3rd Biennial Complexity Symposium

Complexity and Business Analytics: Theory and Applications

University of Michigan-Dearborn

Friday, 10 October 2008

CONFERENCE PLANNING COMMITTEE

Academic Co-Chair:	David Bowen,Wayne State University
Industrial Co-Chair:	Daniel Reaume, General Motors Corporation
	Michael Cavaretta, Ford Motor Company
	Xiuli Chao, University of Michigan-Ann Arbor
	Ratna Babu Chinnam, Wayne State University
	Edward Griffor, Chrysler LLC
	Daniel Grosu, Wayne State University
	Henry Heng, Wayne State University
	Michael Lachance, University of Michigan-Dearborn
	Ed Moylan, SIAM

Schedule of Talks
3rd Biennial Complexity Symposium
University of Michigan-Dearborn
Friday, 10 October 2008

8:00-9:00	North Lobby **Registration**				
9:00-9:10	Quad E **Welcome**				
9:10-10:10	Quad E Data Mining Methods for Neuroinformatics K.P. Unnikrishnan				
10:10-10:30	**Break**				
10:30-11:30	Quad E Case Studies: Agent-Based Modeling in Business and Government Michael North				
11:30-12:30	Dining Rooms B & C **Lunch**				
12:30-2:10	**Parallel Session #1**				
	Session A Room 120 Supply Market Dynamics Datta Kulkarni J.J.Innace T.Klier R.Anupidi S.Kamakshisundaram	Session B Room 126 Social Modeling Allen Batteau W. Rand J. Brewster A.W. Batteau	Session C Room 110 Manufacturing Systems and Processes Leandro Barajas A. Wachs J. Arinez X. Zhu L.G. Barajas	Session D Room 116 Marketing and Revenue Management Dan Reaume H.J. Kintner L. Wallis B. Cheng R. Bordley	Room 194 NetLogo Workshop (Part 1) David Bowen
2:10-2:30	**Break**				
2:30-4:10	**Parallel Session #2**				
	Session E Room 120 Supply Chain Analytics Ratna Chinnam S. Alaniazar N. Aydin I. Dogan	Session F Room 126 General Modeling Michael Lachance D.A. Ostrowski S.C. Vargas M. Ginsberg	Session G Room 110 Bio-Science and Medicine Henry Heng H. Heng H. Ying R. Finley J.B. Stevens	Session H Room 116 Analytics in Vehicle Development Ed Moylan D.A. Lamb S.J. Goldner J. Kotterman R. DeVries	Room 194 NetLogo Workshop (Part 2) David Bowen
4:10	**Close**				

Detailed Schedule of Talks

3rd Biennial Complexity Symposium

University of Michigan-Dearborn

Friday, 10 October 2008

	North Lobby
8:00-9:00	**Registration**
	Quad E
9:00-9:10	**Welcome** **Michael Lachance**, *University of Michigan-Dearborn* **Daniel Little**, *Chancellor, University of Michigan-Dearborn*
	Keynote, Quad E
	Chair: Dan Reaume, *General Motors R&D*
9:10-10:10	**K.P. Unnikrishnan**, *General Motors,* Data Mining Methods for Neuroinformatics
10:10-10:30	**Break**
	Keynote, Quad E
	Chair: David Bowen, *Wayne State University*
10:30-11:30	**Michael North**, *Argonne National Labs,* Case Studies: Agent-Based Modeling in Business and Government
	Dining Rooms B & C
11:30-12:30	**Lunch**

