COLLEGE OF ENGINEERING AND COMPUTER SCIENCE
FLORIDA ATLANTIC UNIVERSITY

Announces the Ph.D. Dissertation Defense of

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for the degree of Doctor of Philosophy (Ph.D.)

"Illuminating Cyber Threats for Smart Cities: A Data-Driven Approach for Cyber Attack Detection with Visual Capabilities"

September 30, 2021, 3:00 p.m.
Virtual Dissertation

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ABSTRACT OF DISSERTATION

Illuminating Cyber Threats for Smart Cities: A Data-Driven Approach for Cyber Attack Detection with Visual Capabilities

A modern urban infrastructure no longer operates in isolation but instead leverages the latest technologies to collect, process, and distribute aggregated knowledge to improve the quality of the provided services and promote the efficiency of resource consumption. However, the ambiguity of ever-evolving cyber threats and their debilitating consequences introduce new barriers for decision-makers. Numerous techniques have been proposed to address the cyber misdemeanors against such critical realms and increase the accuracy of attack inference; however, they remain limited to detection algorithms omitting attack attribution and impact interpretation. The lack of the latter prompts the transition of these methods to operation difficult to impossible. In this dissertation, we first investigate the threat landscape of smart cities, survey and reveal the progress in data-driven methods for situational awareness and evaluate their effectiveness when addressing various cyber threats. Further, we propose an approach that integrates machine learning, the theory of belief functions, and dynamic visualization to complement available attack inference for ICS deployed in the realm of smart cities. Our framework offers an extensive scope of knowledge as opposed to solely evident indicators of malicious activity. It gives the cyber operators and digital investigators an effective tool to dynamically and visually interact, explore and analyze heterogeneous, complex data, and provide rich context information. Such an approach is envisioned to facilitate the cyber incident interpretation and support a timely evidence-based decision-making process. Empirical evaluations using data collected in a testbed representing a small-scale water treatment plant exceeded state-of-the-art performance. The results also show that the proposed approach identifies the exploited ICS assets with more than 8-15\% accuracy improvement over currently available works. We postulate and stress that such proposed methods significantly contribute to the cybersecurity and forensics of critical infrastructure deployed in smart cities. The proposed visual component can be used independently from the proposed attack detection technique, supporting the exploration of various detection methods. It thus can advance the transition to operation by providing rich context information and bridging the interpretation gap. In addition, we draw several potential research directions that aim at promoting cyber situational awareness in the context of smart cities.

BIOGRAPHICAL SKETCH
Born in Prague, Czech Republic
M.S., Dnipropetrovsk National University, Dnipropetrovsk, Ukraine, 2000
M.S., Kyiv Investment Management Institute, Kyiv, Ukraine, 2004
M.S., Florida Atlantic University, Boca Raton, Florida, 2018
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Published Papers:

Nataliia Neshenko, Elias Bou-Harb, and Borko Furht. Illuminating cyber threats for water plants: A data-driven approach for cyber attack detection with visual capabilities. Computers & Security, 2021. Under Review

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