NPS AUV Workbench: Rehearsal, Reality, Replay for Unmanned Vehicle Operations

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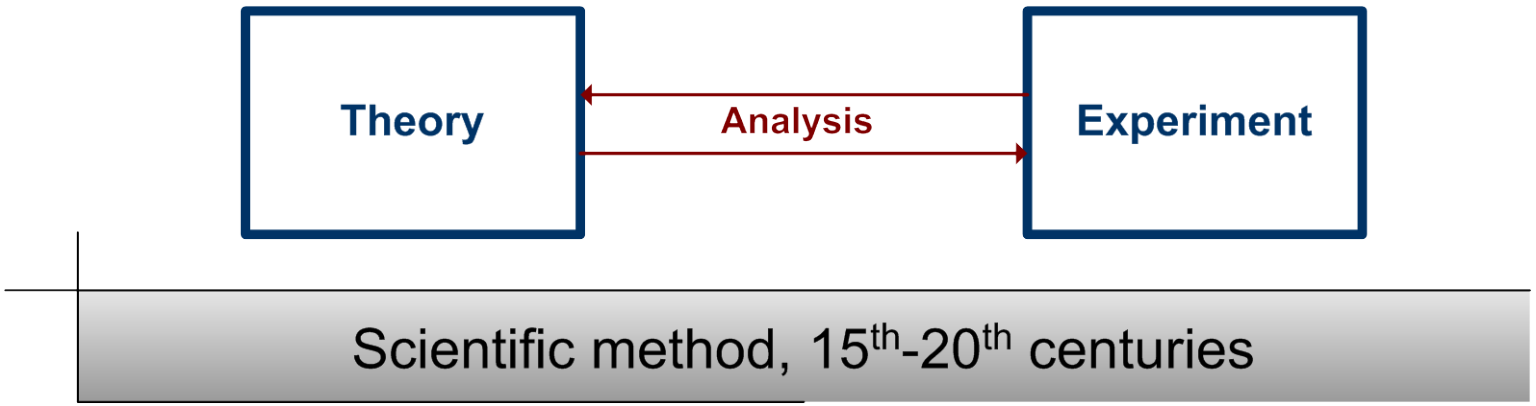
28 April 2011

Topics

- *Why* modeling & simulation?
- AUV Workbench Components
- Sonar Visualization
- Technologies: X3D, XML, XMSF
- Looking ahead
- Demonstrations

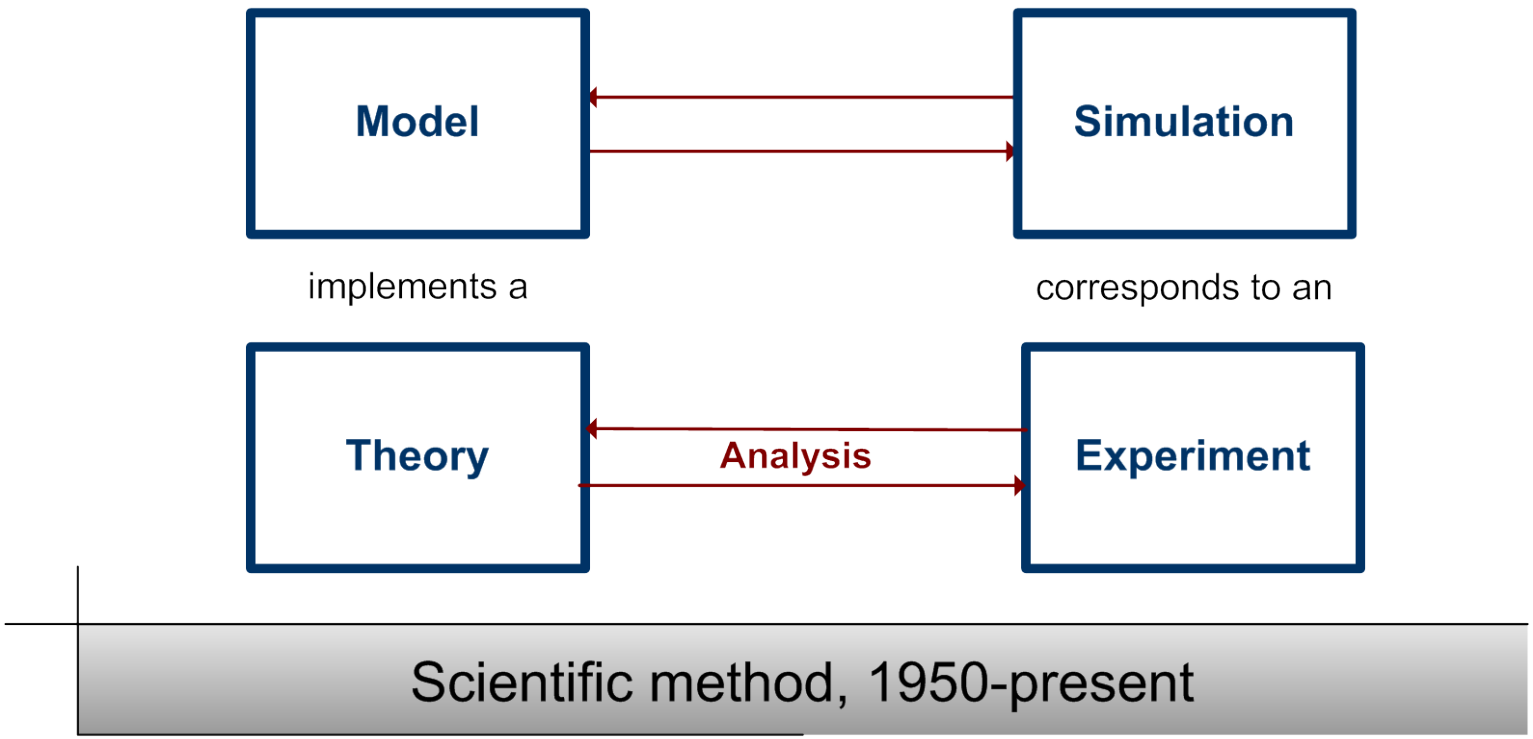
theory = conceptual description of reality

experiment = test theory in physical world



model = formal representation of reality

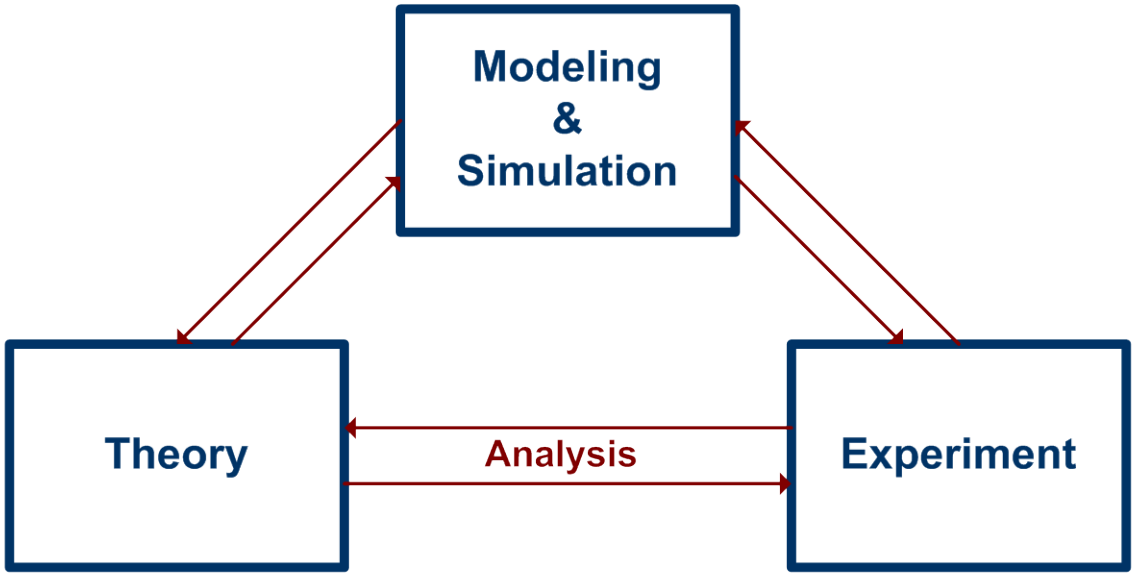
simulation = behavior of model over time



running together

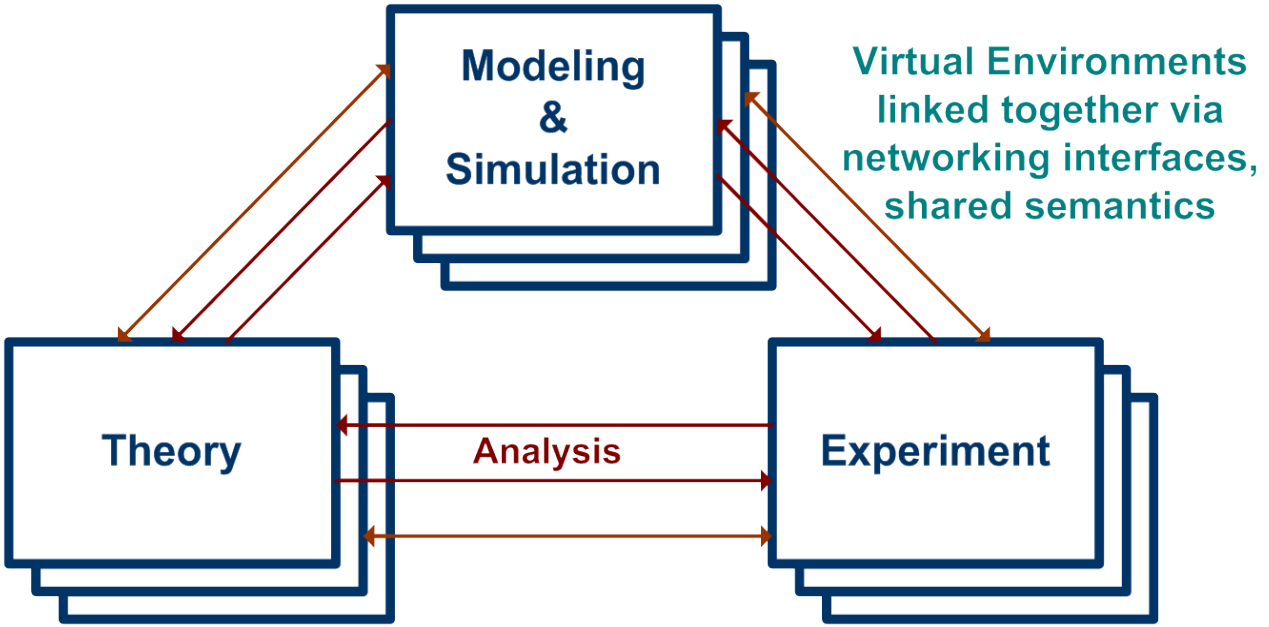
model = formal representation of reality

simulation = behavior of model over time



Scientific method, 1950-present

Virtual environments can connect all models and simulations together

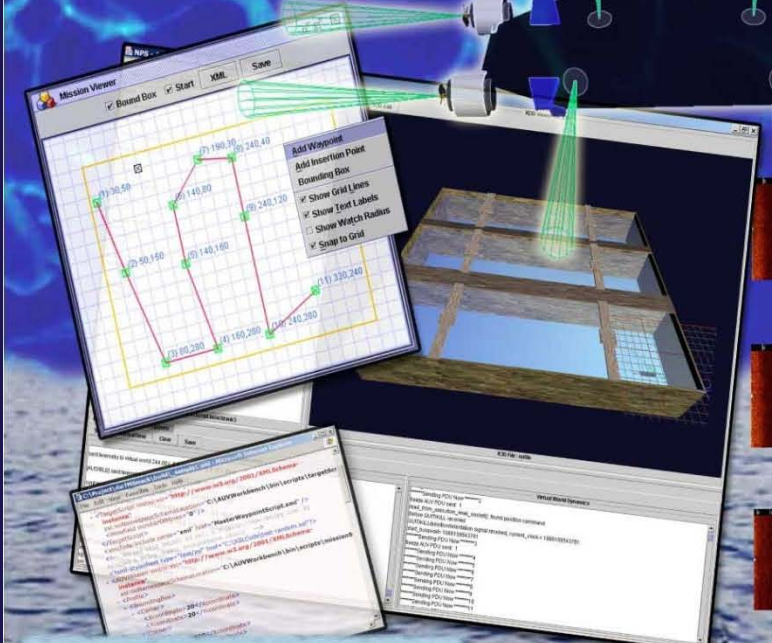


Scientific method, emerging 21st century

AUV Workbench Project Description

- Open source, Java, XML, X3D graphics
- Mission planning
- Robot mission execution
- Hydrodynamics response
- Sonar modeling
- 3D visualization
- Compressed radio frequency (RF) and acoustic communications