	Session 1-A, Room 120
	Supply Market Dynamics
	Chair: Devadatta M. Kulkarni, *General Motors R&D*
12:30-12:55	**Joseph J.Innace**, *Platts,*
	Strategies for Dealing with the New Steel Supply Chain
12:55-1:20	**Thomas Klier**, *Federal Reserve Bank of Chicago,*
	Shifts in the North American Supply Base
1:20-1:45	**Ravi Anupidi**, *UM Stephen M. Ross School of Business,*
	Integrated Optimization of Procurement, Processing, and Trade of Commodities in Network Environment
1:45-2:10	**Sunder Kamakshisundaram**, *Ariba,*
	Effective Sourcing strategies to mitigate supply chain risks caused by rising commodity prices, currency fluctuations and natural disasters
	Session 1-B, Room 126
	Social Modeling
	Chair: Allen Batteau, *Wayne State University*
12:30-12:55	**William Rand**, *Northwestern University / University of Maryland,*
	Adaptive Agents and the Diffusion of Innovation across Diverse Systems
12:55-1:20	**Jon Brewster**, *Lawrence Technological University,*
	Complexity and Coordinated Response to Hazardous Events
1:20-1:45	**Allen W. Batteau**, *Wayne State University,*
	Technological Acceleration and Peripheralization as an Evolutionarily Stable State
	Session 1-C, Room 110
	Manufacturing Systems & Processes
	Chair: Leandro Barajas, *General Motors R&D*
12:30-12:55	**Allise Wachs**, *Integral Concepts, Inc.,*
	Multi-Response Optimization for Manufacturing Processes
12:55-1:20	**Jorge Arinez**, *General Motors R&D, Manufacturing Systems Research Lab,*
	The Manufacturing Systems Information Singularity
1:20-1:45	**Xiaowei Zhu**, *General Motors R&D, Manufacturing Systems Research Lab,*
	Modeling of Manufacturing Complexity in Mixed-Model Assembly
1:45-2:10	**Leandro G. Barajas**, *General Motors R&D, Manufacturing Systems Research Lab,*
	Practical Approaches for Forecasting of Manufacturing Systems
	Session 1-D, Room 116
	Marketing and Revenue Management
	Chair: Dan Reaume, *General Motors R&D*
12:30-12:55	**Hallie J. Kintner**, *Operation Research Activity, GM Research and Development,*
	Leveraging the Wisdom of Crows with Prediction Markets
12:55-1:20	**Lyle Wallis, Mark Paich**, *Decisio Consulting,*
	Dynamic Marketing Models: Combining System Dynamics and Agent-Based Techniques
1:20-1:45	**Bo Cheng**, *Ford Motor Company,*
	Statistical Characterization of Product Complexity in Market Offerings
1:45-2:10	**Robert Bordley**, *Operations Research Activity, GM Research and Development,*
	Using Maximum Entropy to Derive Choice Probabilities
	NetLogo Workshop (Part 1), Room 194
12:30-2:10	Chair: David Bowen, *Wayne State University*

2:10-2:30	**Break**
	Session 2-E, Room 120
	Novel Models for Supply Chain Analytics
	Chairs: Ratna Babu Chinnam & Alper Murat, *Wayne State University*
2:30-2:55	**Saman Alaniazar**, *Wayne State University,*
	Dynamic Capacity Planning and Installation using Bass Model and Markowitz Investment Model in an Agent-based Supply Chain
2:55-3:20	**Nezir Aydin**, *Wayne State University,*
	Impact of Bill-of-Materials Flexibility and Manufacturing Flexibility on Supply Chain Resilience
3:20-3:45	**Ibrahim Dogan**, *Wayne State University,*
	Modeling Closed-Loop Remanufacturing Supply Chains under Non-Stationary Demand
	Session 2-F, Room 126
	General Modeling
	Chair: Michael Lachance, *University of Michigan-Dearborn*
2:30-2:55	**David A. Ostrowski**, *Ford Motor Company,*
	Meta-Analysis for Validation and Strategic Planning
2:55-3:20	**Myron Ginsberg**, *ACM Fellow, IEEE Senior Member, and HPC Consultant,*
	The Missing Links to Widespread Improvements in U.S. Industrial Global Competitiveness
3:20-3:45	**S. Claudina Vargas**, *Western New England College,*
	Complexity: implications for performance modeling and improvement in education systems
	Session 2-G, Room 110
	Bio-Science and Medicine
	Chair: Henry Heng, *Wayne State University*
2:30-2:55	**Henry Heng**, *Center for Molecular Medicine and Genetics, WSU School of Medicine,*
	The genome context defines the genetic network
2:55-3:20	**Hao Ying**, *College of Electrical & Computer Engineering, Wayne State University,*
	A Fuzzy Discrete Event Systems Approach to HIV/AIDS Treatment
3:20-3:45	**Russ Finley**, *Center for Molecular Medicine and Genetics, WSU School of Medicine,*
	Chasing biological networks
3:45-4:10	**Joshua B Stevens, Christine J Ye, Lesley L Lawrenson, Guo Liu, Steve Bremer and Henry Heng**, *Center for Molecular Medicine and Genetics, WSU School of Medicine,*
	The complexity of molecular mechanism for cancer
	Session 2-H, Room 116
	Analytics in Vehicle Development
	Chair: Ed Moylan, *SIAM*
2:30-2:55	**David A. Lamb**, *TACOM,*
	Army Crash Safety: Rollover and Complexity
2:55-3:20	**Steven J. Goldner**, *First Technology Safety Systems,*
	A Vehicle Impact Test Form Based on a Modified Super-Ellipse
3:20-3:45	**James Kotterman, Greg Eckhart**, *Michigan Manufacturing Technology Center,*
	Using Toys to Teach Applied Statistics in the Workplace
3:45-4:10	**Richard DeVries**, *Senior Engineering Specialist, General Dynamics Land Systems,*
	Optimization, Robust Design, and Analytical Tradeoffs in a Systems Engineering Context
2:30-4:10	**NetLogo Workshop (Part 2)**, Room 194 Chair: David Bowen, *Wayne State University*
4:15-4:45	SIAM Great Lakes Section Business Meeting, Room 126

