Navy/USCG Scenario-Based Planning using SPIDERS3D Collaborative Visualization

*Notional Concept Study and Scenario Exploration*

**Maritime Risk Symposium (MRS) 2019**
Strategic Foresight **Evergreen Program**
SUNY Maritime University, Bronx NY
13-15 NOV 2019

Don Brutzman Ph.D., LCDR USN (Ret.)
Naval Postgraduate School (NPS)
Event

**Maritime Risk Symposium (MRS) 2019**

- MRS 2019 will bring together academics, government, and commercial entities to discuss the threats, challenges, and risks associated with the Marine Transportation System, both internationally, and domestically. With a focus on the articulation of current and future marine transportation challenges and threats, the symposium will outline the implementation and operationalization of a sound marine transportation strategy. The symposium will assess threats, vulnerabilities, and recent advancements in research to inspire ideas for innovative research that will help define the next evolution within marine transportation.

**Evergreen Program, USCG Strategic Foresight Initiative**

- The Evergreen Program is the Coast Guard’s Strategic Foresight Initiative, tasked with looking over-the-horizon to inform current planning and better prepare the Coast Guard for an uncertain and unpredictable future. Through the use of scenario-based exercises and workshops involving a diverse group of stakeholders, common strategic needs or key success factors can be identified across multiple plausible scenarios to better inform long-term strategic planning efforts.

Naval Postgraduate School (NPS)

About NPS
• The mission of the Naval Postgraduate School is to provide relevant and unique advanced education and research programs to increase the combat effectiveness of commissioned officers of the Naval Service to enhance the security of the United States.
• Numerous USCG officers, civilians have performed graduate study at NPS.
• 30+ curricula include Center for Homeland Defense & Security (CHDS)

Memorandum of Understanding (MOU)
• Dr. Joe DiRenzo of USCG Research and Development Center
• Dr. Jeff Paduan, NPS Dean of Research
• Six USCG students currently on board in Monterey California
Technology

• NAVFAC SPIDERS3D
  • Virtual infrastructure for Naval ports worldwide, via shared central https server
  • Users can collaboratively create, share, explore, annotate persistent scenes
  • Buildings, piers, pilings data converted into X3D from current database records

• Web3D X3D Standard for http server to Web browsers
  • Web-based architecture: HTML pages with images and JavaScript controls
  • Extensible 3D (X3D) Graphics International Standard, Web3D Consortium
  • 3D models from any source format can be exported, published as X3D
  • Open source and open standards throughout, no commercial licenses

• Deployed, available across both NMCI and public Internet
  • Requires CAC access and prior account approval, use any time
Getting a SPIDERS3D Account

SPIDERS3D Program Manager: Alex Viana, NAVFAC Headquarters.

Please apply for SPIDERS3D account first, CAC then required for entry. Account-application slides attached.

Background information

- SPIDERS3D #X3D Virtual Environment at ASNE Symposium, October 2018
- Naval Facilities Command (NAVFAC) Asset Management: SPIDERS3D
- SPIDERS3D Fact Sheet and SPIDERS3D Frequently Asked Questions (FAQ)
Prior X3D Modeling Work: NPS Thesis for USCG

Modeling, Simulation, and Visualization for Submarine Transit Security and Coast Guard Contingency Preparedness


- Abstract. The U.S. Navy’s Strategic Systems Program (SSP) and the U.S. Coast Guard (USCG) Maritime Force Protection Unit (MFPU) have a close working relationship, access to advanced Modeling and Simulation (M&S) tools, and a mutual interest in the safe escort of naval submarines. The USCG Contingency Preparedness and Exercises (CPE) Branch has a strong interest in maritime security, which extends to the safe navigation of vessels in U.S. territorial waters, including naval submarines. CPE rarely interacts with SSP and the MFPU; further, CPE does not have access to modern M&S tools. The goal of this thesis is to demonstrate that SSP and MFPU can greatly increase maritime security in the littoral waterways used by submarines and other naval vessels by partnering with CPE. A mixed method approach was used to provide an overview of existing maritime security roles and partnerships, and a 3D-simulation experiment was also developed to demonstrate how CPE can enhance exercises by utilizing robust 3D M&S resources.

- This thesis establishes that CPE can drastically improve maritime security and other missions by leveraging M&S and Visualization tools. The thesis also found that by partnering with SSP and the MFPU, CPE can accelerate maritime security improvements.

