chell / bchell(at)stevens.edu
Benchmarking Multidisciplinary Design Analysis and Optimization Architectures with an Aircraft Case Study

This presentation will describe the preliminary results of evaluating two different multidisciplinary design analysis and optimization (MDAO) architectures using a fixed-wing aircraft case study. MDAO problems can be formulated in many ways and each of these architectures offers benefits and limitations, often measured by computing resources required and optimality of solutions. While previous research has done much to describe these architectures, most of the benchmarking studies done to this point have used purely analytical problems. The case study used in this research has four disciplines, two of which, aerodynamics and structural mechanics, are modeled using simulations. The disciplinary models are brought together, tested, and evaluated in the Phoenix ModelCenter framework using the multidisciplinary feasible and interdisciplinary feasible MDAO architectures.

Brian Chell is a PhD student in Systems Engineering focusing on multidisciplinary design analysis and optimization (MDAO). His research interests are optimizing highly stochastic scenarios and techniques for applying MDAO early in the design lifecycle. Brian received an M.E. in Space Systems Engineering from the Stevens Institute of Technology and a B.S. in Aerospace Engineering Sciences from the University of Colorado Boulder.

Abdullah Khanfor
Decomposition of Crowdsourced Software Development Tasks

The study aims to provide a decision-support tool help the project manager (requester) in Crowdsourced Software Development (CSD) context to offer an approachable tasks structure and decomposed tasks. Thus, tasks structure and dependency met the goal of the software project. Therefore, mitigating the risks raises using CSD for the requester and propose available and attractive tasks for the workers. Besides that, it provides an understanding of different aspects of CSD and the impact of each factor on the failure of a task. Besides that, many researchers in crowdsourcing, in general, highlight that smaller tasks are successful and delivered earlier.

Researcher and programmer with an experience working in the higher education industry and websites development. Skilled in many disciplines such as Python, PHP, JavaScript, C++, Search Engine Optimization (SEO), Crowdsourcing, Data Visualization, and Machine Learning. Granted a patent in 2017 and currently pursuing a Doctor of Philosophy in Systems Engineering with a concentration in Software Engineering.

Antonio Pugliese / apuglies(at)stevens.edu
Development of Spectral Structural Complexity Metrics for Cyber-Physical Systems

The systems engineering process can be represented as a series of design decisions which transform a set of stakeholder needs into a product or service capable of satisfying those needs. Early design decisions such as those made during the definition of the system architecture, can create unnecessary interfaces among components, which can lead to impaired functionality. The study of the structural features of a system architecture is an active research field. Approaches include the measurement of entropy of a graph, the cost of design modifications on adjacent components, and the study of the spectrum of the graph. Spectral structural metrics have been proposed for the study of graphs, such as Graph Energy,
first introduced to study organic molecules, and Natural Connectivity, applied as a metric of network robustness. At a given decomposition level, each component within a heterogeneous system contributes in a different way to the complexity of the overall system. This idea has been implemented in the definition of a structural complexity metric developed at MIT, through the introduction of the concepts of component complexity and interface complexity. This metric falls short of embedding these values in the graph representation, thus decoupling the topological contribution from the contributions of components and interfaces. The inclusion of component and interface complexity values in the matrix representation of the system, and the application of the metrics to these weighted matrices is the main contribution of this research. This approach has been applied to engineered systems to understand the relationship between various metrics and features of complex systems such as robustness and attack tolerance, and is currently being validated through a series of experiments that will shed light on the connection between spectral structural complexity metrics and integration time.

Antonio Pugliese is a Ph.D. candidate in systems engineering at Stevens Institute of Technology, in Hoboken, NJ. He received his B.Sc. and M.Sc. in aerospace engineering and a postgraduate master in systems engineering from the University of Naples Federico II, in Italy. His doctoral research is on structural complexity metrics for cyberphysical systems.

Christine Edwards / christyedw(at)gmail.com
Identification of Tipping Points in Supply Chain Dynamics using Effective Dimension and Resilience Index

When a supply chain model is translated into a relatively new and revolutionary mathematical dimension that reveals the location of tipping points, a critical resilience index can be extracted that measures whether supply chains are sustainable or close to collapse. This paper shows the translation of supply chain dynamics equations into this effective plane, the extraction of the critical resilience index, and simulation results that show how the resilience index correlates with stability of the supply chain. These results have great potential for improving the understanding of supply chain management, revealing how close a supply chain is to collapse and providing a metric to help make supply chains more sustainable. For example, one potential application is to use this model to ensure that agri-food supply chains are resilient to continue supporting growing populations.

