Doctoral Dissertation Announcement (Date: 07/21/2016 at 1:00 pm. Location: E214)

Dissertation Title: **Risk-based Optimization Models for Maritime Safety and Security**

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Considering that unprotected assets and infrastructures in the Maritime industry are vulnerable to attacks, we present models and methodologies for protecting these maritime resources from malicious or terrorist attacks. Using risk-based analysis, we use conditional probabilities to establish relationships between consequences, vulnerabilities and threat incidences of maritime events.

In the first part of this dissertation, we address safety/security of maritime assets. We consider vessel routing and scheduling in LNG vessels as a hazardous cargo, and present a risk-based methodology in the choice of alternate vessel routes between a liquefaction terminal and receiving depot(s). While derivations are presented for the quantification of each constituent of the risk-based model, actual historical data of terrorist/piracy attacks made available by a national consortium on the study of terrorism are used in the analysis approach. With a multivehicle routing model, we test our methodology and present results using a practical test case involving delivery of LNG cargo.

In the second part of this dissertation, we address safety/security of maritime infrastructures and use placement of underwater sonars for threat detection. Models and algorithms are developed for providing surveillance to maritime infrastructures such as ports, harbors, jetties, etc. In addition to a general quantitative risk approach, the methodologies in these models include a fortification approach, a greedy-based heuristic approach, and a robust optimization approach. The fortification approach considers the ability of an intending *'attacker'* to possess information related to resource limitations and protection procedure of a *'defender'*. In developing greedy-based algorithms to solve large scale problems in our placement methodology, we exploit the principle of submodularity to propose efficient solution algorithms with some theoretical guarantees. Lastly, we developed a robust formulation for our placement methodology to address uncertainties related to some modeling parameters. To illustrate that the new sonar placement methodologies developed help to improve protection coverage plans for maritime infrastructures, we use practical case studies to provide safety and security to ports. In addition, we provide analytical and experimental results on each of these studies.