GLOBAL SUPPLY MARKET DYNAMICS

Session Chair: Devadatta M. Kulkarni, GM R&D and Strategic Initiatives

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Strategies for Dealing with the New Steel Supply Chain
Joseph J. Innace, Platts

Abstract: Steel prices, as well as other commodities, have soared to record levels. Some argue there is a new age in steel, which has led to scrutiny of many of the historic pricing and market-fundamentals indicators. This presentation will focus on the new supply-chain dynamics in the global steel market, with a special emphasis on North America.

Highlights will include:

An assessment of the industrys consolidation and what it means to market players. A progress report on the development of nascent steel futures contracts. An evaluation of other hedging mechanisms and risk management in the steel supply chain.

Shifts in the North American Supply Base
Thomas Klier, Federal Reserve Bank of Chicago

Abstract: Today's US auto industry is concentrated in the auto corridor, a north-south region that extends from Detroit and Chicago south to Mississippi and Alabama, with fingers reaching into Canada. This presentation illustrates the changes in the spatial organization of this industry for both assemblers and suppliers. By means of a detailed data set on auto supplier plants it demonstrates characteristics of today's supplier networks. Using simple nonparametric descriptive tools, it can be shown that both new and old auto supplier plants are highly concentrated in the eastern United States.

Integrated Optimization of Procurement, Processing, and Trade of Commodities in Network Environment
Sripad K. Devalkar, Stephen M. Ross School of Business, University of Michigan, Ann Arbor Ravi Anupidi, Stephen M. Ross School of Business, University of Michigan, Ann Arbor Amitabh Sinha, Stephen M. Ross School of Business, University of Michigan, Ann Arbor

Abstract: We consider an integrated optimization problem for a firm involved in procurement, processing and trade of commodities in a network environment with a central processing node and multiple procurement nodes. We derive optimal policies for a risk-neutral firm, when the processed commodities are sold using futures instruments. When the firm has unlimited processing capacity, we find that an 'all or nothing' procurement policy is optimal and it is optimal to postpone all processing till the last possible period. With finite processing capacity, the optimal procurement quantity is dependent on the starting inventory levels and it might be optimal for the firm to process earlier in the horizon. We develop heuristics for computing near optimal policies and compare the performance of the heuristics with an upper bound for the value function, derived using the technique of Lagrangian relaxation. We conduct numerical studies to quantify the performance of the heuristics and illustrate the benefits from integrated decision making.

Effective Sourcing strategies to mitigate supply chain risks caused by rising commodity prices, currency fluctuations and natural disasters
Sunder Kamakshisundaram, Ariba

Abstract: The session would explore the effect of rising commodity prices (steel, fuel, etc) on finished goods and sourcing strategies that have been implemented by various world-class organizations to mitigate/contain the risks caused by these commodity price hikes. In addition the discussion would also focus on using tools and technology to factor these risks including currency fluctuations to prevent supply chain disruption.