Robot Mission Planning and 3D Visualization



Autonomous Unmanned Vehicle Workbench

Rehearsal
Reality
Replay

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NAVAL POSTGRADUATE SCHOOL
contact: brutzman@nps.navy.mil

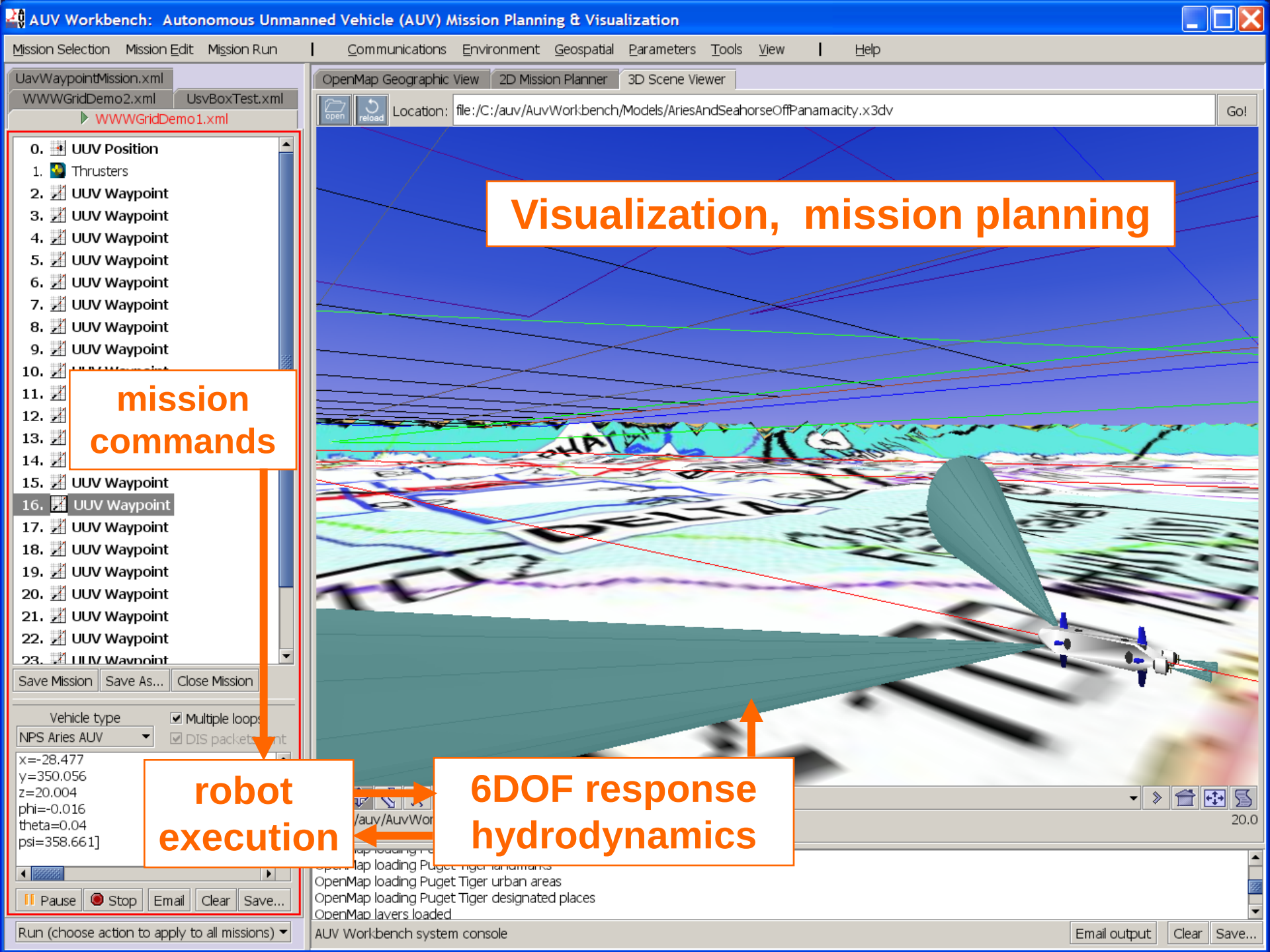
"Effects-Based Thinking"

Our 3 R's: rehearsal, reality, replay

- Same needs and capabilities for each: mission, visualization, data support, etc.
- AUV workbench supports each
  - ongoing work, starting to mainstream
- 15 years of accumulated effort
  - integrating great variety of successful work
  - new work projects occurring regularly
- Collaboration is welcome

Rehearsal

Mission planning and preparation


AUV Workbench: Autonomous Unmanned Vehicle (AUV) Mission Planning & Visualization
Mission Selection
Mission Edit
Mission Run
Communications
Environment
Geospatial
Parameters
Tools
View
Help
UavWaypointMission.xml
WWWGridDemo2.xml
UsvBoxTest.xml
WWWGridDemo1.xml
0. UUV Position
1. Thrusters
2. UUV Waypoint
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22. UUV Waypoint
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Save As...
Close Mission
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Multiple loops
DIS packet
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y=350.056
z=20.004
phi=-0.016
theta=0.04
psi=358.661]
Pause
Stop
Email
Clear
Save...
Run (choose action to apply to all missions)
OpenMap Geographic View
2D Mission Planner
3D Scene Viewer
open
reload
Location:
file:/C:/auv/AuvWorkbench/Models/AriesAndSeahorseOffPanamacity.x3dv
Go!
Visualization, mission planning
mission commands
robot execution
6DOF response hydrodynamics
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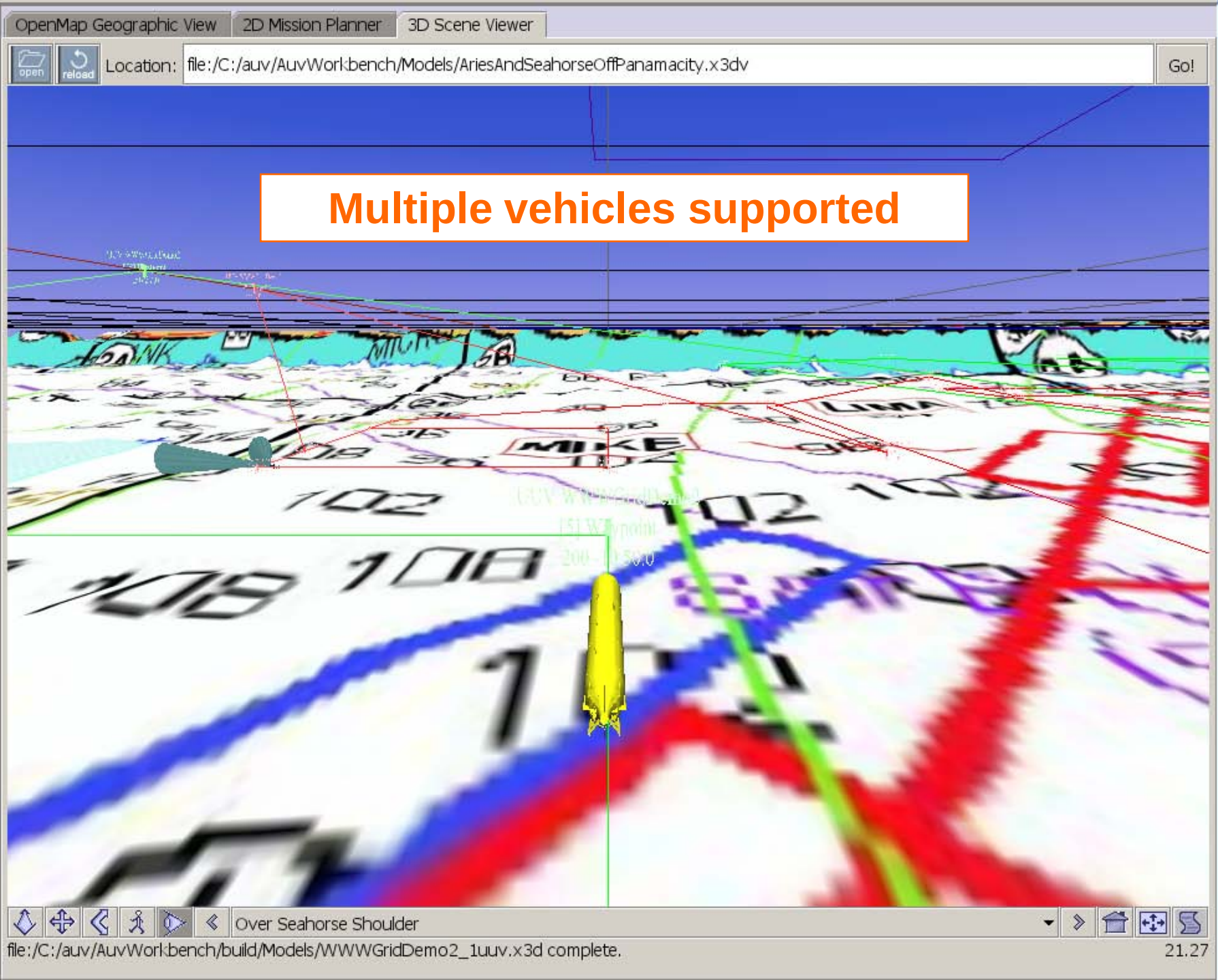
AUV Workbench system console
Email output
Clear
Save...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Multiple vehicles supported
Over Seahorse Shoulder
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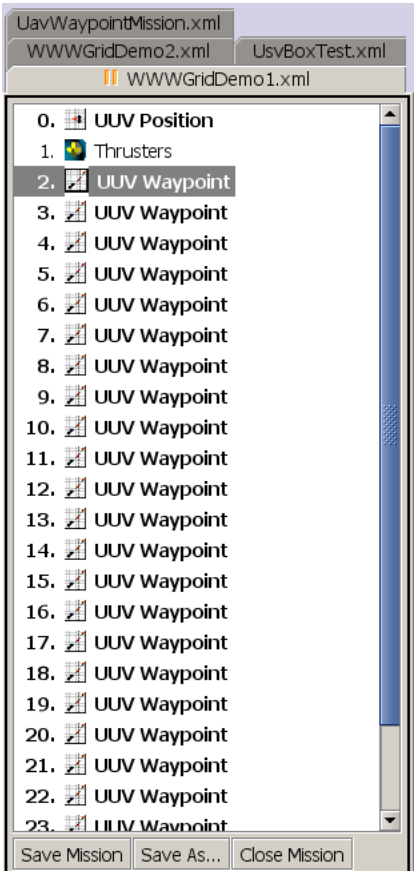
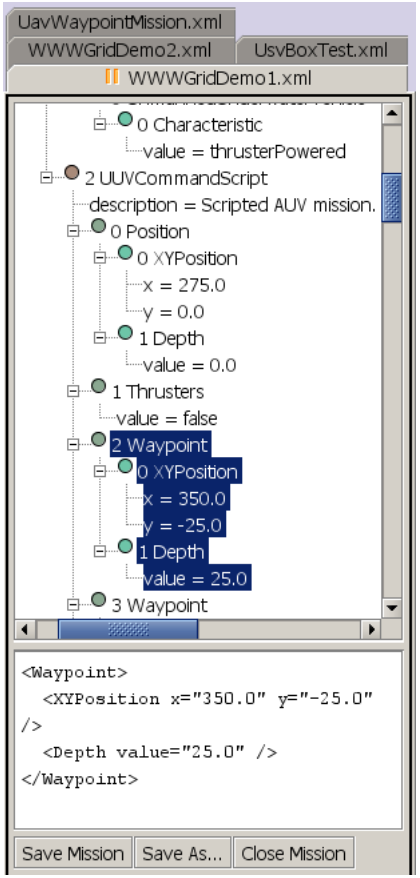
21.27

