METHODS FOR NATIONAL SECURITY RISK QUANTIFICATION AND OPTIMAL RESOURCE ALLOCATION DECISIONS

Robert Brigantic, Pacific Northwest National Laboratory, 902 Battelle Boulevard, Richland, WA 99352, 509-375-3675, robert.brigantic@pnnl.gov
Samrat Chatterjee, Pacific Northwest National Laboratory, 902 Battelle Boulevard, Richland, WA 99352, 509-375-3957, samrat.chatterjee@pnnl.gov

ABSTRACT

The new *National Security Strategy of the United States of America* that was just released in December 2017 highlights "sophisticated challenges to national security" -- from on-going terrorist threats to nuclear, chemical, and biological weapons that threaten our homeland [2]. In turn, these challenges require equally sophisticated approaches and decision making tools to quantify national security risks from a vast array of threats and the best strategies to mitigate such risks. Indeed, tools to support risk-informed decision making is a core theme in the Department of Homeland Security's *Fiscal Years 2014-2018 Strategic Plan* and the Department's Mission 1 to prevent terrorism and enhance security [1]. Likewise, the new National Security Strategy seeks to improve the security and resilience of our critical infrastructure by assessing risk across national security, energy and power, banking and finance, health and safety, communications, and transportation as well as cyber. In turn, the goal is to "prioritize our protective efforts, capabilities, and defenses accordingly." Moreover, this new strategy affirms that "the United States will improve its ability to assess the threats and hazards that pose the greatest risks to Americans and will prioritize resources based on the highest risks" [2].

To accomplish these laudable goals, an underlying computational framework based on scientific and rigorous mathematical underpinnings is essential. Estimating frequencies and societal impacts of security threats is challenging due to imperfect data, along with multi-scale, dynamic, and complex interconnections posed by modern infrastructure systems. As a result, understanding the interplay between threats, systems, and decisions (often under resource constraints) is critical.

With the above in mind, this tutorial will familiarize participants with methods for national security risk quantification, focusing on optimal resource allocation. The techniques are applicable to a variety of systems such as mass transit infrastructure or large-scale public event venues. A key aspect of our methodology is the ability to uniquely allow the core components of risk – consequence, vulnerability, and threat to be quantified as a continuous function of time throughout the day, week, month, or year. Statistical and simulation-based modeling methods are required to analyze and forecast data that drives these various components of risk. The next step in our methodology is to assess the effectiveness, which may include a deterrence factor, of the different security resources that can be used to counter the threat to the venue of interest. This also requires the use of statistical methods for subject matter elicitation. Lastly, we formulate the risk-informed resource allocation problem as a mathematical program (MP) which can be solved to determine the optimal allocation of constrained security resources that minimize risk as a function of time. This tutorial will also provide an overview of open source software packages that can be used to obtain optimal solutions to MP problems.

Keywords: National security, risk, consequence, vulnerability, and threat, optimal resource allocation

REFERENCES

[1] United States (2014). Department of Homeland Security Strategic Plan for Fiscal Years 2014-2018.

[2] United States (2017). National Security Strategy of the United States of America, December 2017.