BIO-SCIENCE AND MEDICINE

Session Chair: Allen W. Batteau, Wayne State University

Adaptive Agents and the Diffusion of Innovation across Diverse Systems
William Rand, University of Maryland

Abstract: Where do fads come from? Why are urban myths popular? Who do CEOs consult for advice? Which of our friends tells us about the next must-have gadget? Underlying all of these questions is a process of diffusion, that is how do ideas, concepts, and best practices spread through a population of individuals? Three cutting-edge modeling methods, Agent-Based Modeling (ABM), Social Network Analysis (SNA) and Machine Learning give us the ability to explore these questions in detail. Agent-Based Modeling simulates individual actors in large systems and examines how those individuals make decisions. Social Network Analysis explores how the structure of a network affects the behavior of individuals interacting in that network. Machine Learning provides automated adaptation techniques so that agents in simulations can change their strategies in response to a dynamic environment.

Using these three techniques together, we can begin to understand the patterns of interactions in complex systems of innovation diffusion, and find points of leverage in these complex systems. By combining ABM and SNA, Watts (2002) showed that innovation will diffuse throughout a network when the network is sufficiently sparse that everyone relies on everyone else, or when the network is dense but the initial adopters of the innovation are "backbone nodes." Building on this work, we have begun to investigate the diffusion of innovation in a variety of diverse topologies.

We have also extended previous work on diffusion of innovation by increasing the computational power of agents in these systems. Most computational models of innovation diffusion processes have contained agents that are merely reflexive. These reflexive agents either adopt or do not adopt an innovation based on some simple input like the number of their neighbors that have adopted the innovation. By using machine learning techniques, our model provides agents with the ability to assess the relative value of an innovation, and decide whether or not to adopt the innovation. In the style of "reinvention", agents in this model are also able to modify the innovation on their own, or to combine multiple disparate innovations into a single comprehensive innovation. By examining this model, we hope to gain a better understanding of how innovation diffuses in systems where the agents are not passive channels of information but can also interact and manipulate the novel information presented to them. The initial results of our model show that with adaptive agents, limited communication channels for innovation can perform just as well as broadcast channels. Moreover, diffusion topologies that enable dynamic and long-range interactions facilitate innovation better than topologies that limit interactions to being static and local.

Complexity and Coordinated Response to Hazardous Events
Jon Brewster, Lawerence Technological University

Technological Acceleration and Peripheralization as an Evolutionarily Stable State
Allen W. Batteau, Wayne State University

MANUFACTURING SYSTEMS & PROCESSES

Session Chair: Leandro G. Barajas, General Motors R&D

Multi-Response Optimization for Manufacturing Processes
Allise Wachs, Ph.D., Integral Concepts, Inc.

Abstract: Often, when one product performance characteristic is optimized, some other performance feature may be compromised. For example, in order to minimize porosity in a component, product strength might be sacrificed. A case study will illustrate a method for predicting product performance characteristics. Then, a method for simultaneously optimizing several product features will be presented. The presentation will include elements from experimental design, statistical analysis and modeling, and optimization.

The Manufacturing Systems Information Singularity
Jorge Arinez, Ph.D., General Motors R&D, Manufacturing Systems Research Lab

Abstract: In the early days of mass manufacturing, information about the state of the manufacturing floor was obtained through the manual data collection efforts of production supervisors. With the advent of modern automation, this data collection and subsequent information processing is now able to be done remotely and automatically. Also, todays powerful computers along with extensive data networks in manufacturing have created fertile conditions for a tremendous growth in the availability in all types of manufacturing-related data in effect, we are now living through a manufacturing information singularity. This talk will discuss both the opportunities and potential pitfalls that come with all of this wealth in data and information that is available to people running todays factories.

