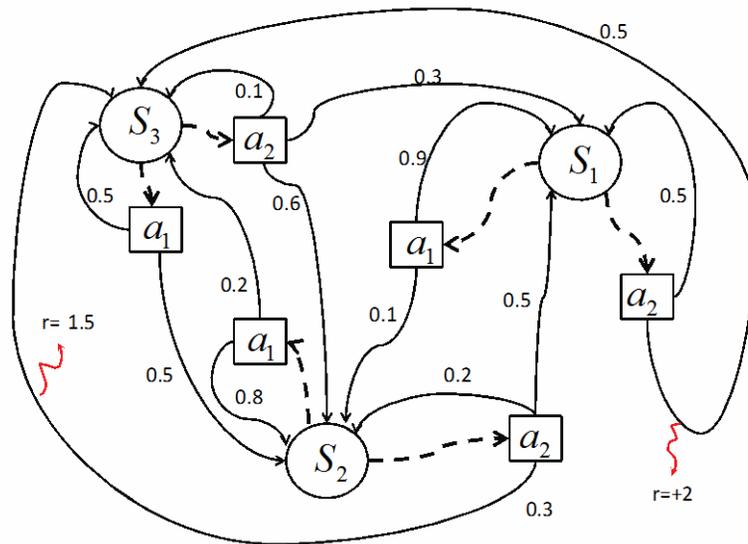


Multi-scale Adaptive Decision Support



Research in the Multi-scale Adaptive Decision Support research group is focused on decision-making in complex systems, with emphasis on Bayesian scoring models, machine learning, and mathematical optimization. Our research has found application in a variety of domains, including manufacturing systems, lender and consumer credit decision-making, high frequency trading, and surveillance and reconnaissance.

The group is led by Peter A. Beling. Dr. Beling is the founder of the Financial Engineering Research Group at UVA, which is a focal point for research on the mathematical modeling and risk management aspects of consumer and retail credit, and co-founder of the Financial Decision Engineering Group at UVA, which focuses on modeling activity in equities and commodities markets. He is active in the UVA site of the Wireless Internet Center for Advanced Technology, which an Industry-University Cooperative Research Center sponsored by the National Science Foundation.

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“Our interests are in complex decision problems that involve humans, computers, and physical processes.”



Multi-scale Adaptive Decision Support

Decision-making in complex systems often involves a variety of decisions defined over different temporal, physical, and organizational scales. We study methods for distributed and coordinated decision-making and for decision support that adapts to environmental changes. Application domains for our work include man-machine decision systems for surveillance and reconnaissance in national security settings, consumer credit lending decisions, and decision methodologies to support the design of cyber security solutions.

Cyber-Physical Decision Systems in Manufacturing

This research centers on the use of newly-available sensor data to support decision making in manufacturing operations, including characterization of human activity, knowledge capture, adaptive control, training, and workforce development. The principal venue for this work is the Commonwealth Center for Advanced Manufacturing (CCAM), which is a consortium of manufacturing companies and Virginia universities.

Financial Decision Engineering

Many financial market participants now employ algorithmic trading to make trading decisions, submit orders, and manage those orders after submission. Algorithmic trading is now so prevalent that the speed of order submission has emerged as a principal characteristic for distinguishing trading agents. Our research focuses on the use of inverse reinforcement learning and other machine learning techniques to characterize trading strategies and the development of agent-based simulations of the markets to support policy analysis. The principal venue for this work is the Commodity Futures Trading Commission.

Machine Learning

This activity centers on the development of new approaches to learning from data. Most of our machine learning work falls into the broad framework of Bayesian statistical inference. We develop theory and algorithms in the areas of classifier combination, multi-instance learning, inverse reinforcement learning, hidden Markov models, and learning representation theory.

RECENT RESEARCH DEVELOPMENTS

- *Tracking worker activity using Microsoft Kinect* – We use inexpensive depth cameras, along with new computer vision and machine learning techniques, for assessment of worker activity in a manufacturing environment.
- *Reverse engineering of trading strategies* – We use inverse reinforcement learning to infer the strategies of market participants based on limited observation of their actions.

RECENT GRANTS

- CCAM – Characterization of Human Performance using Continuous Motion Data
- NSF – Technology Based Evaluation of Classroom Learning
- NSF – Fundamental Research on Adaptive Wireless Video Systems.

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