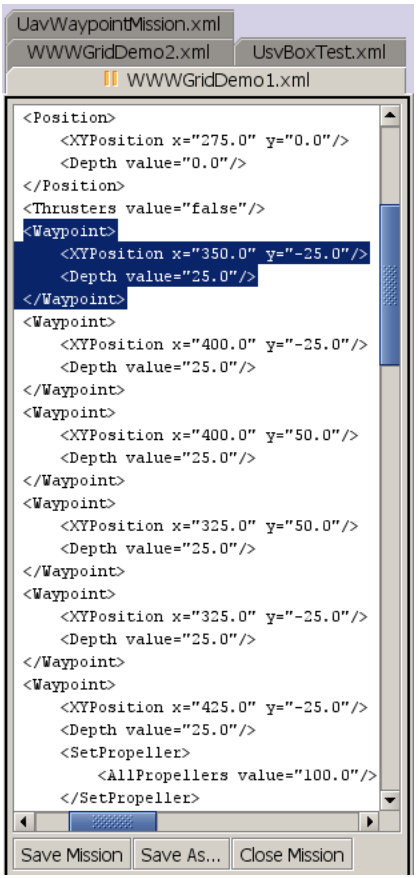
Rehearsal

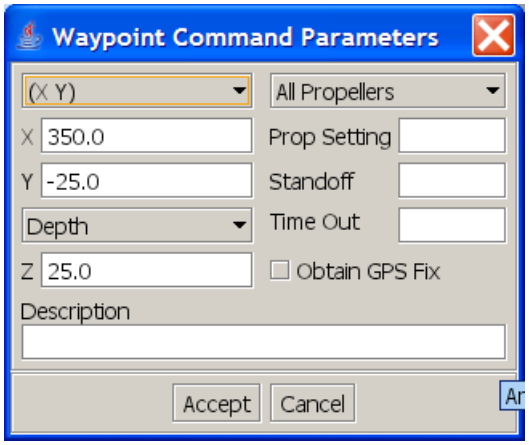
- Prepare missions, either manually or automatically via other software tools
- Test robot software's ability to perform commands
- Test again with physics "in the loop"
  - Hydrodynamics and control are critical, difficult
  - Sonar, environmental modeling
- Repeat until robust, with cautious respect
  - "Simulation is doomed to success" – G. Bekey

Mission views: iconic, tree, XML, dialog box



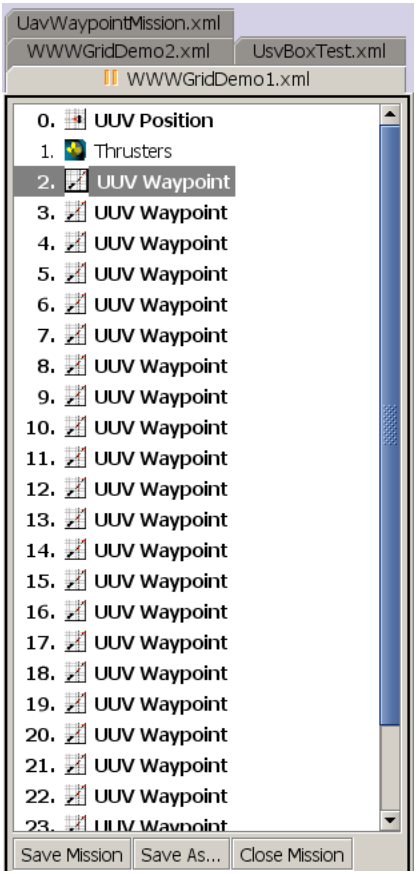


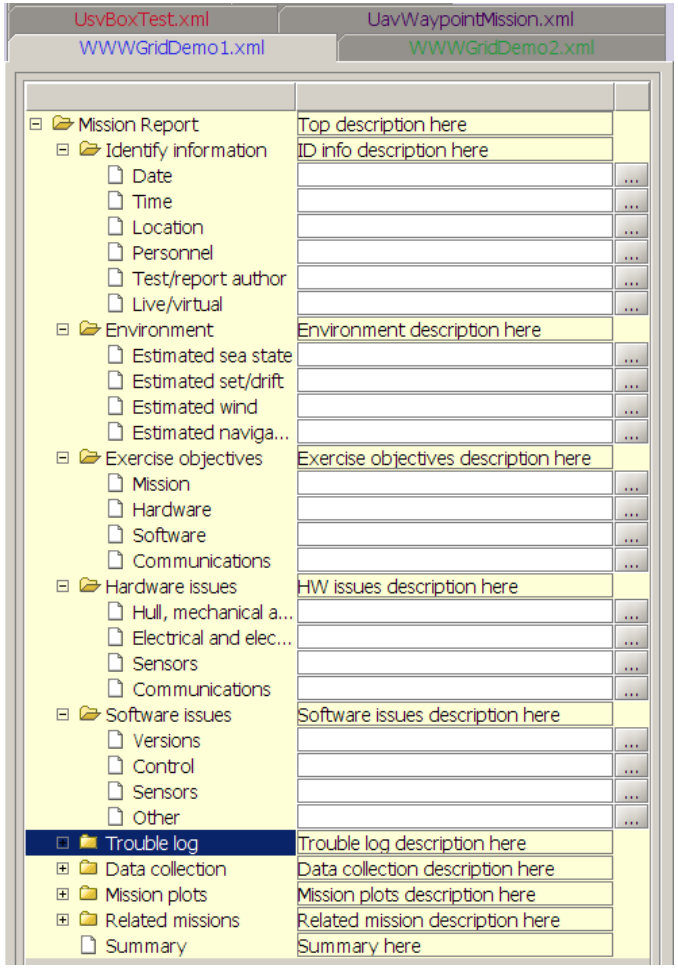


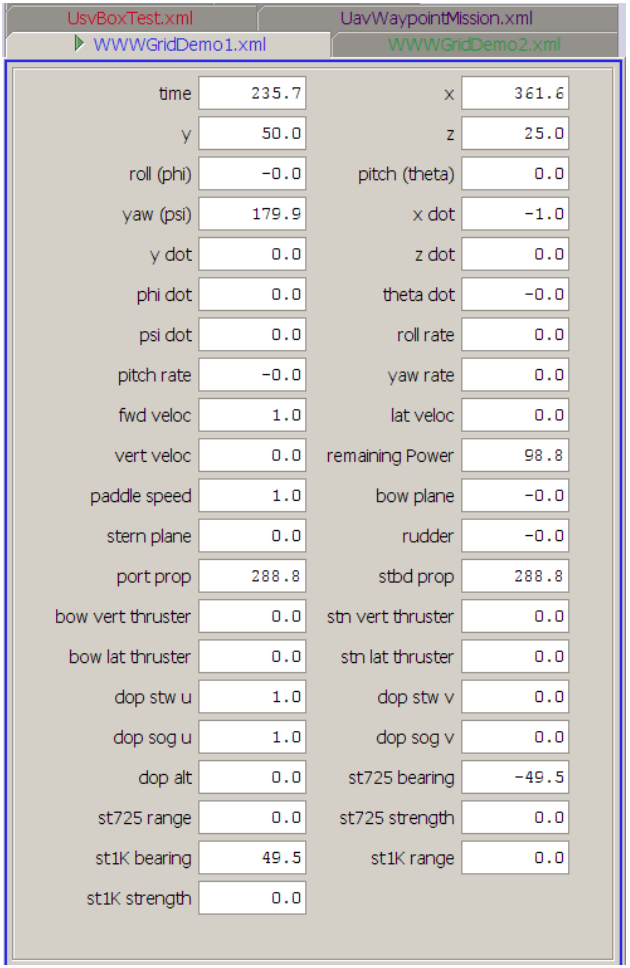


Each view is consistent with GIS, 2D, 3D views

Supporting views: mission metadata, state







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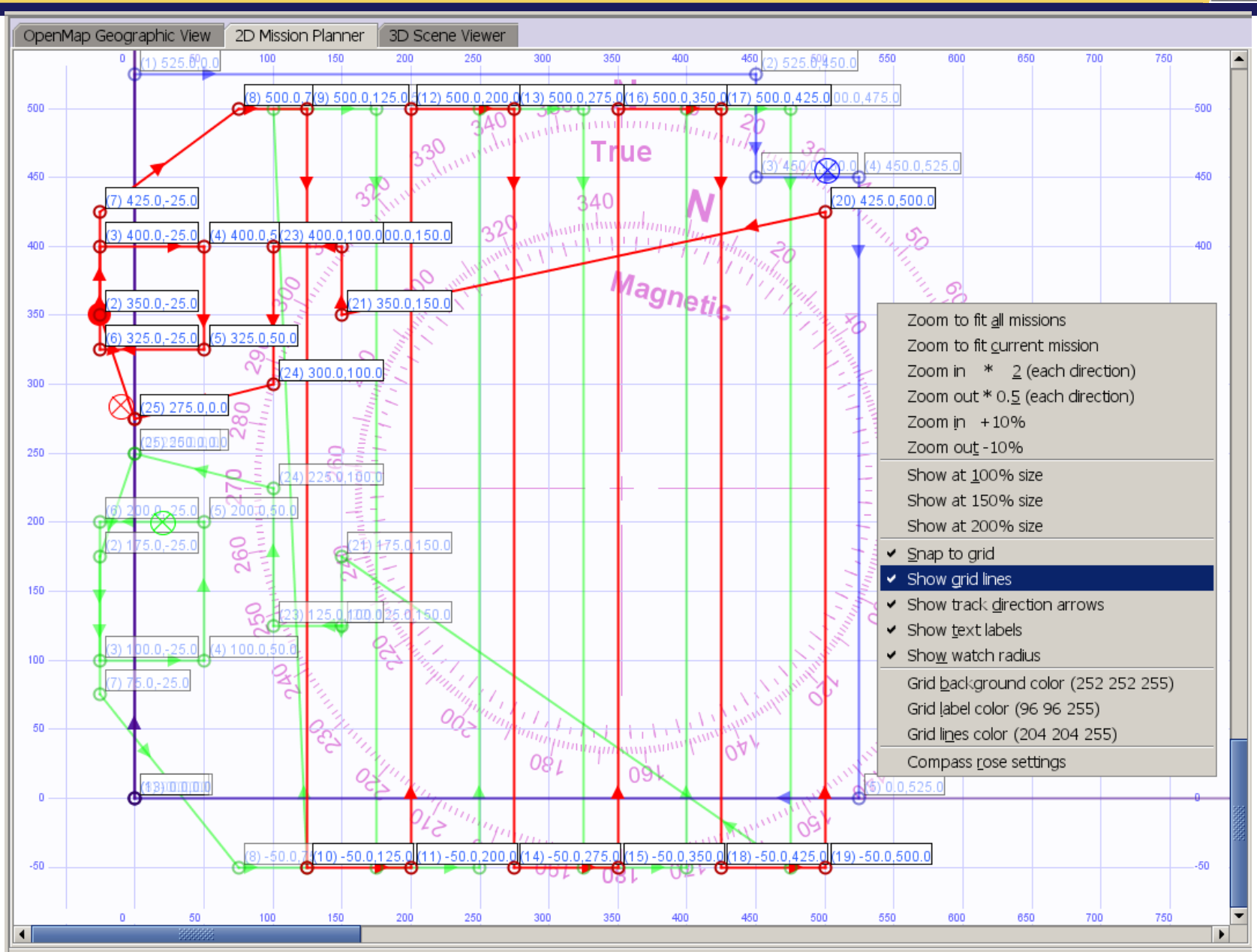
2D planner: script missions

