2022

Advancing the Application of Design of Experiments (DOE) to Synthetic Theater Operations Research Model (STORM) Data

Sanchez, Susan M.; Lucas, Thomas W.; Upton, Stephen C.; McDonald, Mary L.; Hernandez, Alejandro S.; Morgan, Brian L.; Barreto, Jane F.

Monterey, California: Naval Postgraduate School

https://hdl.handle.net/10945/71898

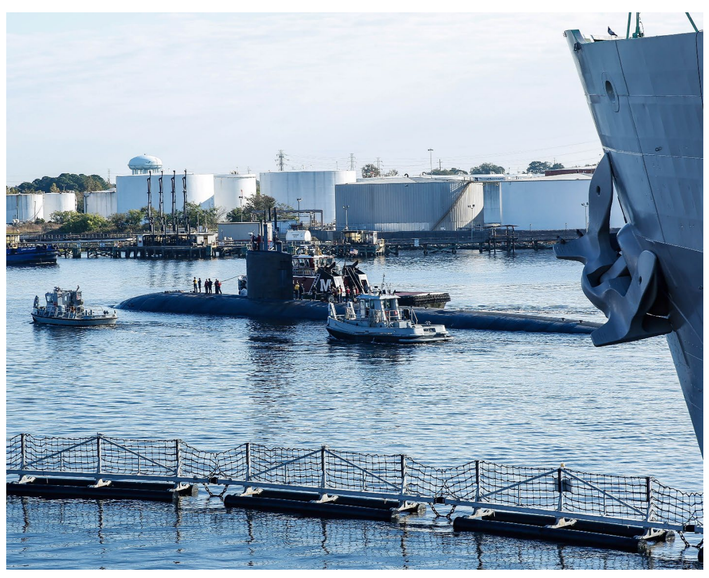
Advancing the Application of Design of Experiments to Synthetic Theater Operations Research Model Data

Naval Postgraduate School

Project Summary

- Simulation-based campaign analysis is used to measure risk for Navy investment options on how best to equip, organize, supply, maintain, train, and employ our naval forces.
- Building, testing, running, and analyzing these in STORM is a complex, time-consuming process.
- Navy leadership is interested in initiatives that might increase the responsiveness of campaign analysis.

The Synthetic Theater Operations Research Model (STORM) is a stochastic simulation model used to support campaign analysis by the U.S. Navy, Marine Corps, and Air Force.



https://www.navy.mil/Resources/Photo-Gallery/igphoto/2002887648/

(US Navy photo by Aldo Anderson)

Design of Experiments (DOE)

- Design points (DP) specify the combinations of settings for the factors of interest within a designed experiment.
  - Major DPs, such as those reflecting qualitatively different operational policies or C2 plans, require a significant investment in analysts' time and computing resources.
  - Minor DPs involve changes to quantitative inputs that are more straightforward to articulate and implement, such as quantitative model inputs that can vary over specified ranges.
- There are limits on the number of these "major" DPs that can be produced, executed, and analyzed during a study's timeframe. DOE is an efficient and effective way to explore alternatives for complex simulation models.

Recommended Methodology

- A sequential approach could suggest future "major" DPs that involve inputs that are difficult to change.
- A comparative approach can be used to aid in verification & validation efforts, and to help identify reasonable factor ranges or levels.
- A focused approach involving one or more existing DPs could provide guidance on appropriate metrics, factor ranges or levels, or sensitivities to components or data provided by others.
- These approaches should be applied to a classified study so we can collectively learn how best to use state-of-the-art DOE methods to complement traditional baseline and excursion modeling.

SEED Center for Data Farming
Simulation Experiments & Efficient Designs
Naval Postgraduate School
https://harvest.nps.edu

The SEED Center's mission – make modeling and simulation more effective for decision makers

Future research

Further research is needed to address the needs of senior leaders who use models (such as campaign models) where some of the design points are difficult to instantiate. For example, some design points might reflect qualitatively different operational policies or command and control plans, and consequently have a long lead time and high cost.

A better understanding of how designed experimentation can complement the traditional baseline and excursion modeling process merits further research.

This may also reveal gaps in existing DOE methods that merit further research.

Researchers: Distinguished Professor Susan M. Sanchez, Professor Thomas W. Lucas, Research Associate Mary L. McDonald, Research Associate Stephen C. Upton
Graduate School of Operational & Information Sciences (GSOIS)

Topic Sponsor: Assessment Division, Navy Headquarters Staff (OPNAV N81)

NRP Project ID: NPS-22-N224-A

This research is supported by funding from the Naval Postgraduate School, Naval Research Program (PE 0605853N/2098). Approved for public release; distribution is unlimited.