Christine Edwards is a systems engineer and associate manager in Commercial Civil Space Advanced Programs at Lockheed Martin Space Systems Company. She specializes in adapting systems to perform new operations for deep-space exploration, and researches how system changes affect resiliency as a doctoral candidate at the Stevens Institute of Technology. Previous positions include lead systems engineer for Mars Reconnaissance Orbiter (MRO) operations, Guidance Navigation and Control (GN&C) operations for the GRAIL, Mars Odyssey, and Stardust missions, launch support for Juno, and Rendezvous, Proximity Operations, and Docking (RPOD) development for the Orion. Christy holds Bachelor and Master of Science Degrees in Aerospace Engineering from MIT. For outreach, she performs public speaking engagements about space exploration as a JPL Solar System Ambassador and collaborates in ecological tipping-point research with the Denver Museum of Nature and Science.

Alexander Gilgur / agilgur(at)stevens.edu
Measuring Community Resilience: a Bayesian Approach

Analysis of community behavior and its interactions within and without (e.g., with other communities, civil and industrial engineered systems, organizations, governments, etc.) is a critical topic in a diverse variety of domains, from sociology and psychology to marketing science, security analytics, defense operations, political sciences, and other fields. Viewing a community as an engineered system allows the researcher to separate metrics characterizing the behavior of the community as a whole from metrics describing activities within it. One of the fundamental parameters of a community is its resilience. There are several accepted definitions of community resilience; however, translating them into practically applicable mathematical terms is a non-trivial task, due to the difficulties in implementation of such definitions. In this paper, we mathematically derive an applicable metric of community resilience. We further
demonstrate how the metric can be estimated iteratively in a Bayesian process. Due to the specifics of community dynamics, implementation of Bayesian correction to metric estimates with real community data is a slow process, as intervals of time between community-affecting events in the real world are usually long (from months to years), while available measurements of community metrics that can be translated into state variables are often excessively aggregated. This limits their usefulness. For these reasons, we use a simulation of community population changes in response to changes in the sentiment of social and public media to demonstrate practical calculation of the proposed metric.

Third year PhD student in SSE; currently Network Data Scientist at Facebook; have been doing R&D in a variety of Engineering, Data Science, and OR fields throughout career.

John Comas / jcomas(at)stevens.edu

Mitigating Risk During Real-Time Deployment to Live Software Systems with the New DevOps Principles of Continuous Phase Transition & Continuous Risk Assessment

In the 24/7 web industry, business owners can feel a constant need to push the latest and greatest software to the live site in order to remain competitive and ensure growth. However, the bottom line to the business must always be that the site is fully available and functional to consumers. The business cannot make money if a customer is greeted with a maintenance page. Also, the business reputation of the company can be severely damaged if the website proves to be unavailable to customers or if orders aren't received due to improper fulfillment. The constant rapid updating and changing of software can cause severe site instability to the point where the business can fail. Systems integration engineers are often the last line of defense in preventing this type of catastrophic failure. Because of the fear of causing an outage, many companies simply won't perform a software deployment and will initiate a site freeze during business sensitive times. Also, they feel the need to perform the deployment work during off-peak hours which is contrary to the DevOps principle of continuous delivery. To enable true DevOps continuous delivery, we need to be able to mitigate risk and increase confidence in the releases. Typically, implementation of DevOps is achieved through use of the 5 C's: Continuous Integration, Continuous Delivery, Continuous Testing, Continuous Monitoring, and Continuous Feedback. In order to supplement the 5 C's and achieve shift-left risk mitigation, the new DevOps principles of Continuous Phase Transition and Continuous Risk Assessment are introduced. This completes the DevOps capability matrix and augments the landscape to the 7 C's of DevOps. Continuous Phase Transition is underpinned by the new principle of Extreme Integration. Continuous Risk Assessment is powered by the Software Deployment Risk Assessment Heuristic (SDRAH). Both principles are introduced, delineated, and proved out in this thesis. Due to the need to rollout software to a live customer-facing production system of systems without the benefit of an outage, a method must be utilized to test for the risk of a production related failure when both legacy code and new code are live and in use simultaneously. Due to the need for rapid software integration, a heuristic for quantitatively measuring risk in the system is invaluable to determine what software is riskiest to deploy and where problems are most likely to occur. The software deployment risk assessment heuristic presented allows systems integration engineers to determine where these risks are most apparent in the system and to explore where best to focus their efforts for ensuring the least disruptive deployment method for live production systems.