XMSF



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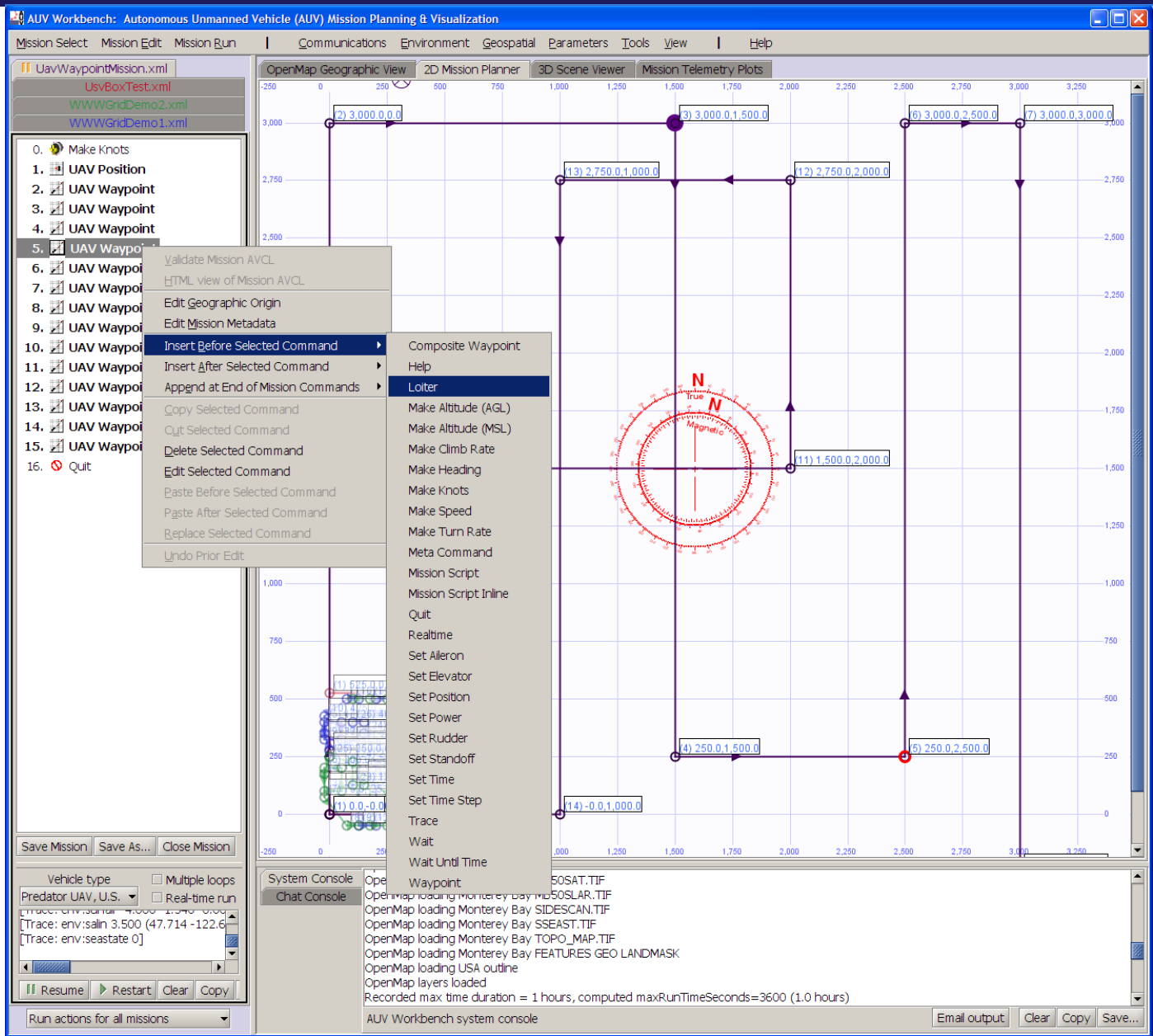
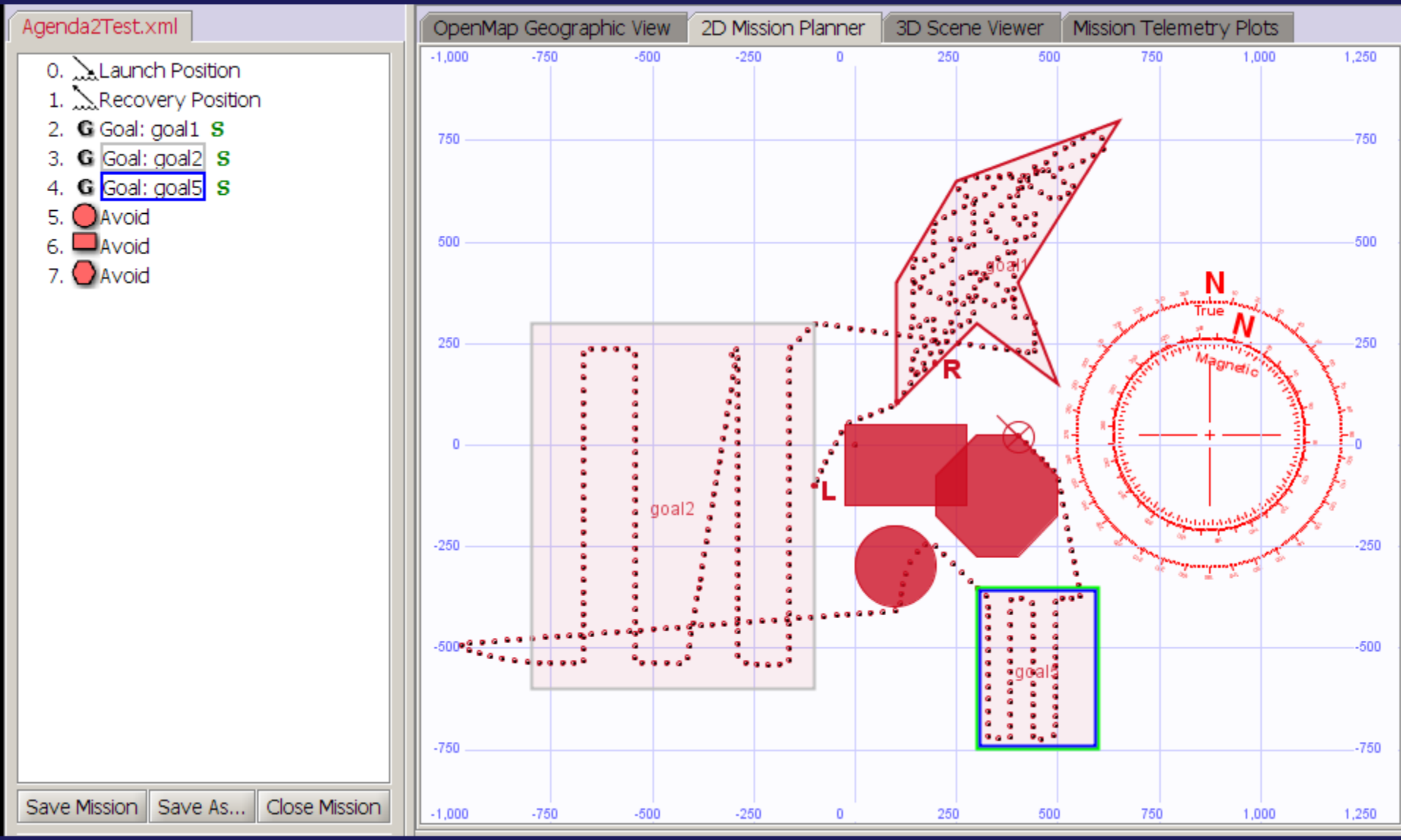
2D planner: script missions

XMSF

Can edit missions by adding or removing script commands

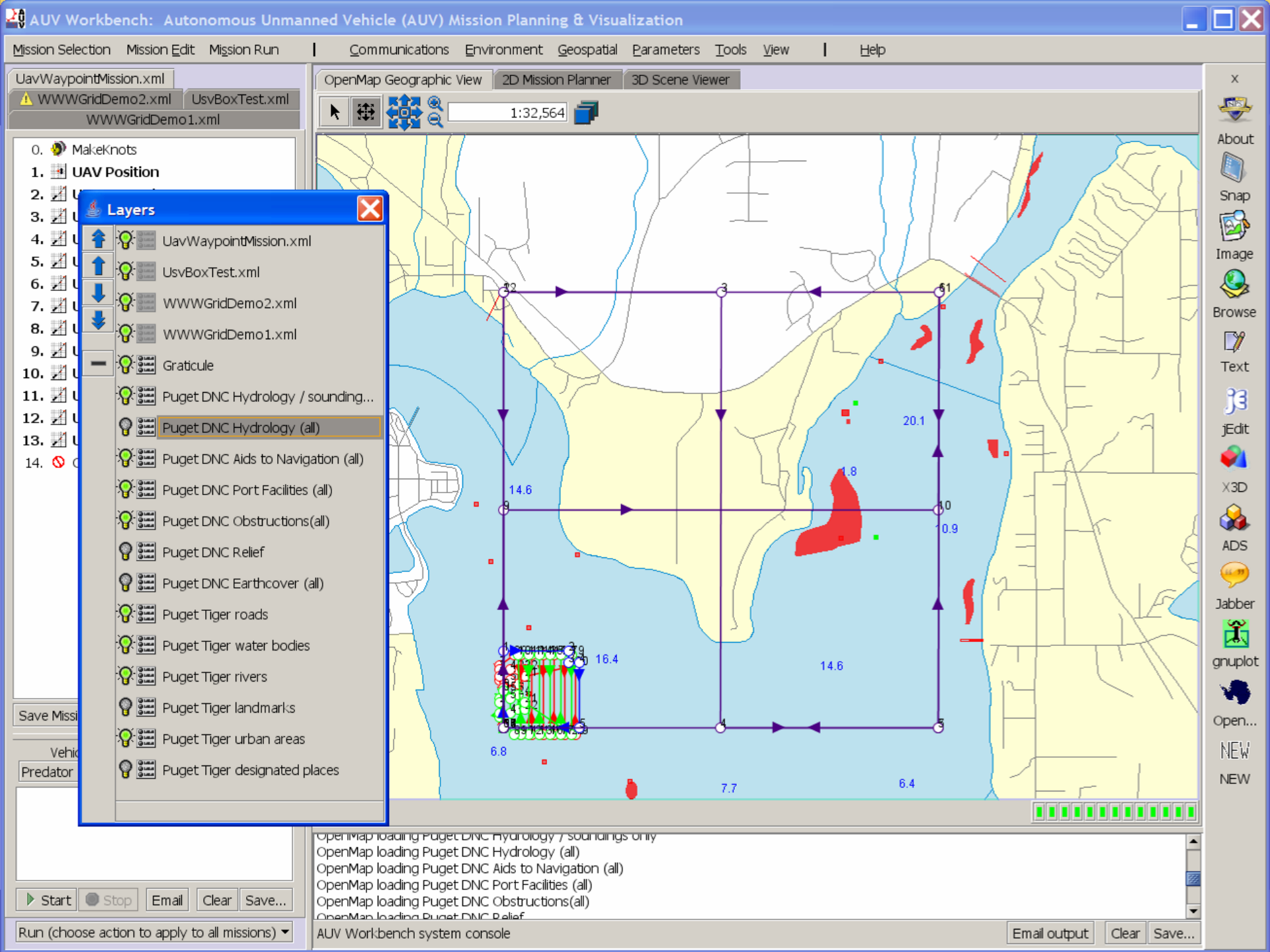


2D planner: agenda missions



OpenMap GIS display

- OpenMap http://www.openmap.org
  - Geographic Information System (GIS)
  - Open source Java, bundled
  - Building layers for areas of interest
  - Geographic coordinates throughout
  - Will synchronize with mission definitions, X3D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Puget DNC Port Facilities (all)
Puget DNC Obstructions(all)
Puget DNC Relief
Puget DNC Earthcover (all)
Puget Tiger roads
Puget Tiger water bodies
Puget Tiger rivers
Puget Tiger landmarks
Puget Tiger urban areas
Puget Tiger designated places
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14.6
10.9
16.4
14.6
6.8
7.7
6.4
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Image
Browse
Text
jEdit
X3D
ADS
Jabber
gnuplot
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Stop
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OpenMap loading Puget DNC Port Facilities (all)
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AUV Workbench system console
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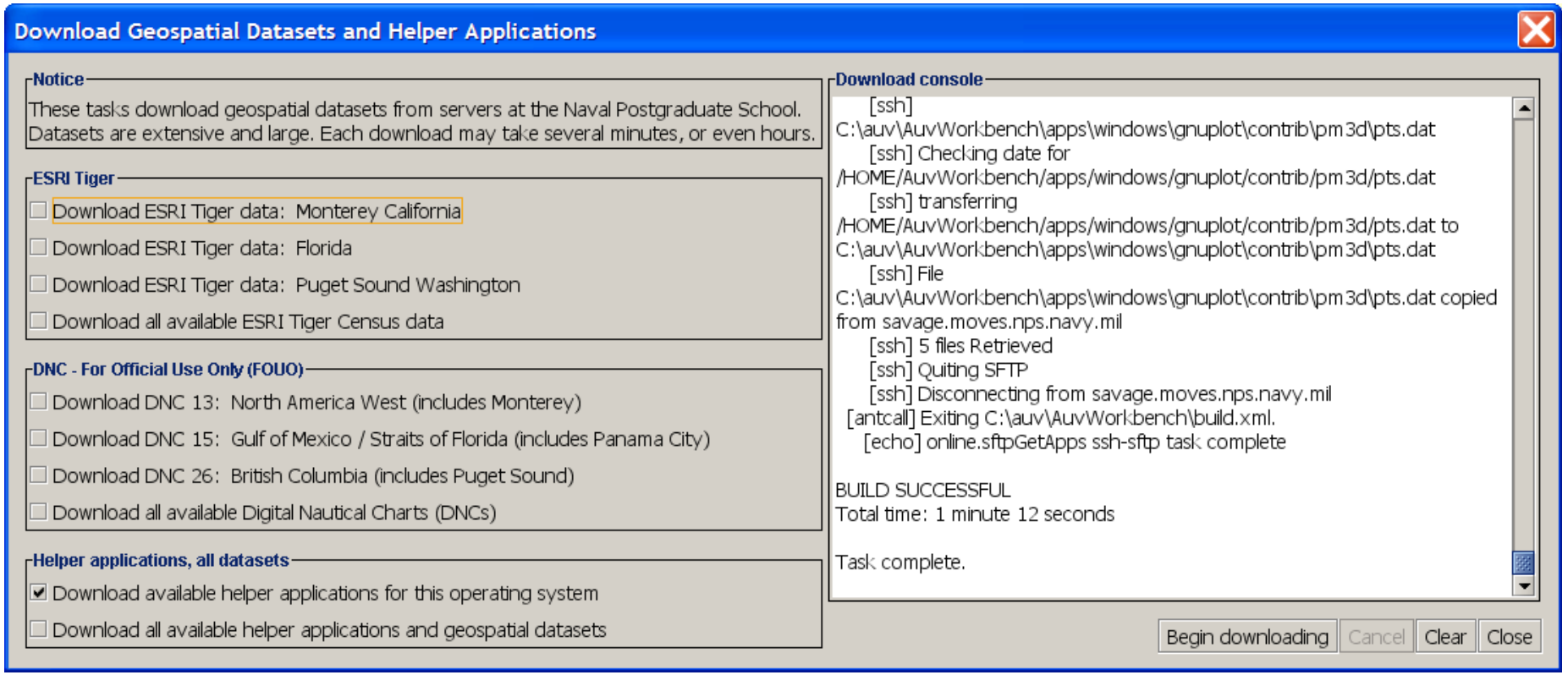
Secure sftp download of large GIS datasets



