Introduction to Decision Support for Complex Networks Minitrack

Wolfgang Bein
University of Nevada, Las Vegas
wolfgang.bein@unlv.edu

Stefan Pickl
University of the Federal Armed Forces, Munich
stefan.pickl@unibw.de

1. Introduction

The mini-track "Decision Support for Complex Networks" invited contributions in the area of complex decision support under multiple criteria and where a multitude of variables have to be considered under great uncertainty. Typically, such systems are used for crisis and risk management in diverse contexts, such as health care, homeland security, aviation, transportation, energy grids, and defense. Techniques run the gamut from heuristics, game theory, mathematical programming, and statistical methods to big data techniques. The mini-track sought to showcase novel techniques or new interactions among existing techniques. Specifically, approaches used in the contributions published here, utilized Bayesian inference models, subgraph matching analytics, visual network analysis, and collaborative interactive learning.

2. Contributions

The paper "XLab: Early Indications & Warnings from Open Source Data with Application to Biological Threat" by Simek *et al*. describes a novel system prototype, which addresses threats arising from biological weapons of mass destruction. The early warning system enables intelligence analysts to visualize, explore, and query a knowledge base constructed from multiple data sources, guided by subject matter expertise codified in threat model graphs. The paper introduces new methods for inexact matching that accommodate threat models with temporal and geospatial patterns. System performance is demonstrated using several simplified threat models and an embedded scenario. Exact and inexact subgraph matching analytics enable analysts to search the knowledge base for instances of modeled threats.

In "Proof of Concept of a Visual Analytics Dashboard for Transportation Network Analysis" Nistor discusses the latest developments in the field of visual analytics, and the role of network analysis for transportation systems. Multilayer and multiplex based visualizations are used for processing vast data decision makers face. A dashboard proof of concept is presented with a focus on a transportation network analysis with multiple network measures and indices in a multiplex visualization.

The paper "Leveraging the Potentials of Dedicated Collaborative Interactive Learning: Conceptual Foundations to Overcome Uncertainty by Human-Machine Collaboration" by Oeste-Reiss *et al.* gives an approach to "crowdsourcing traffic sign labels with self-assessment" that will support leveraging the potentials of dedicate collaborative interactive learning. The authors argue that this is where dedicate collaborative interactive learning comes together: The learning system can decide from which data it learns, copes with uncertainty regarding the categories, and does not require a fully labeled dataset. Against this background, they create the foundations of two central challenges in this early development stage of dedicate collaborative interactive learning: task complexity and uncertainty.

The final contribution in this mini-track is in the realm of traffic network flows. Partial observations of origin-destination trips and vehicle trajectory information are becoming available from mobile sensors such as onboard devices or smart-phones. Such data is very helpful for the network flow estimation problem which can be originally very challenging using only link count. However, with this new information there is still structural bias of the maximum likelihood based approach due to uncertainty in the penetration rates. Tan *et al.* propose a Bayesian inference approach in their paper "Bayesian Inference for Static Traffic Network Flows with Mobile Sensor Data". They argue that the inclusion of mobile sensor data and prior beliefs based on it can produce much better inference results compared to the case with non-informative priors and only link counts.

URI: http://hdl.handle.net/10125/50004
ISBN: 978-0-9981331-1-9