2016

Application of Model-Based Systems Engineering (MBSE) to Compare Legacy and Future Systems in Mine Warfare (MIW) Missions

Paulo, Eugene; Beery, Paul

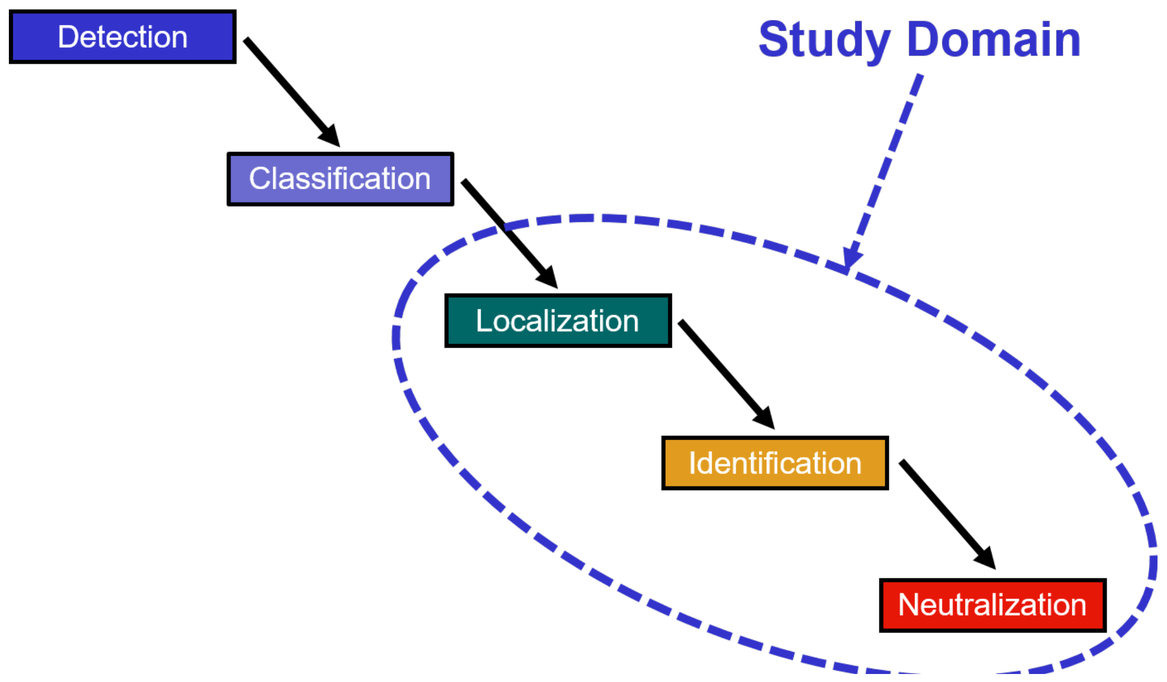
Monterey, California. Naval Postgraduate School

Application of Model-Based Systems Engineering (MBSE) to Compare Legacy and Future Systems in Mine Warfare (MIW) Missions

Naval Postgraduate School

Project Summary

This research analyzes the expected mine countermeasures (MCM) performance of legacy and emerging mine neutralization systems on multiple platforms. The study focused on three measures of effectiveness (MOEs): mission time, weapon expenditures, and mission effectiveness. Using an operational simulation, the team determined which configuration variations of these systems on supported platforms appeared to be the most effective.