- https://calhoun.nps.edu/handle/10945/45872
Prior Work, Heron Thesis 2015: X3D Models in NPS SavageStudio Tool
Naval Program of Interest

• Navy contracted Boeing for multiple ORCA XLUUV vehicles
  • Navy Awards Boeing $43 Million to Build Four Orca XLUUVs, Ben Werner, USNI News, 13 FEB 2019
  • “launch from pier, operate autonomously”

• Multiple stakeholders, program scope has shared attention
  • NAVFAC HQ and Engineering & Expeditionary Warfare Center (EXWC)
  • NAVSEA PEO USC, PMS 406, Unmanned Maritime Systems
  • Commander Operational Test and Evaluation Force (COMOPTEVFOR)

• This concept study considers potential suitability of mixed-use military commercial harbor in Port Hueneme CA.

• Would require handling procedures, ashore maintenance, etc.

• Future challenges face port activity with large-scale robots.
Potential Scenario for Consideration

Notional Partnered Mission
- USN+USCG escort of Orca XLUUV from Port Hueneme CA berth to get underway past Channel Islands and 12-mile limit to open ocean.

Shared Asset
- Use SPIDERS3D to storyboard, plan, coordinate and visualize partnered operations among multiple essential participants.

Goals
- Safe operation through busy commercial port and shipping channels.
- Understand diverse communications and passage requirements.
- Anticipate special protection requirements for coordinated response.
USCG Station Channel Islands Harbor (STA CIH)

- CG District Eleven (D11)
- USCGS BLACKTIP [en.wikipedia.org/wiki/Marine_Protector-class_patrol_boat](http://en.wikipedia.org/wiki/Marine_Protector-class_patrol_boat)
Storyboards, 3D Models, Snapshots

Useful techniques for group collaboration on a shared story:

• List steps for RDVU, getting underway and escorting to sea.

• What coordination requirements are needed for each step?

• What’s wrong (or what’s missing) from these pictures?

• Use: quick looks, operational prebriefs, after-action reports.

Currently 30+ SPIDERS3D Sites
American Samoa
Bahrain
Bangor WA
Bremerton WA
Earle NJ
Everett WA
Guam
Gulfport MS
Pearl Harbor Hawaii
Indian Island WA
Key West FL
King's Bay GA
Little Creek VA
Malaysia
Maritime Plaza WNY DC
Mayport FL
New London CT
Norfolk VA
Portsmouth VA
Panama City FL
Patuxent River MD
Pensacola FL
Point Mugu CA
Port Canaveral FL
Port Hueneme CA
Rota Spain
Sasebo Japan
Seal Beach CA
Singapore
Southeast Bay Greece
Yokosuka Japan
USCG Station
Notional UUV Berth
X3D Resources:
Conversions and Translators

Converted from CAD STEP model by Kshell tool

X3D Resources:
Conversions and Translators
Wondering: is pilot needed for this large robot during transit?
Modeling work in progress using Navy data and other datasets

Development by Synergy Software Design and Versar
High-fidelity terrain + bathymetry mashups (1m DEM)
3D As-Built of MV INDEPENDENCE

3D Scanning by AerialAlchemy for Naval Surface Warfare Center Port Hueneme Division
Storm surge changes in sea level can be shown

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<td>1 m MLLW</td>
<td>2 m MLLW</td>
<td>2.5 m MLLW</td>
<td>3 m MLLW</td>
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Future mashups: let’s hook things together

NOAA Tide Predictions/9411065 PORT HUENEME, CA

2 m MLLW

1 m MLLW

MLLW
SPIDERS3D Work in Progress for 2020+

- Interfaces for storyboard vignette construction, visualization, reports.
- Upload/download of X3D models/metadata for SPIDERS3D publication.
- Further 3D modeling of ships, aircraft, ports, harbors, islands worldwide.
- Inclusion of prerecorded X3D playback from other animation streams.
- Add Live Virtual Constructive (LVC) data streaming via IEEE DIS Protocol.
- Advancement of Extensible 3D (X3D) Graphics Standard to v4.0 HTML5.
- Interoperability with X3D Model Exchange for Navy/Marine Makers.
- Designing, building, using a Virtual Sand Table for tabletop exercises.
- Compatible 3D scanning, correlation, and comparison of ship topsides.
- Further collaboration? Fleet users will discover their own innovations.
Proposed work