Modeling of Manufacturing Complexity in Mixed-Model Assembly
Xiaowei Zhu, General Motors R&D, Manufacturing Systems Research Lab

Abstract: Mixed-model assembly lines can help increase plant flexibility while reducing investment cost. However, it also makes plant more complex when product variety is high. In General Assembly where production heavily depends on manual operations, the process is subject to unpredictable human errors and performance degradation due to complexity. In this study, we model the station level complexity and propose a sequence planning approach to minimize the impact caused by complexity in General Assembly.

Practical Approaches for Forecasting of Manufacturing Systems

Leandro G. Barajas, Ph.D., General Motors R&D, Manufacturing Systems Research Lab

Abstract: This talk summarizes results from several years of research on the application of advanced forecasting techniques to manufacturing systems key performance indicators (KPI) at General Motors. Techniques ranging from standard statistical analysis to hybrids between Bayesian approaches, neural networks, genetic algorithms, and temporal data mining are presented and evaluated. Advantages and disadvantages of each approach are explored for several applications, data types and business process requirements. Finally, a general business process integration framework for optimal KPI estimation and prediction is presented.

MARKETING AND REVENUE MANAGEMENT

Session Chair: Daniel J. Reaume

Leveraging the Wisdom of Crows with Prediction Markets
Hallie J. Kintner, Ph.D., Operation Research Activity, GM Research and Development

Abstract: Have you ever participated in a contest to guess how many jelly beans were in a jar? Surowieckis The Wisdom of Crowds popularized the notion that the average of a set of guesses (like those of the number of jelly beans) can predict better than a single guess, even if it is from an expert. Prediction markets resemble stock markets. They allow people to express opinion as a weighted vote over time in response to new information or a change of opinion. Prediction markets have been used to predict such diverse outcomes as elections, prices, quality problems, academy award winners, the location of a missing submarine, and dates. This talk provides an overview of prediction markets.

Dynamic Marketing Models: Combining System Dynamics and Agent-Based Techniques
Lyle Wallis and Mark Paich, Decisio Consulting

Abstract: System Dynamics and agent based models are complementary techniques for building dynamic marketing models. System dynamics is excellent for building aggregate production-inventory systems that capture fundamental mechanisms without unnecessary detail. Agent modeling is excellent for naturally capturing the heterogeneity and complexity of consumer decision processes. This paper presents concepts and an example of how the techniques can be combined to provide deeper insight into the dynamics of complex market environments

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Statistical Characterization of Product Complexity in Market Offerings
Bo Cheng, Ph.D., Ford Motor Company
Suzhou Huang, Ph.D., Ford Motor Company
Giuseppe Rossi, Ph.D., Ford Motor Company
Helen Shi, Ph.D., University of Michigan, Dearborn
Shaozhong Zhao, Ph.D., University of Michigan, Dearborn

Abstract: A commonly used measure for product complexity in market offerings is the orderable number of configurations. While this measure is often reasonably adequate for simple consumer products, it can become less informative and sometimes misleading for complicated assembled-products such as cars. In order to have a consumer centric perspective, we introduce a statistical index to characterize product complexity in market offerings. We show that the index possesses a number of desirable mathematical properties, such as proper normalization, being order preserving, indicating association between product features and so on. We illustrate how these useful properties make the new index a superior measure of product complexity in the automotive industry.

Using Maximum Entropy to Derive Choice Probabilities

Robert Bordley, Ph.D., Operations Research Activity, GM Research and Development

Abstract: The building block of discrete choice models, the multinomial logit, writes the probability of choosing a product as a function of the product's attributes and the individual's preferences for those attributes divided by a similar function for all other products. Unfortunately it violates the independence of irrelevant alternatives which leads to the need for more complex choice models. But the same choice model can be derived by assuming that the modeler wants to use a maximum entropy distribution subject to some knowledge of the average attribute scores on products the individual buys. In this model, the weights reflecting the importance attached to various attributes are replaced by Lagrangian multipliers which vary — as the choice set varies — in order to keep the average product attribute score unchanged. This means that maximum entropy logit will violate independence of irrelevant alternatives and hence will be a more realistic choice model than the regular logit model.

