VMASC Digital Shipbuilding Research & Design Innovation Lab

Extended reality, IoT, Data Analytics, & Test Facility for Applications in Shipbuilding and Shipboard Operations

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Virginia Modeling, Analysis and Simulation Center (VMASC)
2017 (FY18) ASD(R&E) Grant Recipient

- Previous NSRP (2017) Establish a technology-rich, research-based, immersive instructional environment
  - 2017 ‘Ship Design and Construction’
    - 2018: Siemens Software Solutions full suite running in a standard browser. Leading edge hardware for metrology e.g. GeoSlam.
  - 2017 ‘Ship Repair and Modernization’
    - 2018: IoT driven environment with AWS, custom sensors, testing and mock up space.
  - 2017 ‘Shipboard Operations’
    - 2018: UX research in utilizing extended reality applications and integrations within existing simulation software package Kongsberg
  - 2017 Marine Electric Propulsion Simulation Lab
    - 2018: Separate facility offsite dedicated industrial space for high electrical load.
  - 2018 Community Outreach / Education Initiatives
    - Brooks Crossing Innovation & Fabrication Learning Lab
VMASC

Virginia Modeling Analysis Simulation Center

- VMASC’s roots in M&S applied research for DoD
- 20 years providing M&S Expertise
- 30+ research professionals and staff
- 100+ million in funding
- Premiere center for M&S worldwide
ODU’s MSVE Program

Modeling, Simulation & Visualization Engineering

- Established M&S degree programs in 1998 (world’s first).
- Currently an ABET-accredited engineering program offering BS, MS, ME, PhD, DEng, and Graduate Certificate (M&S and Cyber)
- 11 full-time faculty and additional faculty/collaborators
- Robust Industrial Advisory Board
- Fundamental and applied research across broad spectrum of MSV&E topics.
LAB Features

- IoT neutral network
- Moveable workstations
- Immersive XR environments
- Shipboard / shipyard mock-ups
- Metrology Scanning equipment
- Advanced motion tracker system
- Dedicated Maker Space
- Web/cloud connectivity / instruction
- Shipboard simulation software integration
- Real scale testing environment
VMASC Digital Shipbuilding R. & D. Innovation Lab

- R&D, demonstrate concepts
- Real-time Data Connectivity
- XR tech ship design, construction, operations and maintenance
- Implementation challenges
- Workforce Development Training
- Expand Education Curriculum
- STEM/STEAM Programs
  - Future Naval Engineering Workforce

Navy Relevance
- ‘Revolution in man + machine cooperation’
  - XR will be one of the HCI interfaces
- Reduce the # of manned operations
  - This requires additional training and simulation experiences which can be offset with XR
- STO’s
  - Improve Cognition
  - Improve Quality of Maintenance
  - Optimized sensor synchronization
  - Enhanced Data Discovery & Access
  - Advanced Data Visualization
Digital Shipbuilding Lab
AWS IoT Steps

- Local Infrastructure
- Dedicated IoT Open Network
- Local sensor management
- Cloud integration
- Simulation / Bridge integration
- Data Storage Plan
- Custom Sensors vs. COTS
Kongsberg Simulation Software

- **Navigation**
  - Ship handling and manoeuvring
- **RADAR/ARPA**
  - Simulated radar:
    - Scan Rate / PRF & pulse length
    - Beam width/noise
- **Dynamic Positioning**
  - Add on interface – part of scalability
- **IoT Integration**
  - Will support data streams from other devices.
  - Custom software managing simulation data and sensor data
- **XR UX Interface**
  - HMD’s utilizing outgoing data to build custom XR interfaces that communicate with the IoT network and the simulation system

**Scalable Solution**

- This package offered scalable solutions in both directions
- Start w/ desktop &/or integrated console
Address XR Implementation Challenges

- Examine current problems of real-time data/environment capture
  - Currently expensive lidar devices are used, but does this level of fidelity really needed in all cases?
  - Can we do this with our phones in our pocket and still retain the level of fidelity we need to suffice the job?

- Using current computer vision repository's to identify objects
  - Some are great at general concepts
  - Does their level of deep neural nets contain a repository of shipbuilding relative objects? Probably not…

Object Recognition

- Current systems are fantastic at the everyday
  - Chairs, tables, people, cars, faces, etc.
  - What about [insert ship part]?
  - What about [insert ship part]?
  - Development of this type of object recognition requires access to relevant data
VMASC Sim Experience Lab

- Integrated power & internet in the ceiling
- Real Scale Equipment
- State of the art Motion Capture System
- Fabrication Lab: large print format, carbon fiber, etc.
- Utilize independent ‘PODS’ for small team break outs
- Regional collaborations for curriculum alignment and career pathways
- Large wireless XR space
- Command & Control simulation
- Moveable Cave Like Setups
- Size and space to Host Different Outreach Events
Enhance ODU Undergraduate and Graduate Curriculum

- Benefit current classes
  - MSIM 441/541
    - Computer Graphics and Visualization
  - MSIM 408/508
    - Serious Game Development (Unity)
  - MSIM 742/842
    - Synthetic Environments
  - MAE 450/550
    - Introduction to Naval Architecture/Shipbuilding
  - MET 475
    - Introduction to Marine Systems
  - MET 476
    - Introduction to Digital Shipbuilding
  - MET 485
    - Marine Maintenance Engineering Management

Existing Classes to be Tailored
- These classes currently operate independently
  - Bring them together through use cases developed around Shipbuilding and XR applications

Develop new UG/G courses
Develop CE courses
2017 STEPS : Results 2018

1. Formalize an Industry Advisory Board for the DS Lab
   1. This has been accomplished by Dr. Michaeli

2. Finalize Design Layout and Equipment
   1. Equipment has been purchased, design implemented, fitting it all together by Q4 2018

3. Build partnerships for research / workforce opportunities
   1. NASA Suits Challenge Sponsorship
   2. Always Ongoing

4. Lab opening in 2018 (Opening Nov ’18)
   1. AWS IoT support: ETA Oct./Nov. ‘18
   2. Simulation software purchase agreement (Oct/Nov ‘18) Install Jan ’19 / Feb ’19
   3. Mock up construction- on going with the fall ODU maritime engineering class
Discussion

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