Department of the Navy SBIR/STTR Transition Program

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ONR Approval #43-8743-21

Topic # N181-077

Surf Zone Simulation for Autonomous Amphibious Vehicles

Dynamic Dimension Technologies

WHO

SYSCOM: ONR

Sponsoring Program: ONR Code 331 Advanced Naval Platforms

**Transition Target:** Future autonomous landing craft and amphibious vehicle programs for the Navy and USMC

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Other transition opportunities:
• Water craft launch and recovery
• Unmanned Systems launch and recovery
• Autonomy systems development for land, sea and air systems
• Manned-Unmanned Teaming
• Littoral Operations
• Interactive Synthetic Environments
• Digital Twin, Smart Bases and Smart Facilities

Notes: VxSIM designed with a multitier software architecture and integrated with autonomy software via the Robotic Operating System (ROS), provides an *accurate, scalable and flexible interactive simulation environment for new technology risk mitigation, CONOPS development and acquisition support.* VxSIM can support many on many simulations for collaborative operations, formation maneuvers, swarming behaviors and manned-unmanned teaming in complex environments such as surf zones, off-road and urban regions.

VxSIM – Interactive Simulation Framework
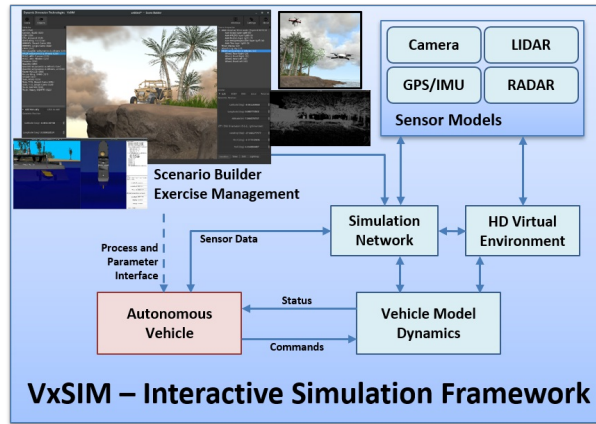
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WHAT

Operational Need and Improvement:
The Navy is accelerating autonomy capabilities for landing craft and amphibious vehicles with a focus on complementing experimentation with simulation. A major challenge of these vehicles is operating from the sea through the surf zone. A realistic simulation environment which provides appropriate sensor feedback and vehicles motions for software-in-the-loop testing is needed.

Specifications Required:
The simulation environment must:
• Represent the sea surface, breaking waves, bathymetry and beach/landing zone characteristics
• Characterize sensor performance in visual, thermal, and radar bands
• Describe underwater features such as bottom types and depth in the acoustic and visual spectrum
• Incorporate static and moving obstacles on the surface and submerged
• Incorporate realistic vehicle response model for wave, surf, and bottom interactions
• Allow for modular autonomy components such as sensors, fusion, path planning, obstacle avoidance, and low-level vehicle controls to be incorporated and executed by the vehicle under simulation

Technology Developed:
Dynamic Dimension Technologies (DDT) is developing the Water incorporated, Autonomy enabled Virtual vehicle testing Environment (WAVE) module for our Virtual experimental Simulation environment (VxSIM). VxSIM is a high-fidelity, multi-physics-based simulation framework which provides the ground-truth, labeled data required to test and train autonomy and artificial intelligence algorithms and systems in the loop.

Warfighter Value:
Navy gains an accurate, high-fidelity interactive simulation environment for the littoral domain that can be used to develop, test and train autonomy enabled systems for land, air, sea and undersea operations. The Warfighter benefits from more robust autonomy systems, improved search and surveillance effectiveness and more accurate decision making tools.

WHEN

Contract Number: N68335-20-C-0107   **Ending on:** December 4, 2021

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Surf zone interface framework	Low	Demonstrate framework for ocean waves	3	3rd QTR FY20
Amphibious vehicle physics model	Low	Demonstrate amphibious vehicle with hydrodynamics and terrain interactions	3/4	3rd QTR FY20
Robotic Operating System integration	Low	Demonstrate ROS client/server data transmission	3/4	4th QTR FY20
Autonomy System Integration	Low	Integrate with Navy's autonomy system	4/5	4th QTR FY20
Breaking wave visualization	Med	Demonstrate breaking waves rendered in visual and sensor modes	5/6	1st QTR FY21
Soft soil and tracked vehicles	Med	Demonstrate tracked vehicles and soft soil models	6	1st QTR FY22

HOW

Projected Business Model:
DDT is proud to support the Navy, Army, Air Force and commercial sector with the development of high fidelity Modeling and Simulation applications, including VR, AR and Model-based Systems Engineering solutions. Our innovations include AI, Blockchain and Cloud-based applications for data analytics and security, and transfer learning technologies.
DDT intends to market VxSIM in support of Autonomous Vehicle, sensor fusion and AI testing and algorithm training for Government and Commercial applications. VxSIM will be license managed. DDT will provide service support, training, custom model development and integration with hardware or software in the loop. We will also provide independent system testing for performance and behavior analysis to support system certification and safety requirements.

Company Objectives:
DDT was founded with a vision of applying innovative research and development technologies to benefit the broader community. Our mission is to add value to our clients and the community as a whole. Our objective is to leverage our research in the field of digital connected and virtual environments, to aid development of applications that improve emergency response, increase safety, reduce environmental impact, reduce costs for maintenance, planning, and much more. We are interested in discussing this technology with PEO USC for applications with littoral craft.

Potential Commercial Applications:
• Automotive autonomous vehicle development
• Off-shore oil and gas
• Digital Twin and Smart Cities
• Connected Automated and Autonomous Vehicle infrastructure
• Renewable energy such as wave energy harvesting

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