Reality: real-time mission support

- Monitor mission progress
- Task-level control using same mission vocabulary
- Visualize and supervise operations
  - caveat, again: work in progress
- Integrate acoustic and RF communications
- Chat for distributed collaboration among participants, both human and robotic

Real-time mission data import/export

- Export
  - Mission commands that are already rehearsed
  - Convert to specific dialect particular to that robot
- Import
  - Mission telemetry recording detailed track data
  - Data products: imagery, video, mission log, etc.

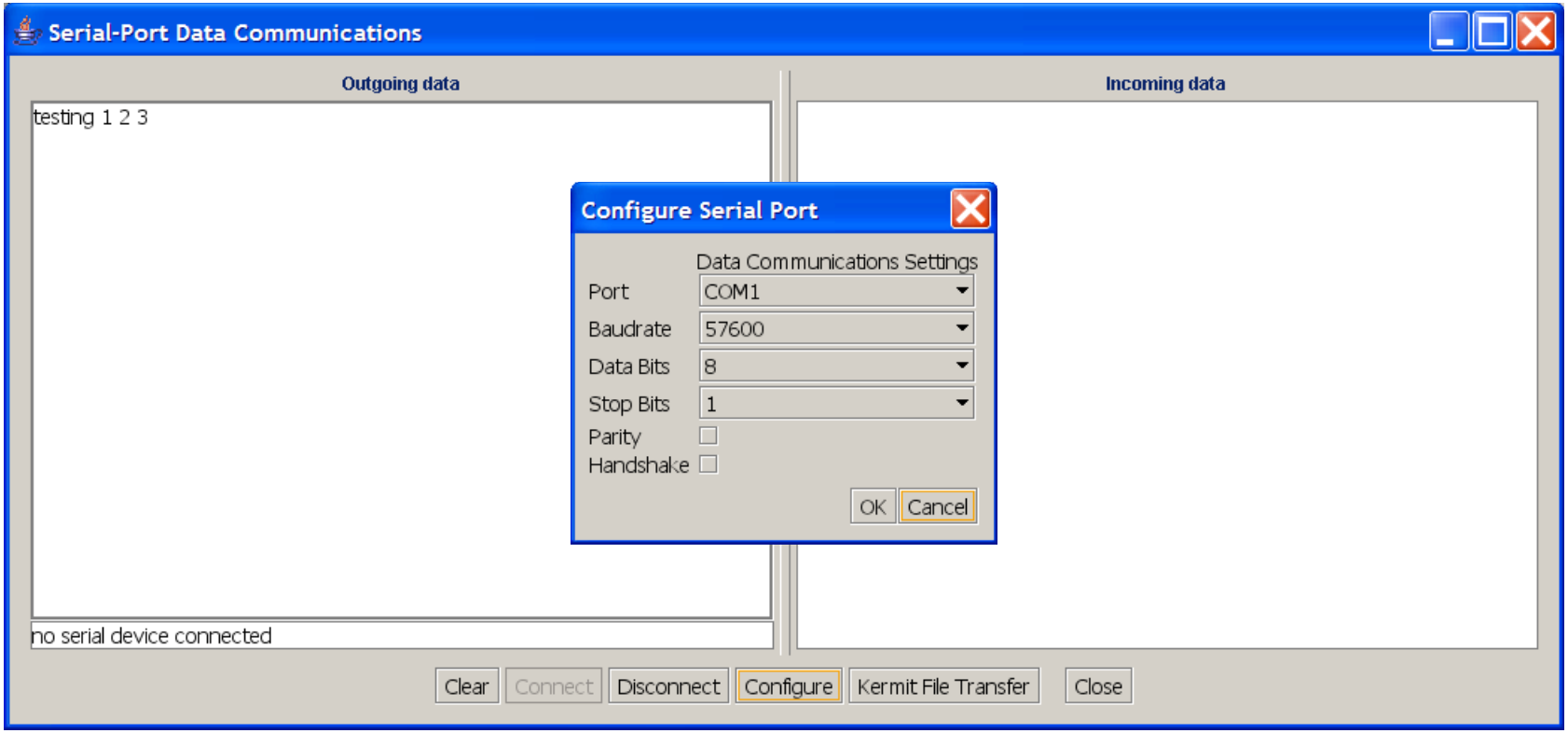
Record mission metadata for archives

- Support operator keeping detailed notes, kept in context when conducting mission
- Prompt for full details as appropriate
- Archive notes for later review and followup

- Future work
  - Automatic tests to confirm configuration, control
  - Automate pre-underway checklists

Serial port communications

- Configurable to different devices, ports



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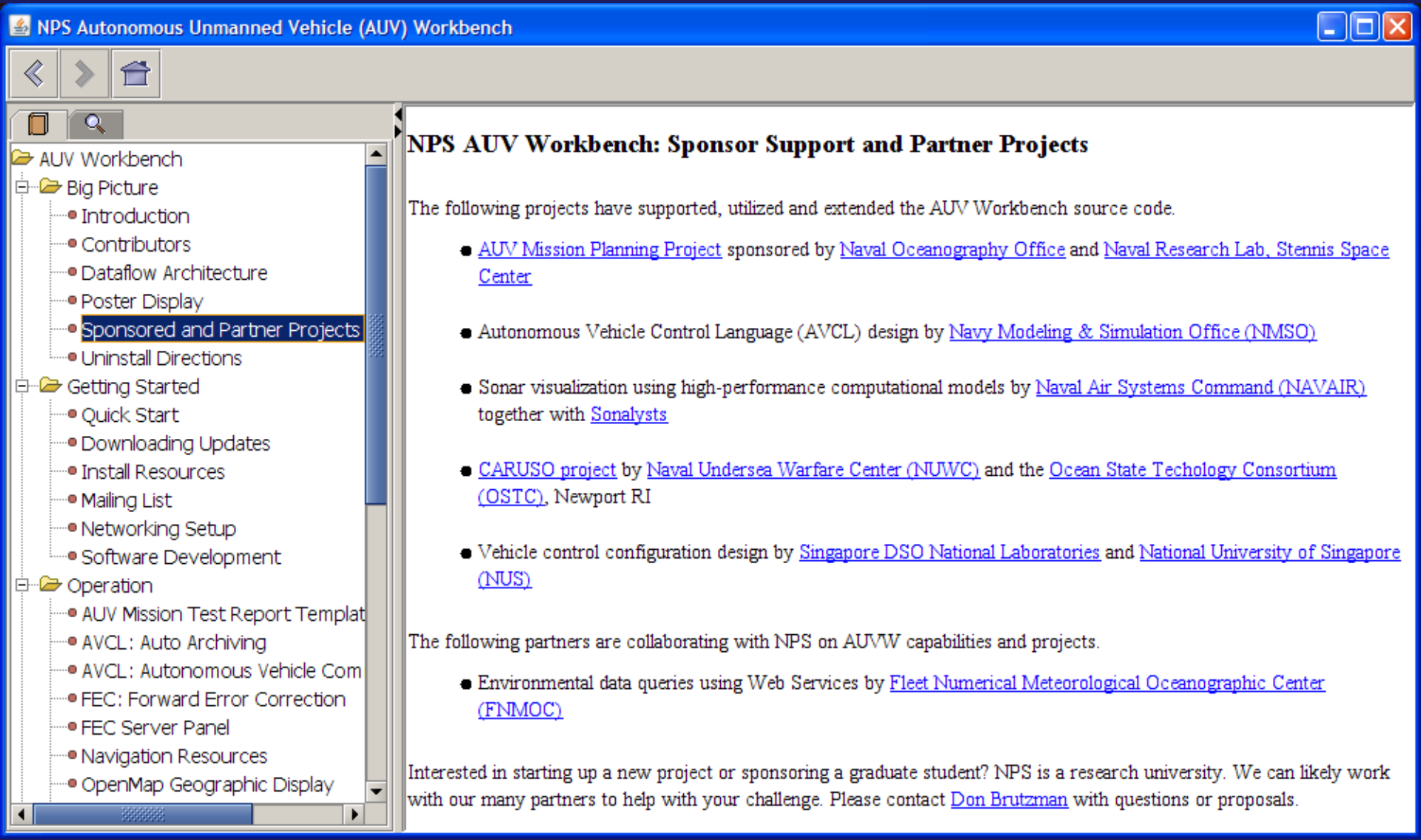
JavaHelp support

XMSF



AUV Workbench
- Big Picture
  - Introduction
  - Contributors
  - Dataflow Architecture
  - Poster Display
  - Sponsored and Partner Projects
  - Uninstall Directions
- Getting Started
  - Quick Start
  - Downloading Updates
  - Install Resources
  - Mailing List
  - Networking Setup
  - Software Development
- Operation
  - AUV Mission Test Report Template
  - AVCL: Auto Archiving
  - AVCL: Autonomous Vehicle Comma
  - FEC: Forward Error Correction
  - FEC Server Panel
  - Navigation Resources
  - OpenMap Geographic Display
  - Telemetry Plots
  - Xj3D Viewer Navigation Hotkeys
  - XSBC: XML Schema Binary Compre
  - XSBC Server Panel
- Research Documentation
  - Articles
  - Dissertations
  - Papers
  - Presentations
  - Reports
  - Theses
  - Video Demonstrations
- Software Development
  - Bug Reports + Feature Requests
  - Help Page Creation
  - Internationalization
  - Javadoc Source Documentation
  - Open Source License
  - Software Developer Guides