NOVEL MODELS IN SUPPLY CHAIN MANAGEMENT

Session Chairs: Ratna Babu Chinnam, Ph.D. and Alper Murat, Ph.D., Industrial & Manufacturing Engineering Department, Wayne State University

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Dynamic Capacity Planning and Installation using Bass Model and Markowitz Investment Model in an Agent-based Supply Chain

Saman Alaniazar, Department of Industrial and Manufacturing Engineering, Wayne State University Alper Murat, Ph.D., Department of Industrial and Manufacturing Engineering, Wayne State University Ratna Babu Chinnam, Ph.D., Department of Industrial and Manufacturing Engineering, Wayne State University

Abstract: Increased demand for product variety, innovative technologies, and global competition are three main trends contributing to the shortening of product life cycles. With the constant introduction of new products, Supply chain (SC) managers are under pressure to optimally reconfigure their SCs which involves expensive and irreversible capacity planning and installation decisions. We consider the dynamic capacity planning and installation in a multi-agent based SC (Tamagotchi supply chain) for new product introductions. We design an intelligent agent responsible for dynamic capacity planning and management. The agent employs a hybrid-strategy of short-term demand forecasting and long-term demand modeling based on the Bass diffusion model to manage the capacity installation and termination. The agent also takes into account the uncertainty in long-term demand modeling via a Markowitz investment model. We report on the experimental results of this agents performance vis--vis the static capacity management strategy.

Impact of Bill-of-Materials Flexibility and Manufacturing Flexibility on Supply Chain Resilience

Nezir Aydin, Department of Industrial and Manufacturing Engineering, Wayne State University Alper Murat, Ph.D., Department of Industrial and Manufacturing Engineering, Wayne State University Giuseppe Rossi, Ph.D., Ford Research & Advanced Engineering, Ford Motor Company

Abstract: The recent trends such as the proliferation of product variety, shrinking product lifecycles, and aggressive global outsourcing have increased the risk of supply chain disruptions. In particular, supply disruptions, such as strikes and large-scale quality problems, differ from regular supply fluctuations in that they are low-probability and high-impact events. The disruption vulnerability can be reduced by risk mitigation strategies such as increasing resiliency by adding redundancy such as excessive safety stock and working with multi-suppliers. These approaches are costly, do not guarantee return on the investment, and depend heavily on the subjective vulnerability predictions. Alternatively, various product and process flexibilities provide resiliency against supply disruptions. In this work we study the impact of flexibility decisions made in the product development and process design stages on the supply chain resilience against supply disruptions. In particular, we consider the volume and the mix rate flexibility decisions in the process design stage and the bill-of-materials flexibility decisions in the product development stage. Based on extensive computational experiments, we demonstrate that flexibility decisions are important sources for supply chain resilience against supply disruptions and reduce the need for more costly risk mitigation mechanisms. Our results indicate that most of the supply chain resilience benefit

of flexibility decisions can be achieved with a limited but integrated levels bill-of-materials and process flexibilities.

Modeling Closed-Loop Remanufacturing Supply Chains under Non-Stationary Demand

Ibrahim Dogan, Ph.D., Department of Industrial and Manufacturing Engineering, Wayne State University Ratna Babu Chinnam, Ph.D., Department of Industrial and Manufacturing Engineering, Wayne State University

Abstract: In todays increasingly competitive global economy, firms are seeking any and every possible opportunity to differentiate themselves from competition, reduce costs, and add value to supply chains and end consumers. One option is to excel in reverse logistics and remanufacturing. In the literature, most operations management models dealing with reverse logistics and remanufacturing assume that product demand generally follows an independent and identically distributed (i.i.d.) probability distribution. However, in reality, factors such as customer behaviors, market conditions, and product life-cycle aspects often lead to different types of uncertainties, for example, periods of growth followed by maturity and decline. In this study, we deviate from the literature by modeling this non-stationary fluctuating demand process as a Markov chain, where demand information is maintained in the different states and transitions between the states are governed by a state-transition matrix. Our aim in particular is to support CLSC operations in tackling these demand variations and uncertainties in forecasting returns quantity and timing.

