2014

High Power Radio Frequency (HPRF) Dynamic Surface Engagement M&S Tool, Phase 1

Blais, Curtis

High Power Radio Frequency (HPRF) Dynamic Surface Engagement M&S Tool, Phase 1

Project Abstract

High Power Radio Frequency (HPRF) weapons are being developed for the US Navy. To assess the utility of potential of these systems for surface Navy applications, a tool is required to simulate dynamic aspects of vessel versus vessel engagements to evaluate their effectiveness and the development of optimum concepts of employment. Such development may be aided by the use of modeling and simulation software capable of modeling the engagement of the HPRF platform and the threat in surface engagement scenarios. This project is a Small Business Innovative Research (SBIR) award to WarpIV Technologies (http://www.warpiv.com) in San Diego, CA, with NPS as part of the project team providing multi-disciplinary technical expertise across modeling, environmental effects, visualization, statistical analysis, and HPRF physics. WarpIV will employ its high-speed, distributed simulation software as the underlying code base for the project. The MOVES Institute will provide technical consultation together with coordination and liaison with other disciplines at the school.

Sponsor
NRL

Principal Investigator(s)
Curtis Blais

Point of Contact
Curtis Blais
clblais@nps.edu

High Power Radio Frequency (HPRF) Dynamic Surface Engagement Modeling and Simulation Tool, Phase 1

Abstract: High Power Radio Frequency (HPRF) weapons are being developed for the US Navy. To assess the utility of potential of these systems for surface Navy applications, a tool is required to simulate dynamic aspects of vessel versus vessel engagements to evaluate their effectiveness and the development of optimum concepts of employment. Such development may be aided by the use of modeling and simulation software capable of modeling the engagement of the HPRF platform and the threat in surface engagement scenarios. This project is a Small Business Innovative Research (SBIR) award to WarpIV Technologies (http://www.warpiv.com) in San Diego, CA, with NPS as part of the project team providing multi-disciplinary technical expertise across modeling, environmental effects, visualization, statistical analysis, and HPRF physics. WarpIV will employ its high-speed, distributed simulation software as the underlying code base for the project. The MOVES Institute will provide technical consultation together with coordination and liaison with other disciplines at the school.

Sponsor: Office of Naval Research

MOVES Principal Investigator: Curtis Blais

1.0 INTRODUCTION

High Power Radio Frequency (HPRF) weapons are being developed for the US Navy. To assess the utility of potential of these systems for surface Navy applications, a tool is required to simulate dynamic aspects of vessel versus vessel engagements to evaluate their effectiveness and the development of optimum concepts of

employment. Such development may be aided by the use of modeling and simulation software capable of modeling the engagement of the HPRF platform and the threat in surface engagement scenarios.

The simulation tool should account for environmental conditions. This includes sea state, fog, and rain that could influence the propagation of the HPRF beam as well as mobility and visibility. Such conditions could be significant contributors to the utility of a system. Unless proven otherwise, the modeling should be a combination of user driven and agent-based simulation (ABS) control of objects and events. Innovative research and development is needed in ABS methodology to develop the capability to accurately explore the statistical space for the user.

To aid in the degree of realism and the rapid conveying of engagements, realistic objects need to be included in the simulation. A library of 3-Dimensional objects to be used in the simulation should be included. This includes boats, ships, ports, UAVs, and USVs. Software for the conversion of 3D models to the type used in the simulation tool should be included in the software suite so that available models from other libraries may be imported into the simulation tool. In addition, software enabling the inclusion of topology from freely available sources such as Google maps or other sources should be part of the software suite. The tool should also have the ability to modify this topology.

In Phase I, the basic ABS system involving a ship and small boat attackers shall be developed using existing ABS software. The HPRF system shall be implemented and shall include the RF multipath effect. The weapon should be paired with a sensor agent on the ship that controls the detection of threats. The key part in Phase I is describing the proposed optimization algorithms that will be developed in the follow-on phases. The methodology should be described and demonstrated sufficiently to be able to estimate the computer resources that will be required for full implementation. This phase should also include the development of user friendly GUIs that employ natural language and military terminology for scenario development. It is not expected that the natural language function be completely implemented, but that the capability is demonstrated sufficiently so that estimates may be made of the computer resources required for full implementation.

Scenarios to be tested include: (1) attack by a single exploding boat, posing as a noncombatant, and (2) a swarm of 5 attacking boats. Displays should be able to show a planar view of developing movements at selected timescale. Views from selected agents are also useful. Simplified agent models may be employed but capability of expansion to full capability modeling needs to be demonstrated. The optimization algorithm will be demonstrated. Recommended hardware to host the development package shall be described. Estimates of computer resources for the full model shall be conducted. Successfully demonstrating feasibility in this restricted model will be the criteria for Phase II selections.

2.0 SCOPE

Provide technical expertise in engagement modeling, agent-based simulation, statistical analysis, 2D/3D visualization, and environmental data, analysis, modeling, simulation, and impacts assessment with the purpose of advising the prime contractor on models, methods, and tools for specifying functional requirements and technical design of the HPRF dynamic surface engagement M&S tool.

3.0 TECHNICAL REQUIREMENTS FOR PHASE 1

NPS shall perform the following tasks:

1. Provide technical advice on weapon system performance characteristics and modeling, including tactical considerations in engagement modeling.
2. Provide technical advice on design and development of the ABS portion of the tool to represent entities, behaviors, and effects.
3. Provide technical advice on relevant approaches for environmental data, analysis, modeling, simulation, and

impacts assessment. Provide a technical foundation for the design, development, testing, and validation of the environmental inputs to the tool in later phases of the project.

4. Provide technical advice on 2-dimensional and 3-dimensional visualization techniques and models for integration into a prototype version of the tool.
5. Provide technical advice on integration of statistical data processing and analysis techniques for efficient exploration of the multi-dimensional response surface from the simulation computations.
6. Provide technical and management liaison and coordination with the prime contractor. Provide technical and financial progress/status reports as required. Coordinate and prepare final deliverables to the prime contractor.

4.0 DELIVERABLES

The following deliverables will be provided from the work performed in concert with the prime contractor:

1. Phase 1 software products. Due: At end of Phase 1 tasking.
2. Informal technical report describing Phase 1 technical approach and progress, and provides a plan of action for an optional Phase 1 extension and Phase 2. Due: At end of Phase 1 tasking.
3. Monthly written technical progress and financial status reports. Due: End of first full month of project performance; end of each month thereafter to end of Phase 1 tasking.

*Period of Performance:*Jan 2014 to Apr 2014
*Tags:*Modeling, Simulation, US Navy
*Focus Area:*Simulation Modeling for Analysis