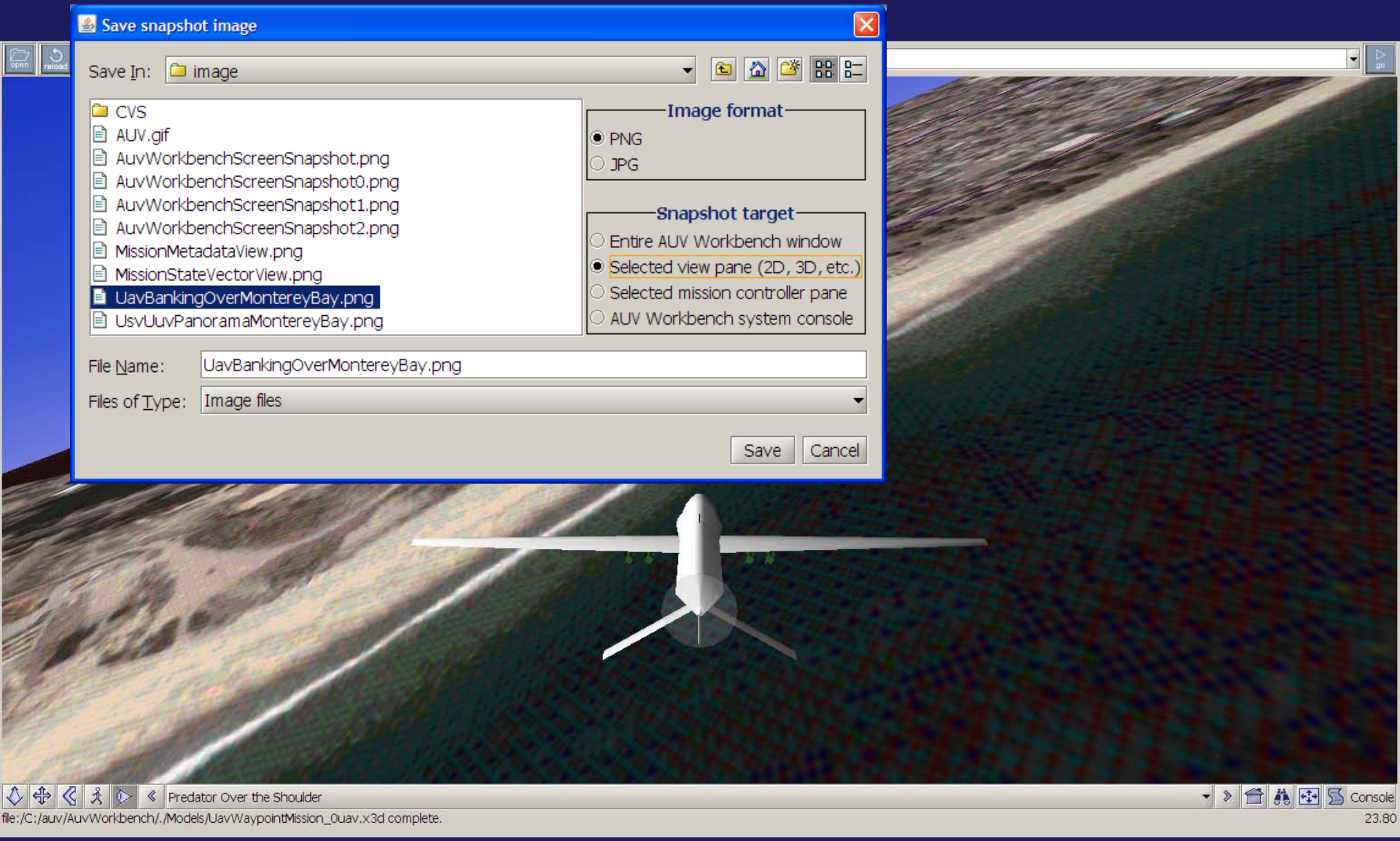
NPS AUV Workbench: Theses

All NPS theses and dissertations are searchable online via the Bosun search engine at the Dudley Knox Library.

The following theses are included in the NPS AUV Workbench documentation distribution.

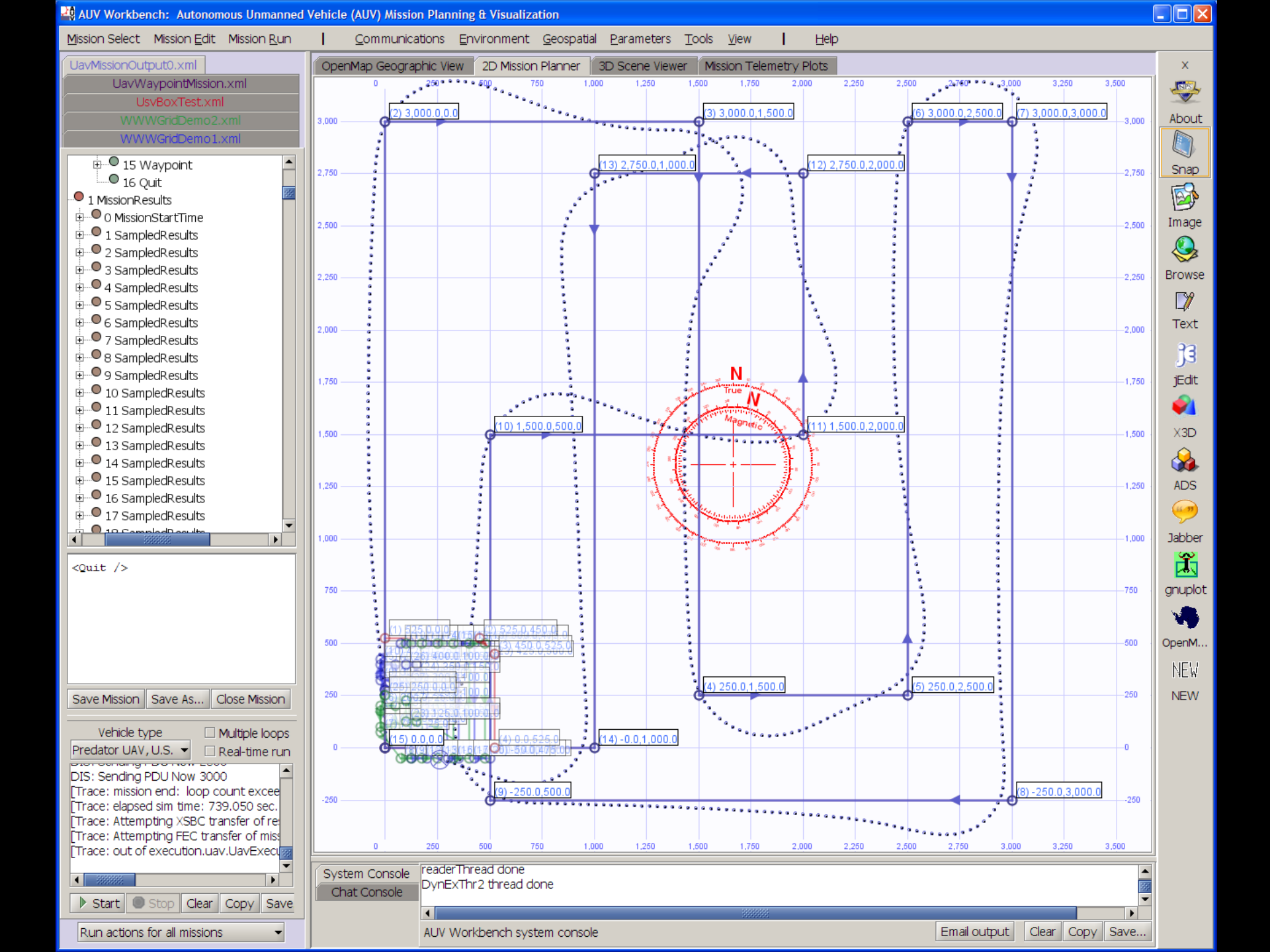
- Ayala, Miguel Arnaldo, *Execution-Level Java Software and Hardware for the NPS Autonomous Underwater Vehicle (AUV)*, Masters Thesis, Naval Postgraduate School, Monterey California, September 2002.
- Boncal, Richard J., *A Study of Model-based Maneuvering Controls for Autonomous Underwater Vehicles*, Masters Thesis, Naval Postgraduate School, Monterey California, December 1987.
- Burkley, Frederick Garvin, *An Acoustic Sensor History Server for a Submarine Combat Control System*, Masters Thesis, Northeastern University, Boston Massachusetts, August 2002.
- Burns, Michael L., *Merging Virtual and Real Execution-Level Control Software for the Phoenix Autonomous Underwater Vehicle (AUV)*, Masters Thesis, Naval Postgraduate School, Monterey California, September 1996.
- Byrne, Kevin Michael, *Real-Time Modeling of Cross-Body Flow for Torpedo Tube Recovery of the Phoenix Autonomous Underwater Vehicle (AUV)*, Masters Thesis, Naval Postgraduate School, Monterey California, March 1998. Also available: slideset.
- Davis, Duane T., *Precision Control and Maneuvering of the Phoenix Autonomous Underwater Vehicle (AUV) for Entering a Recovery Tube*, Masters Thesis, Naval Postgraduate School, Monterey California, September 1996.
- Fodrea, Lynn Renee, *Obstacle Avoidance Control for the Remus Autonomous Underwater Vehicle (AUV)*, Masters Thesis, Naval Postgraduate School, Monterey California, December 2002.
- Hawkins, Darrin L. and Van Leuvan, Barbara C., *An XML-based Mission Command Language for Autonomous Underwater Vehicles (AUVs)*, Masters Thesis, Naval Postgraduate School, Monterey California, June 2003.
- Holliday, Timothy M., *Real-Time 3D Sonar Modeling and Visualization*, Masters Thesis, Naval Postgraduate School, Monterey California, June 1998.
- Johnson, Jay, *AUV Steering Parameter Identification for Improved Control Design*, Masters Thesis, Naval Postgraduate School, Monterey California, June 2001. Also available: slideset.
- Kucik, Daniel P., *"Follow the Leader" Tracking by Autonomous Underwater Vehicles (AUVs) using Acoustic Communications and Ranging*, Masters Thesis, Naval Postgraduate School, Monterey California, September 2003.
- Leaver, R. Greg, *VRML Terrain Modeling for the Monterey Bay National Marine Sanctuary (MBNMS)*, Masters Thesis, Naval Postgraduate School, Monterey California, September 1998.
- Lee, Chin Siong, *NPS AUV Workbench: Collaborative Environment for Autonomous Underwater Vehicles (AUVs) Mission Planning and 3D Visualization*, Masters Thesis, Naval Postgraduate School, Monterey California, March 2004. Also available: thesis slideset, Jabber agents slideset, and XML Tactical Chat (XTC) slideset.
- Leonhardt, Bradley J., *Mission Planning and Mission Control for the Phoenix Autonomous Underwater Vehicle (AUV): Implementation and Experimental Study*, Masters Thesis, Naval Postgraduate School, Monterey California, March 1996.
- Neushul, James D., *Interoperability, Data Control and Battlespace Visualization using XML, XSLT and X3D*, Masters Thesis, Naval Postgraduate School, Monterey California, September 2003.
- Norbraten, Terry D., *Utilization of Forward Error Correction (FEC) Techniques with Extensible Markup Language (XML) Schema-based Binary Compression (XSBC) Technology*, Masters Thesis, Naval Postgraduate School, Monterey California, December 2004. Also available: thesis slideset.
- Rauch, Travis, *Tactical Savage Modeling Analysis Language (SMAL): Metadata for Tactical Simulations and Visualizations*, Masters Thesis, Naval Postgraduate School, Monterey California, March 2006.
  "http:RosettiSonarVisualizationThesis.September2004.pdf">*Tactical Web Services: Using XML and Java Web Services to Conduct Real-time, Net-centric Sonar Visualization*, Masters Thesis, Naval Postgraduate School, Monterey California, September 2004.
- Serin, Ekrem, *Design and Test of the Cross-Format Schema Protocol (XFSP) for Networked Virtual Environments*, Masters Thesis, Naval Postgraduate School, Monterey California, March 2003. Also available: slideset.
- Zeswitz, Steven*NPSNET: Integration of Distributed Interactive Simulation (DIS) Protocol for Communication Architecture and Information Interchange*, Masters Thesis, Naval Postgraduate School, Monterey California, September 1993.