- “Front door” to upload/download printable X3D models
- Vertical projector can create repeatable “virtual sand table”
SPIDERS 3D
Geo-Enabled Model-Based Visualization and 3D Communication Tool

Connect via the web across the enterprise and collaborate real-time in 3D

Account holders can login at https://spiders.navfac.navy.mil

Multi-user 3D whiteboard to accelerate speed of shared knowledge and consensus
Requesting NAVFAC Portal account to access SPIDERS 3D (DOD PKI required)

1. First go to: [https://www.navfac.navy.mil](https://www.navfac.navy.mil)

2. Click on “Employees”

3. Click “Request an SSO…”

4. Fill out required fields. Please use one of the following NAVFAC IPS team members as portal account sponsors:
   - Alex Viana, alex.viana@navy.mil, 202.685.9259
   - Gerritt Lang, gerritt.lang@navy.mil, 805.982.2736

5. You will receive a “NAVFAC SSO Registration Confirmation” E-mail. Go to the link to complete, then wait for your sponsor to approve. You will receive an E-mail confirming approval.

6. Once approved, you will be able to login to NAVFAC portal and access SPIDERS 3D using the Mozilla Firefox web browser:
   - Link to SPIDERS 3D eTool on NAVFAC Portal: [https://spiders.navfac.navy.mil](https://spiders.navfac.navy.mil)
Important references of related interest

Department of Defense [Digital Engineering Strategy](#), June 2018

- “The goals promote the use of digital representations of systems and components and the use of digital artifacts as a technical means of communication across a diverse set of stakeholders.”
- “This approach can enable DoD programs to prototype, experiment, and test decisions and solutions in a virtual environment before they are delivered to the warfighter.”

Department of Navy [Business Operations Plan](#), FY 2020-2022

- “DESIGN AN INTEGRATED NAVAL FORCE STRUCTURE. In FY20, develop a fully integrated Department of the Navy and Industrial Base Management Plan for a modern, integrated naval force and supporting infrastructure capable of global projection, interoperable with partner nations and lethal overmatch from warfighting capability and capacity delivered ahead of global business trends.”
- “Create an integrated priority list of range improvements that leverage live and virtual training and testing solutions to meet range capability requirements and mitigate encroachment.”
Potential for Live Workshop Sessions

These SPIDERS3D collaboration capabilities offer a repeatable pattern for future Evergreen studies.

- ✔ SPIDERS3D introductory discussion with interested parties,
- ✔ NPS prepares X3D storyboard for Port Hueneme scenario,
- ✔ NAVFAC has 30+ harbors and locales available with more to follow,
- ❑ Identify whether a few participants from each study subgroup are willing to get familiarized and "SPIDERS3D qualified",
- ❑ 1-hour online training session before arrival at event,
- ❑ “Prepare to get underway” SPIDERS3D session for participants onsite.
Conclusions and Recommendations for USCG

• Visualizing 3D geospatial relationships is helpful for storyboards.
• Collaboratively exploring locations improves shared understanding.
• Partnered scenario review confirms requirements, expectations, risks.

• Are SPIDERS3D scenario storyboards helpful for Evergreen teams?
• Progress on this open-source open-standards work steadily continues.
• SPIDERS3D feedback, participation, use by USCG is always welcome.
• Keep sending officer and civilian graduate students to NPS!
Contact

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Workshop: Collaborative 3D Visualization for Ashore, Afloat and Expeditionary Readiness

Save the date!
• Friday 6 DEC 2019, 0900-1600
• Virginia Tech (VT), Web3D Consortium
• Organizers Don Brutzman NPS, Nicholas Polys VT, Alex Viana NAVFAC
• Progress showcase: X3Dv4 Standard
• List technical goals for SPIDERS3D distributed virtual environment (DVE)
• Organizers: alex.viana@navy.mil brutzman@nps.edu npolys@vt.edu

• Virginia Tech, Web3D Consortium are hosting a one-day workshop to provide Naval enterprise leaders presentations on collaborative Web-based 3D visualization techniques by Government, Academia, Industry practitioners.
• Demo driven, technology savvy, operational focus, discussion is key
• Provides annual baseline report, sets compelling objectives for 2020