Currently, Manager of Platform DevOps

Brian Michael Gardner / bgardne1(at)stevens.edu

Evaluation of Robustness of Space Exploration Logistics Network Subject to Uncertainty

Due to the high-risk and high-cost of manned space exploration missions, strategic mission planning is required to ensure the mission objectives can be accomplished within the funding, schedule, and risk constraints. The logistics network is an important part of mission planning and has been the focus of research to determine the optimal logistics network to support a prescribed mission. Currently, mission planning optimization is based on deterministic methods utilizing sensitive analysis to evaluate model response to varying inputs. The incorporation of uncertainty into the mission optimization model for strategic mission planning will enable the development of more robust mission plans to improve
the probability of mission success in real world applications and enable an improved understanding of the sensitivity of
the logistics network to uncertainty. This research addresses the question “How does the incorporation of uncertainty
alter the robustness of the strategic mission planning optimization for space logistics problems?” The goal of this
research is to identify the required resources and the overall logistics strategy based upon a balance of mission cost and
robustness to uncertainties that arise over the course of the mission. Example uncertainties for space exploration
missions include launch date, resource consumption rate, resource generation rate and equipment repair. The mission
uncertainties considered in this research are broadly classified as demand uncertainties, performance uncertainties and
delivery uncertainties. Two methods identified for incorporating uncertainty into the logistics network optimization are
Robust Optimization and Approximate Dynamic Programming. Each of these methods has been successfully used to solve
optimization problems with embedded uncertainty in other application domain areas.

Brian Gardner is a part-time doctoral student working with Dr. Paul Grogan. He started his graduate education in Systems
Engineering at Stevens Institute of Technology as a member of the Space Systems Engineering cohort at Orbital Sciences
Corporation (now Orbital ATK) in Fall 2011 and transitioned to a doctoral student in Fall 2016. His research focus is the
use of modeling and simulation to support manned space exploration mission planning and development. He has a BSME
from Virginia Tech and a MSME from Georgia Tech.

Patrick O'Brien / pobrien2(at)stevens.edu

Liquidation strategy for uninformed traders in the presence of Dark Pools

In the last few years dark pools have gained a large share of the markets for equity trading. In 2017 it was estimated that
there are over 40 different dark pools in operation, executing an estimated 37% of equity trades. This off exchange
alternative trading system is quite different from traditional markets in many respects. Specifically dark pools do not
publish information about the liquidity they hold and they do not set prices. Instead prices are set via information
published by the traditional exchanges. This makes execution in dark pools unpredictable and sometimes risky. Consider
an uninformed trader who has to liquidate a single security from a portfolio within a finite time horizon [0,T]. This trader
has the option of trading in either a traditional exchange, a dark pool or some combination of both. In the traditional
markets, price impact can be linearly modeled, while the uncertainty in dark markets can be modeled by a Poisson
process. Based on factors such as the liquidity of the equity being traded and market conditions, the trader has a set of
beliefs about the expected payoff of strategies. The traders utility is strictly defined as the expected proceeds from the
liquidation. In order to maximize the proceeds the trader wants to minimize both adverse selection and execution risk. We
model this as a Stochastic Bayesian Game. We consider the stochastic nature of the market as the role of Nature which
determines the type of trader interested in taking the other side of this trade. We further simplify the game by assuming
alternating moves between our uninformed trader and the market. Based on our traders beliefs on the state of the market
we intend to derive a strategy that maximizing proceeds by minimizing trading risks.

Patrick is a part-time Ph. D. student in Systems Engineering. His research interest is in strategic decisions in complex
systems. He is currently a quantitative developer at Bank of America using Big Data to develop risk models. He has a BS
in Electrical Engineering and an MS in Computer Science from Johns Hopkins.