Snapshot support



Replay: post-mission support

- Automatic archiving of mission to server
  - Being built into workbench – simplify user tasks
- Integration and compression of all relevant data into single compressed XML file
  - Metadata for mission
  - Many pieces: ordered mission, commands, telemetry, coefficients, contacts, etc. etc.
  - Autonomous Vehicle Control Language (AVCL) is Ph.D. work by CDR Duane Davis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UsvBoxTest.xml
WWWGridDemo2.xml
WWWGridDemo1.xml
15 Waypoint
16 Quit
1 MissionResults
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1 SampledResults
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Save Mission
Save As...
Close Mission
Vehicle type
Predator UAV, U.S.
Multiple loops
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3D Scene Viewer
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System Console
Chat Console
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DynExThr2 thread done
AUV Workbench system console
Email output
Clear
Copy
Save...
About
Snap
Image
Browse
Text
jEdit
X3D
ADS
Jabber
gnuplot
OpenM...
NEW
NEW

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Geographic track plot

XMSF

- AUVW Mission Telemetry
  - UsvMissionOutput0.xml/2007.04.22/15.05.03 PDT
    - Geographic chart
      - Geographic XY plot
    - Vehicle posture versus time
      - Position x y z
      - Orientations phi theta psi
      - Linear velocities u v w
      - Rotational velocities p q r
    - Vehicle effectors versus time
      - Plane surfaces forward aft
      - Rudder and heading (psi) values
      - Propeller values port starboard all
  - UavMissionOutput0.xml/2007.04.22/15.05.26 PDT
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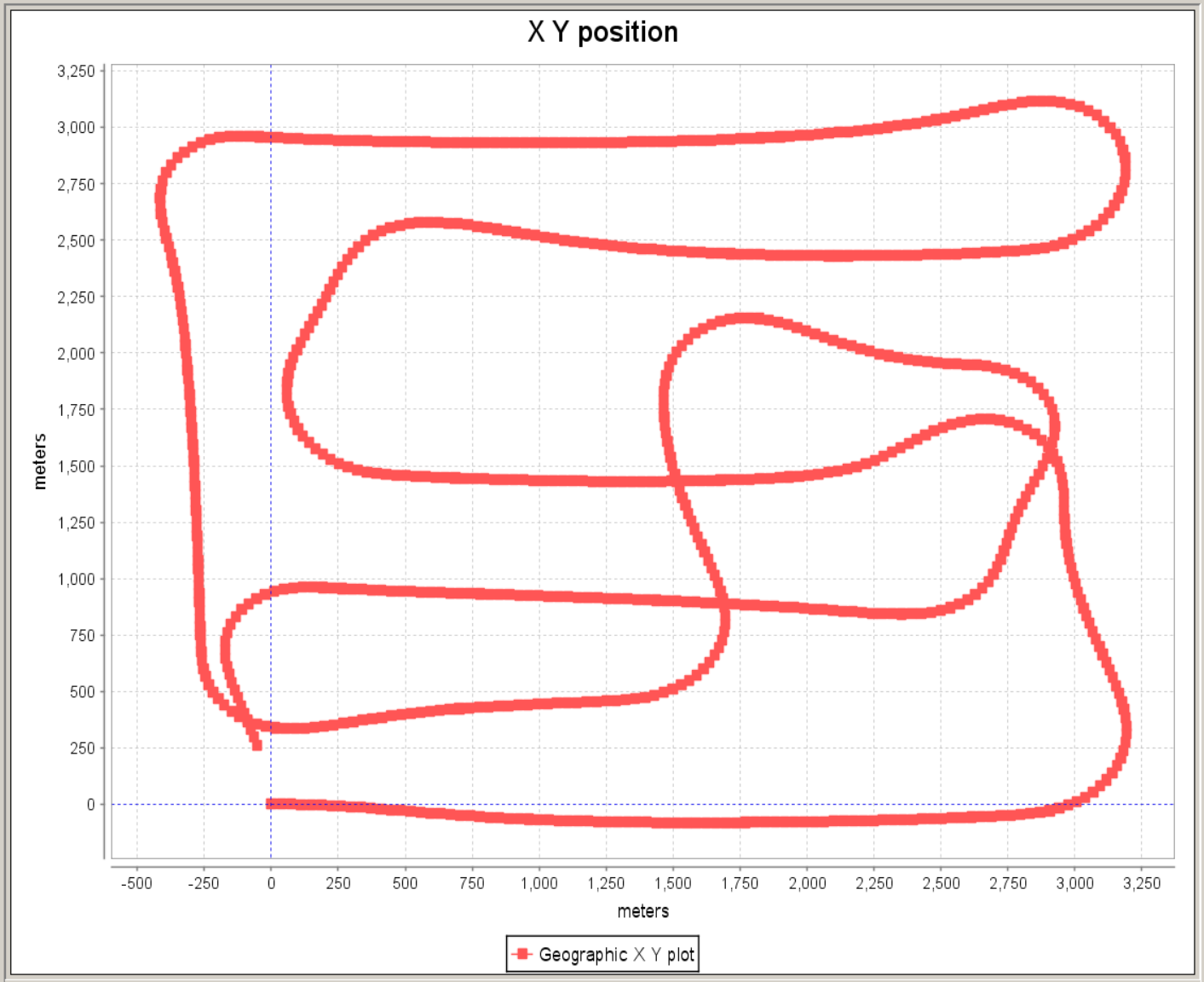

Geographic X Y plot. Robot coordinate system: world coordinates for vehicle position. +X (North) and +Y (East) data in meters.

NAVAL POSTGRADUATE SCHOOL

x y z versus t plot

XMSF

- AUVW Mission Telemetry
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    - Vehicle effectors versus time
      - Plane surfaces forward aft
      - Rudder and heading (psi) values
      - Propeller values port starboard all
  - UavMissionOutput0.xml/2007.04.22/15.05.26 PDT
    - Geographic chart
      - Geographic XY plot
    - Vehicle posture versus time
      - Position x y z
      - Orientations phi theta psi
      - Linear velocities u v w
      - Rotational velocities p q r
    - Vehicle effectors versus time
      - Plane surfaces forward aft
      - Rudder and heading (psi) values
      - Propeller values port starboard all
  - UuvMissionOutput1.xml/2007.04.22/15.06.16 PDT
    - Geographic chart
      - Geographic XY plot
    - Vehicle posture versus time
      - Position x y z
      - Orientations phi theta psi
      - Linear velocities u v w
      - Rotational velocities p q r
    - Vehicle effectors versus time
      - Plane surfaces forward aft
      - Rudder and heading (psi) values
      - Propeller values port starboard all
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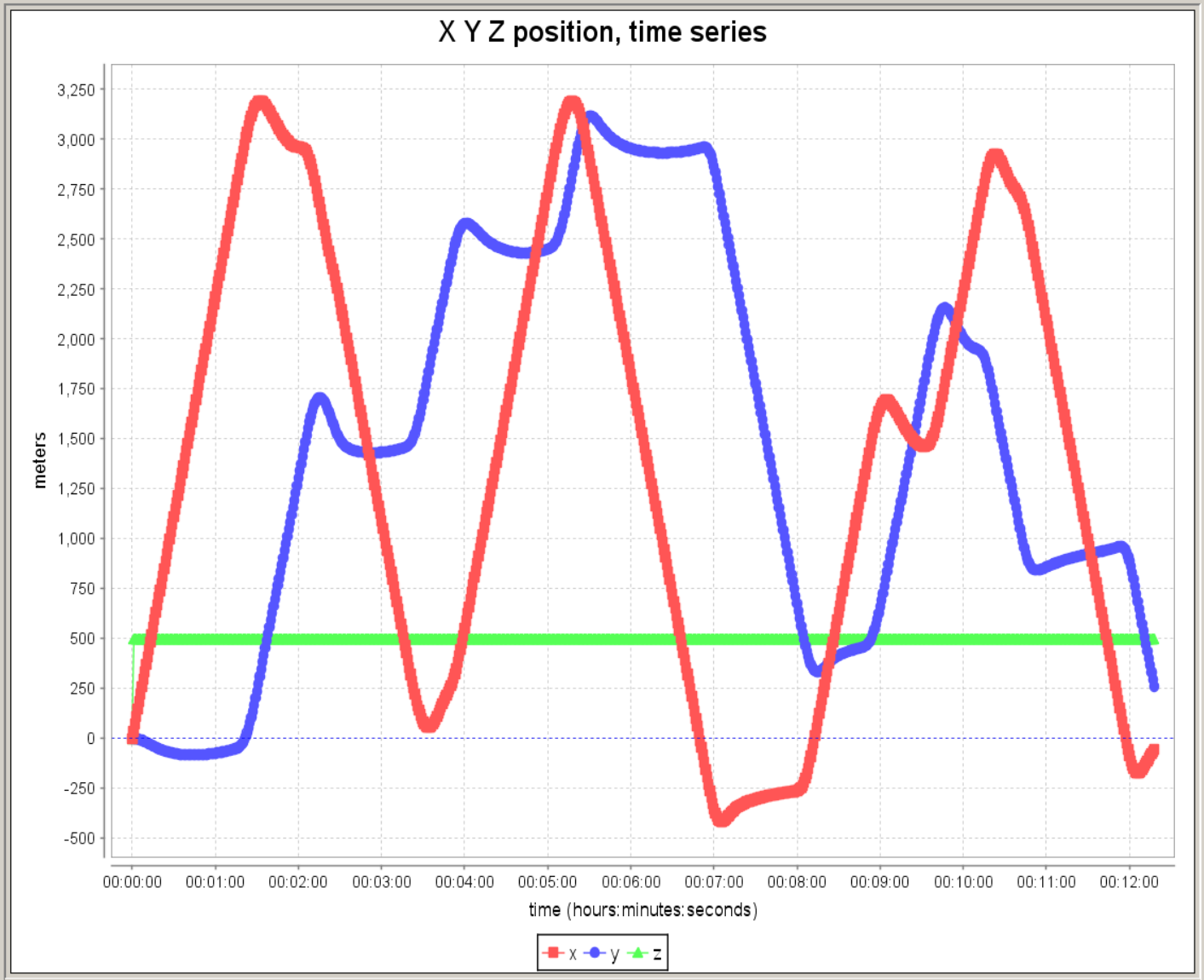
    - Geographic chart
      - Geographic XY plot
    - Vehicle posture versus time
      - Position x y z
      - Orientations phi theta psi
      - Linear velocities u v w
      - Rotational velocities p q r
    - Vehicle effectors versus time
      - Plane surfaces forward aft
      - Rudder and heading (psi) values
      - Propeller values port starboard all



X Y Z telemetry time-series plot. Robot coordinate system: world coordinates for vehicle position. +X (North), +Y (East) and +Z (down) data in meters versus mission time.

NAVAL POSTGRADUATE SCHOOL

phi theta psi versus t plot

XMSF

- AUVW Mission Telemetry
  - UsvMissionOutput0.xml/2007.04.22/15.05.03 PDT
    - Geographic chart
      - Geographic XY plot
    - Vehicle posture versus time
      - Position x y z
      - Orientations phi theta psi
      - Linear velocities u v w
      - Rotational velocities p q r
    - Vehicle effectors versus time
      - Plane surfaces forward aft
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      - Propeller values port starboard all
  - UavMissionOutput0.xml/2007.04.22/15.05.26 PDT
    - Geographic chart
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    - Vehicle posture versus time
      - Position x y z
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      - Linear velocities u v w
      - Rotational velocities p q r
    - Vehicle effectors versus time
      - Plane surfaces forward aft
      - Rudder and heading (psi) values
      - Propeller values port starboard all
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    - Vehicle effectors versus time
      - Plane surfaces forward aft
      - Rudder and heading (psi) values
      - Propeller values port starboard all
  - UuvMissionOutput0.xml/2007.04.22/15.06.45 PDT
    - Geographic chart
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    - Vehicle posture versus time
      - Position x y z
      - Orientations phi theta psi
      - Linear velocities u v w
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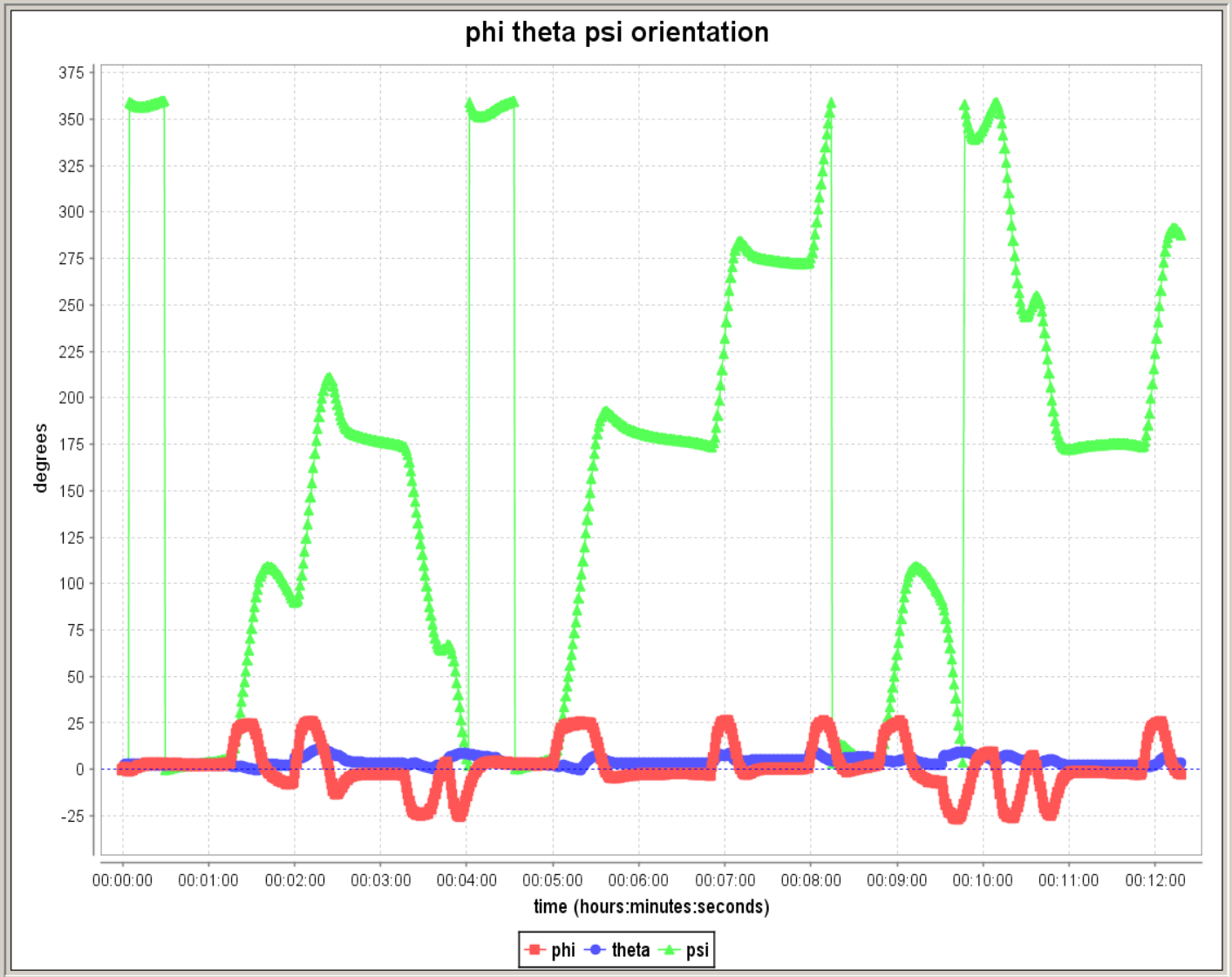
    - Vehicle effectors versus time
      - Plane surfaces forward aft
      - Rudder and heading (psi) values
      - Propeller values port starboard all



