REPPERGER RESEARCH INTERN PROGRAM

RESEARCH PROJECT #: AFRL-RHW-27-01

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, including cognitive warfare and cyber defense. In applied operational settings, it is often necessary to characterize networks when their underlying structure is unknown and to develop descriptive and anticipatory analytics derived from network and media content data to inform assessments 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 from publicly available information (PAI) obtained from social media data. Current research efforts focus 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 goal of this research is to provide novel models for wargaming and OIE problem sets, experimental data, and strategies to build information resilience within the Department of Defense (DoD).

LEARNING OBJECTIVES: Under the guidance of a mentor, you will gain hands-on experience to complement your education and support your academic and professional goals. Along the way, you will engage in activities and research in several areas, including but not limited to:

1. Utilize state-of-the-art capabilities to develop a network characterization and modeling framework that provides adaptive characterization of a given network and alerts users to significant and/or anomalous changes as the network is monitored.
2. Report research updates during weekly meetings.
3. Participate in team-based research efforts and gain experience with model development.
4. Perform data analysis.
5. Adhere to ethical and laboratory health and safety protocols.
6. Share research findings through publications and presentations.

Through these activities, you will also gain knowledge in network analysis and modeling, statistical modeling, computational modeling, Bayesian inference, the R programming language, and RStudio.

ACADEMIC LEVEL: Master's; Doctoral

DISCIPLINES NEEDED: Probability and Statistics, Data Science, Computer Science

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

RESEARCH MENTOR: Fairul Mohd-Zaid, Ph.D.

Probability and Statistics, Air Force Institute of Technology, 2016

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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 an MS in Operations Research and a 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.

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