Department of the Navy SBIR/STTR Transition Program

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NAVSEA #2019-0577

Topic # N171-052

System for Naval Data Aggregation and Planning with Probabilistic Reasoning (SNAPPR)

Charles River Analytics Inc.

WHO

SYSCOM: NAVSEA

Sponsoring Program: PEO IWS 1.0 NSWC Port Hueneme

Transition Target: Aegis Weapons System SPY-6 Radar

TPOC:
(805)228-0553

Other transition opportunities: Enterprise Air Surveillance Radar (EASR) and Ship's Signal Exploitation Equipment (SSEE) system

Notes: As an example of an alternate SBIR transition path successfully pursued on another program, Charles River developed a tool that detected and displayed alerts on health and status data collected from two ships in near-real time (Contract Number N68335-18-C-0358) and guided naval operators in locating the root cause of system level faults. The tool eventually underwent a successful integration on board the Ship Signals Exploitation Equipment (SSEE) system, and is still in use with NWIC pacific.

United States Navy image 031109-N-9769P-076 available at https://www.navy.mil/management/photodb/webphoto/web_130515-D-ZZ999-005.jpg

WHAT

Operational Need and Improvement: Large amounts of data warehoused offshore and directly on ships can be leveraged in conjunction with Machine Learning techniques to improve preventative and corrective maintenance of the Navy's Aegis Weapons System. Our System for Naval data Aggregation and Planning with Probabilistic Reasoning (SNAPPR) is a hardware health-monitoring tool that provides real time prediction of faults and system health. It uses these predictions to recommend maintenance actions that enhance mission readiness and control costs.

Specifications Required: To improve the maintenance of Aegis Weapons System, SNAPPR must first parse through large amounts of unstructured data from 2Kilo Logs. These data sources must be aligned and fused with structured data sources that come directly from hardware sensors to obtain a comprehensive understanding of the hardware's current state and behavior. Next, SNAPPR must be able to estimate and predict the Operational Availability (Ao) of the hardware in real time, and use those predictions to infer the remaining useful life of the hardware system. Finally, SNAPPR must optimize the preventative maintenance schedule to maximize the long term Ao of the hardware system while simultaneously minimizing cost and time to repair and replace a component.

Technology Developed: SNAPPR parses unstructured data from 2Kilo Logs by leveraging Natural Language Processing (NLP) techniques. The structured and unstructured data sources are then fused using a multi-stream computing platform. SNAPPR then uses the fused data to train a Model of the hardware system, which then predicts Ao in real time given new sensor and 2Kilo data. SNAPPR then uses these Ao readings as an objective function for our multi-objective optimization algorithm that leverages heuristic search techniques to find an optimal maintenance schedule.

Warfighter Value: SNAPPR's ability to improve preventative and corrective maintenance will yield immense savings in resource, both physical and temporal. For a complex sub-system like the SPY-6 radar, choosing to replace or repair the component that maximizes Ao in the long term will not only reduce time spend on maintenance but also improve the performance of the radar. SNAPPR will also drastically improve mission readiness, as shipboard operators will have greater confidence that all components are operating appropriately and will have a better understanding of how they should maintain and replace components to ensure long term Ao.

WHEN

Contract Number: N68335-19-C-0116 **Ending on:** January 9, 2020

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Design and evaluate proof of concept prototype	N/A	Proof of concept of real time Ao prediction	3	January 2018
Develop and evaluate full-scope prototype in simulated environment	Low	Performance evaluation of real time Ao prediction and Optimization	5	January 2020
Field test prototype on Navy platform in an operational scenario (if option is exercised)	Med	Performance requirements met in an operational scenario	7	August 2020
Transition technology into PEO IWS 1.0 program and/or integrate with commercial platform (if option is exercised)	Med	Operational requirements met in a developmental test vessel or equivalent real world system	8	January 2021

HOW

Projected Business Model: Charles River has over 30 years of steady growth providing innovative, cost-effective solutions through intelligent systems R&D. Over 100 Charles River projects have produced a wealth of advanced-technology prototype software that can facilitate the rapid integration of critical technology into operational systems. Charles River will license the SNAPPR technology to large system integrators and integrate into Navy platforms, such as EASR and SSEE. Once integrated, Charles River will provide users with full documentation on how to use features of SNAPPR. For example, we have licensed our VisionKit ®, partly funded by DoD and NASA SBIRs, to developers of image and video analysis solutions.

Company Objectives: Health monitoring, condition based maintenance and machine learning are core business areas for Charles River, making the success of this effort fall squarely within our corporate interests and competencies. Charles River expertise will ensure the success of the innovations developed under the SNAPPR program beyond the SBIR contract. In particular, Charles River plans to pursue a multi-part plan to transition this technology to the U.S. Navy and other U.S. Government customers, as well as provide benefits to commercial markets and customers seeking to improve maintenance efficiency and increase up-time during critical operating conditions.

Potential Commercial Applications: We expect the full-scope SNAPPR to have immediate and tangible benefits for a number of commercial systems that require regular maintenance and repair, such as the automotive, transportation, and biomedical sectors. We will develop a broad commercial product for diagnostics and prognostics of industrial machinery systems. In particular, SNAPPR will help reduce overhead and costs associated with maintaining complex hardware systems on board the Aegis Weapons System and enable them to maximize Ao in both the short and long term. Maximizing Ao will enable naval operators to execute mission-critical tasks without fear of unexpected component failures or degradations.

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