The Mine Neutralization Continuum

Study Focus

This study focused on the Localization, Identification, and Neutralization (L-I-N) segment of the mine neutralization continuum (see figure above) for current platform/ system configurations, and also for proposed combinations, under a range of field configuration and environmental conditions to investigate the following study questions:

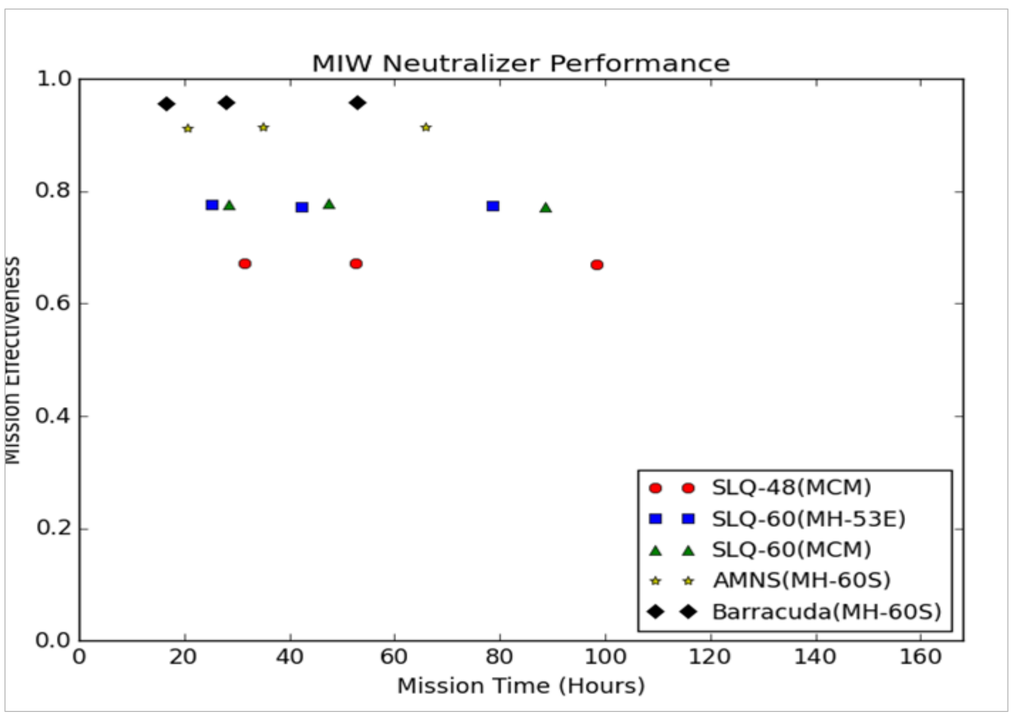
- What configurations, using current neutralization systems and platforms, are most effective (fastest) in clearing a minefield?
- What configurations, using current and / or proposed neutralization systems and platforms, are most effective (fastest) in clearing a minefield?
- What individual platform or neutralization system performance parameters (i.e. range, speed, probability of kill, etc.) have the greatest impact on the efficacy of current or proposed operational scenarios?

Findings and Conclusions

Platform	Mine Neutralization System (MNS)
MCM-1 Avenger Class Ship	AN/SLQ-48 Mine Neutralization System
MH-53E “Sea Dragon” Helicopter	AN/SLQ-60 Sea Fox
Littoral Combat Ship (LCS)	AN/ASQ-235 AMNS Archerfish
MH-60S "Knight Hawk" Helicopter	AMNS Barracuda *(Future System)*

Using a simulation built with the Python programing language (Python Software Foundation, https://www.python.org), models representing mine fields of varying target density, depth, type, and environmental conditions were created to test each operational combinational variant of the platform and MNS.

This analysis allowed for determination of the efficacy of each type of operational scenario as illustrated in the figure below.



Neutralizer Performance

Findings and Future Work

Overall, analysis shows a significant performance increase from aerial-deployed neutralizers and those deployed simultaneously in parallel configurations due to the decreased mission time required to clear a given minefield. Future work should include the expansion of this model, and input variables used to represent neutralizer and platform capabilities should be set as constants representing the actual capabilities of the neutralization systems reviewed in this report. This information and the associated result would, however, require a classified environment

Researchers Names: Eugene Paulo, Paul Beery
NPS School: GSEAS
Topic Sponsor Organization:
OPNAV N952C

IREF ID Number: NPS-N16-N264-A
Title: Application of Model-Based Systems Engineering (MBSE) to Compare Legacy and Future Systems in Mine Warfare (MIW) Missions