GENERAL MODELING

Session Chair: Michael Lachance, UM-Dearborn

Meta-Analysis for Validation and Strategic Planning

David A. Ostrowski, System Analytics and Environmental Sciences Research and Advanced Engineering, Ford Motor Company

Abstract: This paper presents framework to support design of meta-rule constructs. A prototype is described towards the application of credit analysis. The focus of this system is to define a higher level of inference that will guide pre-established object-level rule constructs. This architecture is supported by the incorporation of machine-learning techniques to support the acquisition of business rule-based knowledge. This knowledge is applied to specific parameters that ultimately guide an object level decision making process. By developing this knowledge, we are interested in up front actions including validation and support of intended responses. We intend to further classify and categorize this acquired knowledge to support future policy modifications.

Complexity: implications for performance modeling and improvement in education systems

S. Claudina Vargas, Complex Systems Optimization Lab, Department of Industrial Engineering, Western New England College, MA

Abstract: This work addresses the issue of satisfying completeness in the formalization of a descriptive model of an educational (ES) with a view at analyzing its performance. Completeness is a necessary condition for model accuracy and resolution, but completeness is difficult, perhaps impossible, to achieve when the system being analyzed is complex like an ES. In this work, the ES is a set of interdependent classrooms, which are parts of a larger hierarchal structure. Each classroom is a process with many dynamic and imprecise transformation technologies (learning models), each of which produces a single stochastic output; however, the forms of the individual technologies are unknown. We know, however, that the technologies change each period and that these changes are not perfectly predictable. Moreover, each period, the performance of each technology is determined by many complex factors and these factors are not homogeneous across the technologies. The goal of the modeling process is to understand the structure and dynamics of the individual technologies and their contribution to the system performance, but the effectiveness of this process depends on how well the system being modeled is described and how the model resolves the uncertainties. This is difficult in an ES because the performance shaping factors are ill-defined. In this work, we conduct an extensive review of the research literature and identify factors generally deemed determinants of performance in an ES; then, we construct a matrix of characteristics for each factor and map the interactions among them and among the factors. We found that the factors cannot be unambiguously defined or measured. This limits completeness and consequently, the usability of models using these factors for decision-making. Following, we employ network techniques and NK modelling theoretic to explore possible ways of configuring the performance-shaping factors and how the contribution of individual technologies to the systems overall performance. The main goal of this exercise is to find out if it is possible to configure performance-shaping factors with optimal or greater resolution using complex system modeling techniques. The results are still tentative, but we believe that any improvement will have great implications for educational policies.

The Missing Links to Widespread Improvements in U.S. Industrial Global Competitiveness

Myron Ginsberg, Ph.D. ACM Fellow, IEEE Senior Member, and HPC Consultant

Abstract: This presentation will focus on current high-performance computing (HPC) barriers in U.S. industry and several approaches to improve the situation and resultant U.S. industrial competitiveness. The following topics will be included: U.S. Council on Competitiveness studies of U.S. globalization; reasons for lagging behind government research labs/academic research groups; reducing the time gap between product conception and production via use of HPC tools; arising opportunities for cooperative and innovative efforts with government labs and universities; and a collection of internet references documenting U.S. industry successes and failures as well as challenges to significantly improve effective product globalization.

BIO-SCIENCE AND MEDICINE

Session Chair: Henry Heng, Wayne State University

The genome context defines the genetic network
Dr. Henry Heng, Center for Molecular Medicine and Genetics, Wayne State University School of Medicine

Abstract: The patterns of genetic networks are distinctively different between bacteria and mice. The seemingly conflicting information from KO mice and manipulated bacteria can be resolved using the genome-centric concept where the explanation may lie at the level of genome dynamics. When some genes are knocked out, there are different mechanisms available to restore or establish a new network by either re-shaping the genome or by adjusting the interactions among the remaining genes. The genome context, defined as an entire set of genes and their physical relationship among chromosomes, defines the pattern of network dynamics.

A Fuzzy Discrete Event Systems Approach to HIV/AIDS Treatment
Dr. Hao Ying, College of Electrical & Computer Engineering, Wayne State University

Abstract: We have combined fuzzy logic technology with discrete event systems technology to form the novel fuzzy discrete event systems technology that takes advantages of the distinct merits of the individual technologies. The new technology has been applied to selection of the first-round of HIV/AIDS treatment regimens most suitable for the given patient with encouraging preliminary results.

