REPPERGER RESEARCH INTERN PROGRAM

RESEARCH PROJECT #: AFRL-RHW-25-06

Network Characterization and Monitoring via Mixed Modeling of Network Properties

PROJECT DESCRIPTION: Models of networks have applications in many areas of research – such as sociology and engineering – and in numerous operational settings of interest to the US military – such as cognitive warfare and cyber defense. In applied operational settings, it is often necessary to characterize the networks when the underlying structure is unknown, and to have descriptive and anticipatory analytics that derive from network and media content data to inform assessment and decision making. AFRL researchers have developed both semiparametric and Bayesian statistical methods to characterize and detect changes within a given network of interest. Recently, researchers have also developed a workflow for extracting network structures given publicly available information (PAI) from social media data. Research efforts are currently focused on leveraging these new methods for network understanding and insight generation with the goal of creating models and analytics that can characterize the impact of operations in the Information Environment (OIE). The ultimate goal of this research is to provide novel models for wargaming and IE problem sets, experiment data, and strategies to build information resilience within the DoD.

LEARNING OBJECTIVE: During this internship, the student intern will assist in utilizing current results and capabilities to develop a network characterization and modeling framework that can provide an adaptive characterization for a given network as well as alerting the user of significant and/or anomalous changes that occur as the network is monitored. The student intern will provide research updates in weekly meetings, participate in team-based research efforts, engage actively in model development, participate in data analysis, adhere to ethical and health safety protocols in the laboratory, and share research findings through publications and presentations. The student should expect to gain knowledge in (but not limited to) network analysis and modeling, statistical modeling, computational modeling, Bayesian inference, R programming language, and RStudio.

ACADEMIC LEVEL: Masters; Doctoral

DISCIPLINE NEEDED:

- Probability and Statistics
- Data Science
- Computer Science

RESEARCH LOCATION: Wright-Patterson Air Force Base, Dayton, Ohio

The material was CLEARED on 04 Nov 2024; Case Number: AFRL-2024-6170.

RESEARCH MENTOR: Fairul Mohd-Zaid, Ph.D.
Probability and Statistics, Air Force Institute of Technology, 2016

Dr. Fairul Mohd-Zaid is a Mathematical Statistician at the Air Force Research Laboratory's Cognition and Modeling Branch conducting research in network analysis and statistical visualization with other research interests in machine learning and multivariate analysis. Dr. Mohd-Zaid received a BS in Mathematics from Southern Polytechnic State University and a MS in Operations Research and PhD in Applied Mathematics from the Air Force Institute of Technology. He is a three-time recipient of the DOD funded Science, Mathematics, And Research for Transformation (SMART) scholarship.

RESEARCH MENTOR: Wen Dong, Ph.D.
Media Arts and Sciences, Massachusetts Institute of Technology, 2010

Dr. Wen Dong is a Computer Scientist at the Air Force Research Laboratory's Cognition and Modeling Branch, where he conducts research in machine learning, data mining, and human dynamics. He earned his PhD in Media Arts and Sciences from the Massachusetts Institute of Technology. Before joining the Air Force Research Laboratory, Dr. Dong served as a faculty member in the Department of Computer Science and Engineering at the University at Buffalo.

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