Christopher Klesges / cklesges(at)stevens.edu

Mathematical Engineered Systems as Categorical Construction

A mathematical definition for engineered system was proposed by Wayne Wymore whose deductive system formed the
basis for the 'model-based' paradigm to systems engineering. Sets and functional relations form the base theory for the
definition, and research has shown this describes well many technically engineered environments. However there are
several validity questions surrounding these primitives in more "complex" environments, particularly 'socio-technical' and
similar that have non-standard compositional aspects. Because of this, an alternate formulation is presented using
category theory that in the presentation using centrally functor, epimorphic, and isomorphic structuring, and shows
coverage of major theorems in 'model-based' intuition. Results are discussed as they relate to many systems thinking and
other "soft system" methods. Then future research is concluded discussing potential use on categorical aspects of diagramming, duality, and extensional against problems in "complex" environments.

Am currently a third year graduate student after two as a full-time master's student. Recently moved into a position as a systems engineer at MITRE after previously completing an internship there with their healthcare transformation work. My research interests integrating social science methods into socio-technical systems particularly integrating theoretical approaches into enterprises. This has been developed through previous work as an industrial engineer and research assistant work through the Systems Engineering Research Center and Center for Complex Systems Research.

Ambrosio De Jes Valencia Romero / avalenci(at)stevens.edu

Toward a Model-based Experimental Approach to Assessing Collective Engineering Systems Design Processes

This work presents a multi-agent model to study collective decision-making processes in engineering systems design. The objective of this research is to understand the tradeoffs, risks, and dynamics between autonomous but interacting designers with individual and shared objectives. The proposed approach combines value-driven design and simulation experimentation to study how technical and social factors of a design decision-making process facilitate or inhibit collective action. A multi-actor design model considers two levels of decision-making: 1) lower-level design exploration; and 2) upper-level strategy selection. In the first stage, the actors concurrently explore strategy-specific design spaces through coupled decision variables to maximize individual value. The second stage maps outcomes from the lower-level design activities to a strategic form, leading to a final decision. Results from a preliminary simulation study using multi-agent modeling and game theoretic analysis assess the validity of proposed design spaces and generate hypotheses for subsequent studies using human subjects.

Ambrosio is entering his second year of doctoral studies in Systems Engineering at the School of Systems and Enterprises. He works under the supervision of Dr. Paul T. Grogan on generating insights on collective systems design decision-making processes, their interrelationship with the structure of the design problem, and how federated designers make tradeoffs between individual and shared objectives. He holds a Bachelor's in Mechanical Engineering from the Universidad Del Atlántico in Colombia and a Master of Science degree in M.E. from the University of Puerto Rico at Mayagüez, and has worked in the heavy machinery and naval ship design sectors.

TUESDAY | MORNING SESSION

Turki Nasser Alelyani / talelyan(at)stevens.edu

Obsolescence Management in COTS-Centric Cyber Physical Systems

Today there are a growing number of organizations shifting from traditional purpose-built to commercial off-the-shelf (COTS) for cyber physical systems. These COTS-centric systems often contain software, and hardware that have procumbent lives that end before the system they are in reaches the end of its life. The shortage of life requires frequent upgrading of COTS components which can be one of the root causes for obsolescence in these systems. Various studies have been conducted on hardware obsolescence where in most complex systems, software life cycle costs contribute as much or more to the total life cycle as hardware. In order to ensure the sustainment of hardware and software together, this research goal is to explore the effects of various technical debt that contribute to obsolescence in COTS-centric systems and provide techniques to overcome some of these issues. In this talk, I will introduce our research approach, analysis techniques, and the expected outcomes.

Turki Alelyani is a Ph.D. candidate in the School of Systems and Enterprises - Systems and Software Engineering. Turki received his MS in Computer Science from Stevens Institute of Technology. His research covers topics including software crowdsourcing design and obsolescence in COTS-centric systems. He approaches these problems by using an array of tools including statistical modeling, machine learning, computational and experimental techniques.
**Theoretical Real System Age Calculation**

This work develops a mathematical relationship for the real system age of an engineered system based on its non-functional attributes. This work builds on the literature from the biological systems, software aging, and medical fields to develop a theoretical real system age equation. The research applies this equation to a set of fourteen DoD system to determine if the equation provides an accurate indication of when the DoD should retire a system. From this analysis three heuristics emerge that provide valuable insights for DoD leadership on the health of these systems. This work provide a start point for research into the aging of engineered systems and suggests several areas for future work to expand the theoretical real system age of engineered systems.

