7a.014.UVA – Data-Driven Models for Exploring Systemic Risk with Unknown Inputs

Report Date	Project Start	Project End	Project Budget	Amount Spent To Date
12/31/18	6/30/18	6/30/19	$40,000	

PROJECT SUMMARY

This research project will develop a general methodology that will take data streams (time series of data) and/or simulation models (agent-based or other) and create state-based, dynamic macro models, and perform analysis of the created models to explore critical issues. These include: i) what ranges of parameter values would cause the model to become unstable, ii) what is the likelihood of certain critical states occurring and at what recurrence, iii) can we create controls to manage the dynamic system, etc. Such a formal dynamic model would allow for organizations, such as regulators, to explore the impacts of policy changes and modifications to existing polices. This research would also have broader applications in other data-driven systems, such as the internet, telecommunications, healthcare, and the intelligence community.

PROJECT TEAM

Team Member Name	Team Role *(PI, Co-PI, Student, Researcher)*	Academic Site
William Scherer	PI	University of Virginia
Hunter Moore	Student	University of Virginia

IAB PROJECT MENTOR(S)

IAB Project Mentor Name	IAB Organization
Anil Deane	Northrop Grumman

PROJECT FUNDED BY

IAB Organization(s)
Northrop Grumman

OVERALL PROGRESS/ACHIEVEMENTS TO DATE

Three datasets have been acquired for study, a biological, a building infrastructure, and an energy-related dataset. These datasets will allow for testing of methodology across different fields. Current efforts have focused on an initial analysis of the biological and energy-related dataset. As can be seen in Figure 1, Subject A moves into a critically unstable state (hypoxic in this example), Subject B moves into a mildly unstable state, and Subject C remains in a stable state. This project is currently working on (1) a methodology for detecting and predicting these unstable states and (2) the susceptibility to move into these unstable states [i.e., what features are most important? And what ranges of these features cause this? Are there certain states which are more likely to lead into states of instability?]. Future work during this project will explore methods for creating controls to manage the systems.

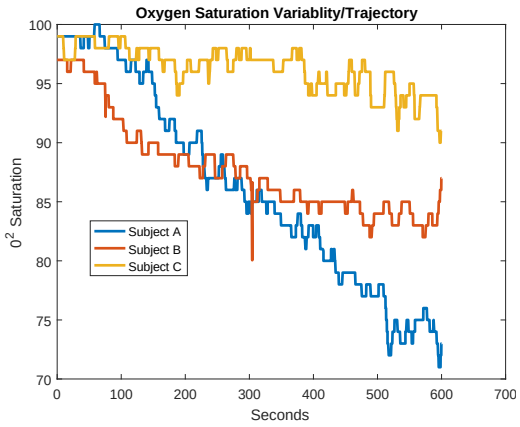

Figure 1. Current biological system under study. This diagram shows Subject A moving into a critically unstable state (hypoxic), Subject B moving into a mildly unstable state, and Subject C remaining in a stable state.

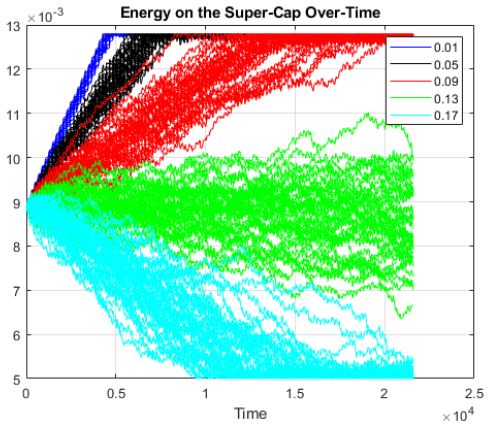

Figure 2. Current energy-related system under study. This figure details energy on a super-cap which is being charged through energy-harvesting efforts. Different colored curves correspond to indicated frequency of discharge events.

PROJECT DELIVERABLES

Deliverable	Achievements	Remaining To Do
1. Literature Review	Review of literature in progress	Continuation/completion of review
2. Preliminary Methodology	Review/research of methods in progress	Finalization of initial methodologies
3. Exploration on sample problems	Acquisition of multiple datasets, initial analysis of one dataset	Continuation of testing and application of developed methodologies
4. Report including explanation of method, model and testing results	Development of report content underway	Develop report