Chasing biological networks
Dr. Russ Finley, Center for Molecular Medicine and Genetics, Wayne State University School of Medicine

Abstract: The properties of biological systems emerge through interactions among genes (DNA), RNAs, proteins, and other molecules. A deep understanding of any biological system will require a map of these interactions showing which molecules touch each other. Unfortunately, the tools currently available for making such maps are far from perfect. Thus, we are forced to seek biological insight from inaccurate and incomplete representations of biological networks. The solution to this problem will require novel combinations of experimental and computational approaches.

The complexity of molecular mechanism for cancer
Drs. Joshua B Stevens, Christine J Ye, Lesley L Lawrenson, Guo Liu, Steve Bremer and Henry Heng, Center for Molecular Medicine and Genetics, Wayne State University School of Medicine

Abstract: Historically cancer research has focused on finding a stepwise pattern of gene mutations that drive cancer initiation and progression. However, recent large scale sequencing of cancer genome reveals an unexpectedly high level of complexity in gene mutation patterns and their molecular pathways. These surprising findings challenge the gene-centric concept of cancer, but can in fact be explained by the evolutionary dynamics of complex systems, a typical feature of cancer evolution.

ANALYTICS IN VEHICLE DEVELOPMENT

Session Chair: Ed Moylan, SIAM Great Lakes Section

Army Crash Safety: Rollover and Complexity
David A. Lamb, Computational Reliability & Safety Research Team, TACOM

Abstract: Rollover accidents in Army vehicles have been identified as a significant safety concern for the soldier. Efforts to improve the safety of Army vehicles in a rollover are using modeling and simulation (M&S) in a critical way. There are several major areas of complexity in the modeling of a rollover event, and this is reflected in the mathematics used in the models. This talk will discuss several ways the Army is handling the complexity of the rollover crash event in simulation.

A Vehicle Impact Test Form Based on a Modified Super-Ellipse
Steven J. Goldner, First Technology Safety Systems, Plymouth Michigan

Abstract: The physical form and use of an automotive impact testing head is based on a modified super-ellipse of the mathematical form (X/X0)2 + (Z/Z0)3 = 1. A comparison to the shape of an equivalent human head is given. The utility and effects of the tests and the test program on motor vehicle safety are introduced. Comparisons to other uses of standard super-ellipses are discussed.

Using Toys to Teach Applied Statistics in the Workplace
James Kotterman, Greg Eckhart Michigan Manufacturing Technology Center

Abstract: Statistics can be powerful tools for making critical decisions in our lives and in the workplace. Despite their value, statistics remain a mystery to most and feared by many. We strive to reduce the fear and make statistical analysis and hypothesis testing interesting and fun while teaching classes in Six Sigma. Six Sigma is a rigorous process improvement methodology partially predicated on the practical application of statistical analysis. To teach statistics and hypothesis testing Six Sigma trainers have traditionally used catapults and other toys to teach learners how and when to use statistical tools to solve complex problems. We would like to share some of our methods, exercises, and toys we use at the Michigan Manufacturing Technology Center to teach learners how statistics can help them solve problems in areas such as business, manufacturing, and healthcare.

Optimization, Robust Design, and Analytical Tradeoffs in a Systems Engineering Context
Richard DeVries, Senior Engineering Specialist, General Dynamics Land Systems

Abstract: (Under Management Review)

NET LOGO WORKSHOP

Session Chair: David Bowen, Wayne State University

Abstract: NetLogo is a popular open-source agent-based modeling system that runs on all computers supporting Java. Agent-based modeling is perhaps the most widely-used technique in the study of complex systems, such as natural and social systems. An agent-based model consists of software agents, which can represent many types of entities, from molecules to planets to people to families to nations, to individual organs, or organisms in an ecosystem. The modeler also constructs the rules of action and interaction for the agents, and then the modeling system plays out the interactions over time. A model can contain several agents, up to several thousand.

This workshop will cover agent-based modeling background, downloading and installing NetLogo, a survey of the wide variety of existing models in the standard installation and others on the NetLogo site, and an introduction to modifying existing models and programming your own models.