**Abbas Ehsanfar / aehsanfa(at)stevens.edu**

**Mechanism Design in Federated Networks**

We introduce a mechanism for pricing and sharing resources in federated networks of task processing elements. An operational model is developed to allocate processing, storage and communication resources to computational demands. This model suggests an efficient and stable solution to combinatorial routing in a network with multiple sources, destinations and links with capacity and cost constraints on links and elements. Using mixed-integer linear programming (MILP) formulation, we suggest optimal solution to federates for processing tasks, allocating links, storing and delivering data to destination. An auctioneer suggests new prices to federates for sharing resources using a mechanism that maximizes the collective value for federation and ensures an expected value for each federate. The operational and pricing mechanisms don't assume access to utility functions and available resources by the auctioneer a priori. Instead, the auctioneer improves federated and collective value and suggests alternative prices for sharing resources in a federation with self-centric and rational participants. An application of federated satellite systems (FSS) is developed with endogenous parameters such as bidding behavior by federates. Numerical results shows that strategic bidding by federates has negative effects on collective value of a federated solution versus the centralized solution while the proposed mechanism improves the collective and expected values for federates.

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**Word-of-Mouth Recommendations in an Automobile Market System**

Improving design in the context of market systems requires an understanding of how consumers learn about and evaluate competing products. Marketing models frequently assume that consumers choose the product with the highest utility, and that businesses adjust their design and pricing strategies to maximize profits based on their understanding of the market. Consumer interactions within social networks and the ways their purchasing decisions are impacted by others have been investigated in the recent literature, seeking to overcome the limitations of commonly used aggregated statistical analyses for socio-technical systems. However, these studies do not allow a deeper look at the emergent behavior of the entire system to enable tracing the patterns to specific individuals in the complex network of consumers whose decisions may change based on the recommendations of others. To address this shortcoming, an agent-based modeling approach that incorporates social network models is proposed to simulate consumer decision-making within a market system. This paper investigates the extent to which word-of-mouth communications are influential in changing consumer preferences. To this
end, a classic random topology has been used to represent social connections, and the effects of the number of referrals and the degrees of similarity between the sender and receiver of the recommendation on changing a purchase decision are studied. The simulation results indicate that in comparison with the same model with no referral effects, significant changes are seen in the system-level metrics of interest for the competing firms, including the forecasted market shares and profits.

Amineh Zadbood is a second-year Ph.D. student, doing research under the advisement of Dr. Steven Hoffenson. Her research focuses on exploring new ways to improve decision-based design and design for markets systems analysis with interdisciplinary systems modeling approaches to design more sustainable products and systems.

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Architecting for Adaptability in Development of Human Space Exploration Systems

Major space exploration initiatives such as Apollo, the Space Shuttle, and the International Space Station involve many years of formulation, design, and development. Some, such as X-33 Venture Star or Constellation, and others never proceed beyond the development phase. One key feature of these long development phases is changes outside of the program that alter the value perceptions of the architecture under development. This research seeks to develop a theoretical framework for architecture adaptability with the goal of defining an approach and method which improves the adaptability of large, complex system architectures in the face of exogenous changes encountered during the development phase. Many strategies have been developed for measuring and augmenting the ability of architectures to maintain value in the presence of exogenous change during the operational phase. This research seeks to define an approach that holistically considers human space exploration architectures, the context in which they must be developed, and the selection and application of strategies for maintaining value as the context changes over the course of formulation, preliminary design, and development phases that collectively have a duration on the order of 10 years.

Mr. Forrest is a part-time graduate student at Stevens Institute of Technology and a full-time aerospace engineer at NASA Johnson Space Center. He earned a B.S.A.A.E from Purdue University in 1988 and joined Rockwell Space Operations Company in Houston, Texas as a Space Shuttle ascent performance engineer. In 1996 he completed a M.S. in Aerospace Engineering at the University of Houston. In 1997 he joined TRW Space & Electronics Group in Redondo Beach, CA working on avionics IRAD and spacecraft autonomy. In 2000 he joined NASA and has pursued multiple new spacecraft development programs and human exploration architectures including Orbital Space Plane, Constellation, and the Commercial Crew Program. He is currently pursuing a Ph.D. in Systems Engineering at Stevens Institute with a concentration on adaptability of human spaceflight architectures during the development phase.

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System Integration Approach to Carbon Dioxide Washout in an Advanced Extravehicular Mobility Unit

Over the past decade, the National Aeronautic and Space Administration (NASA) has realized tremendous progress in Extravehicular Activity (EVA) system development of a new space suit. The new space suit, namely the Advanced Extravehicular Mobility Unit (AEMU) is being concepted in-house at NASA. The AEMU is being planned as a demonstration unit on the International Space Station. The AEMU will have a newly designed advanced portable life support system (APLSS). The APLSS is a complicated architectural system with many variables potentially influencing its performance. The APLSS will have to be optimized not only for missions in low-Earth orbit, but potentially destinations such as the Moon, near-Earth asteroids, and Mars. The focus of this work will be on the low-earth orbit approach. The main purpose of the APLSS is to provide an astronaut life support while in the space suit. One of the main functions of the APLSS is to remove carbon dioxide (CO2) and provide humidity control. The APLSS CO2 removal system is currently designed to be vacuum-regenerable real-time during EVA operations. The current space suit that is used on ISS today is not regenerable real-time. A significant part of the CO2 removal is ensuring that the CO2 concentrations in the space suit are maintained at adequate levels especially in the space suit helmet. This phenomena is referred to as the washout characteristics. It will be important to optimize the CO2 washout from a system perspective. The overall goal of the research is to: 1) evaluate whether the APLSS provides exemplary system performance in ensuring that the CO2 is
removed sufficiently; and 2) verify that the ventilation flow is adequate to maintain CO2 washout in the AEMU helmet of the crew member during EVA operations. This research will include assessing the medical implications of CO2 concentrations from a space suit system perspective, a review of the CO2 removal technologies for EVA, recent developments in CO2 washout, system testing for CO2 washout, and the associated analytical work. The battery of system testing will be accomplished at the NASA Johnson Space Center in the ventilation subsystem laboratory using the Suited Manikin Test Apparatus to validate the system effectiveness of CO2 washout. This research will provide a foundation of knowledge for the system integration CO2 washout success in the AEMU.

Ms. Chullen has over 33 years of experience with NASA in life support development, technical contract management, business management integration, and knowledge capture. She holds a B.S. in Thermal and Environmental Engineering from Southern Illinois University, an M.B.A. and M.S. in Environmental Science from University of Houston – Clear Lake. She is currently working on her Ph.D. in Systems Engineering from Steven’s Institute of Technology. She is the Extravehicular Activity Small Business Innovative Research Topic Manager. She is also a senior project engineer working on the advanced spacesuit portable life support system and manages NASA’s spacesuit knowledge capture program. She has authored or co-authored over 41 peer-reviewed technical papers. She is married to a NASA engineer and they have four children. She enjoys exercising and holds second degree black belt in Tae Kwon Do.

Stephanie Sharo Chiesi
Transformation to Digital Engineering: Exploring the systems engineering challenges in aerospace and defense

[ABSTRACT Pending for approval from company]

Ms. Chiesi earned a B.S. in Aeronautics and Astronautics, a B.S. in Biology, and an M.S. in Aeronautics and Astronautics at the Massachusetts Institute of Technology. During that time, she worked at NASA's Jet Propulsion Laboratory (JPL). While in graduate school, she worked as a research assistant in the Complex Systems Research Laboratory (CSRL). Her research in the CSRL lab included design visualization translation into intent specifications, incorporation of system safety into intent specifications and utilizing system modeling tools for early design phase execution of system level requirements. Ms. Chiesi has worked as a systems engineer at the Charles Stark Draper Laboratory (CSDL) in Cambridge, MA and at Paragon Space Development Corporation as a space systems engineer supporting Paragon’s role with the Environmental Control and Life Support System (ECLSS) for the Orion program. In addition to her work on Orion, Ms. Chiesi was Paragon’s Systems Engineering group Technical Lead. Ms. Chiesi joined Raytheon Missile Systems (RMS) in May of 2014 as a principal systems engineer. She works with other subject matter experts to develop and implement Model Based Systems Engineering across the enterprise. In addition to her modeling work, Ms. Chiesi was also a member of the first cohort of the Raytheon Women in Engineering, Science and Technology (RWEST) program to further promote women in technical leader roles. In 2017 she became the first RMS SERC doctoral fellow, beginning her studies at Stevens Institute of Technology. In addition to her assignments at her places of employment, Ms. Chiesi is also an active member of the International Council on Systems Engineering (INCOSE), serving as chapter president for the Southern AZ chapter 2013-2015. She achieved the Certified Systems Engineering Professional (CSEP) certification through INCOSE in April of. Ms. Chiesi is a member of the inaugural cohort of the INCOSE Technical Leadership Institute.