Rotational angles (phi theta psi) time-series plot. Rotational angles (phi theta psi) measured about world-coordinate axes (+X +Y +Z) respectively. Units are degrees/second versus mission time. Positive values rotate according to the right-hand rule.

Physical modeling

- Control algorithms and 6 degree-of-freedom (6DOF) hydrodynamics response
- Sonar propagation, attenuation
- Collision detection
  - Direct vehicle contact and sensor contact
  - Separate use of same X3D graphics models
- Visualization greatly aids understanding
  - provides good “forcing function” for integration

Control algorithm coefficients

jEdit - C:\auv\AuvWorkbench\build\configuration\controlCoefficients\AriesControlConfiguration.xml

File Edit Search Markers Folding View Utilities Macr

Search for:

AriesControlConfiguration.xml (C:\auv\AuvWorkbench\build\configuration\controlCoefficients\)

```
<?xml version="1.0" encoding="UTF-8"?>.
<ExecutionDynamicsConfiguration vehicle="aries" date="02 February 2005" description="Sample combined configura
        <UUVControlConstants units="metric" description="Control coefficients applicable to control laws imple
                <PIDControl enabled="true" description="PD depth and waypoint coefficients are unstable and ne
                        <AngularConstants kTheta="15.0" kThrusterTheta="15.0" kPsi="5.0" kThrusterPsi="0.6" kP
                        <LinearConstants kV="0.0" kW="6.5876" kThrusterV="3.2938" kThrusterW="263.5046"/>.
                        <HoverConstants kPropellerHover="658.7615" kSurgeHover="19762.85" kThrusterHover="26.3
                        <DepthConstants kZ="10.0" kThrusterZ="30.0" kZIntegral="1.524"/>.
                        <CurrentConstants kPropellerCurrent="6600.0" kThrusterCurrent="40.0"/>.
                </PIDControl>.
                <OpenLoopControl enabled="true" description="Response independent coefficients for lateral and
                        <LateralConstants kThrusterLateral="48.0"/>.
                        <RotationalConstants kThrusterRotate="1.5"/>.
                </OpenLoopControl>.
                <SlidingModeControl enabled="true" description="Sliding mode plane and rudder control for head
                        <HeadingConstants kSigmaR="-0.9499" kSigmaPsi="0.5103" kEtaSteering="1.0" kPhiSteering
                        <DepthConstants kSigmaQ="0.7693" kSigmaTheta="0.6385" kSigmaZ="0.0221" kEtaDive="1.0"
                </SlidingModeControl>.
                <LQRControl enabled="false" description="LQR (DSO Singapore developed) plane and rudder contro
                        <HeadingConstants kPsi="1.4142" kR="-1.4047" kV="0.1486"/>.
                        <DepthConstants kZ="0.6325" kTheta="3.5185" kQ="3.1305" kW="-0.1776"/>.
                </LQRControl>.
                <SonarControl targetDiscriminationDistance="5.0" st725ScanWidth="60.0" st1000ScanWidth="60.0"
                <ControlLimits maxRpm="700.0" minWaypointRpm="200.0" nominalWaypointRpm="400.0" maxThruster="2
                <Standoff distance="10"/>.
                <HoverPointTransition distance="7"/>.
        </UUVControlConstants>.
        <UUVExecutionParameters description="Miscellaneous defaults that may be overridden by command-line valu
                <InstalledHardware st1000="true" st725="true" displayScreen="true"/>.
                <RunOptions trace="false" realTime="false" tacticalLevel="false" textOutput="false" multipleLo
                <Dynamics host="localhost" port="3211"/>.
```

2,66 Top (xml,none,UTF-8) - - - - W 5/6Mb

6DOF dynamics coefficients

jEdit - C:\auv\AuvWorkbench\build\configuration\dynamicsCoefficients\AriesDynamicsConfiguration.xml

File Edit Search Markers Folding View Utilities Macr

Search for:

AriesDynamicsConfiguration.xml (C:\auv\AuvWorkbench\build\configuration\dynamicsCoefficients\)

```
<?xml version="1.0" encoding="UTF-8"?>.
<ExecutionDynamicsConfiguration vehicle="aries" date="02 February 2005" description="Sample combined configura
        <UUVDynamicsCoefficients units="british" description="ARIES mathematical model coefficients">.
                <Vehicle weight="435" buoyancy="435" length="10.0" diameter="0.79" height="0.79" mbtWeight="0",
                <GravityCenter x="0.0104" y="0" z="0.08917"/>.
                <BuoyancyCenter x="0.0104" y="0" z="0"/>.
                <ControlConfiguration bodyThrusters="false" squareHull="true" xBowVertical="1.41" xSternVertic
                <OperationalCharacteristics maxSpeed="6.1" maxSurge="15" maxSway="15" maxHeave="15" maxRoll="1
                <InertiaMatrix Ixx="2.7" Iyy="210" Izz="225" Ixy="0" Ixz="0" Iyz="0"/>.
                <SurgeCoefficients XuDot="-0.00282" XvDot="0" XwDot="0" XpDot="0" XqDot="0" XrDot="0" Xuu="0"
                <SwayCoefficients YuDot="0" YvDot="-0.0343" YwDot="0" YpDot="0" YqDot="0" YrDot="-0.00178" Yuu
                <HeaveCoefficients ZuDot="0" ZvDot="0" ZwDot="-0.0934" ZpDot="0" ZqDot="-0.00253" ZrDot="0" Zv
                <RollCoefficients KuDot="0" KvDot="0" KwDot="0" KpDot="-0.00024" KqDot="0" KrDot="0" Kuu="0" K
                <PitchCoefficients MuDot="0" MvDot="0" MwDot="-0.00253" MpDot="0" MqDot="-0.00625" MrDot="0" M
                <YawCoefficients NuDot="0" NvDot="-0.00178" NwDot="0" NpDot="0" NqDot="0" NrDot="-0.00047" Nuu
                <CrossSectionArrays arrayElements="15">.
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                        <XX element="1" value="-3.2667"/>.
                        <XX element="2" value="-2.9333"/>.
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                        <XX element="14" value="3.6417"/>.
```
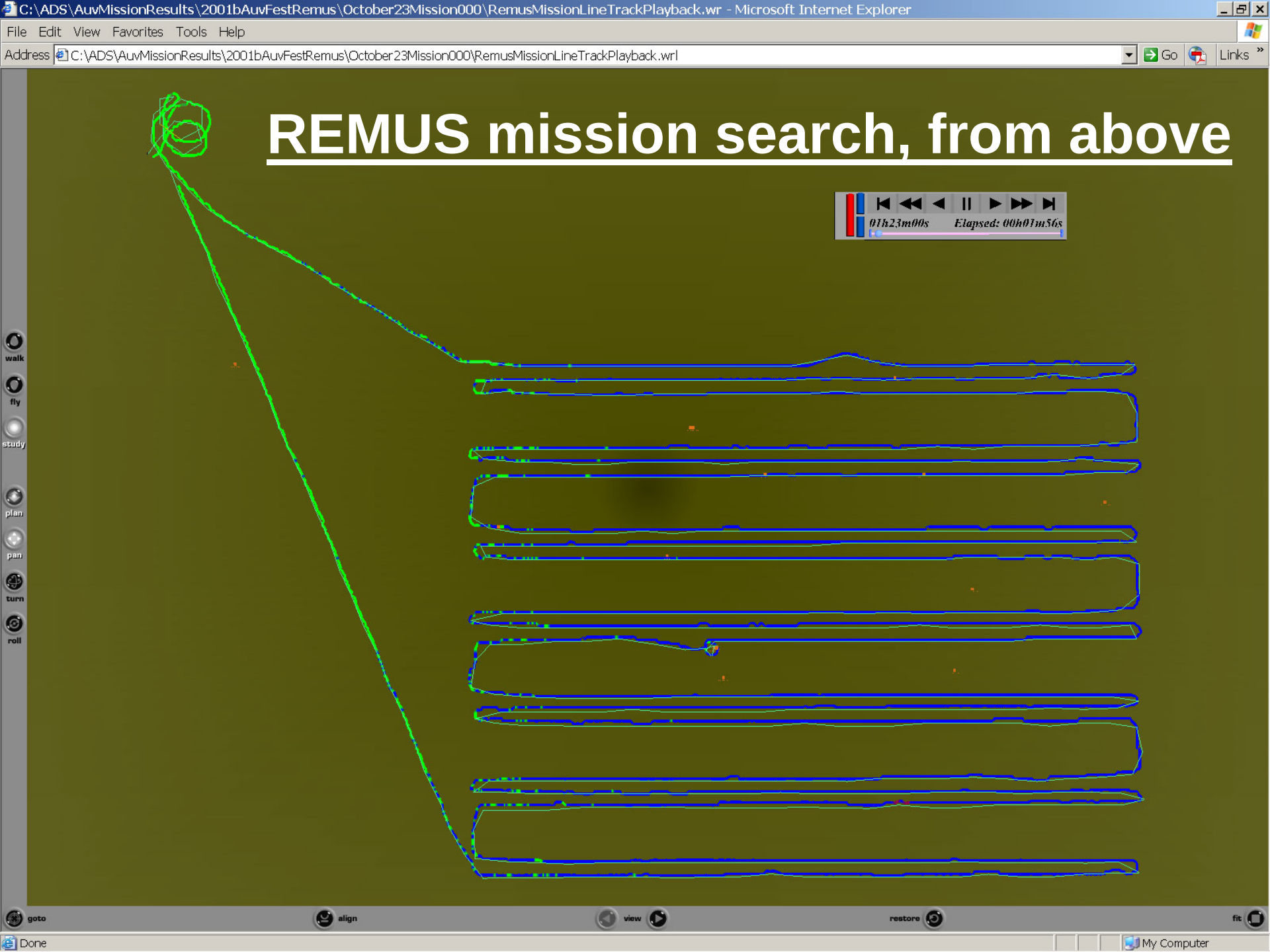

7,48-62 Top XML parsing complete, 2 error(s) (xml,none,UTF-8) - - - - W 4/7Mb

Wave modeling

- Triple sinusoid Pierson Moskowitz equations provide good emulation of variable sea state
  - Well understood example model
  - Many other variations exist, could substitute
- Real-time modeling of underwater vehicle response when broached
  - Split hull into sections
  - Compute each one as linear approximation
  - Buoyancy components add to overall response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File Edit View Favorites Tools Help
Address C:\ADS\AuvMissionResults\2001bAuvFestRemus\October23Mission000\RemusMissionLineTrackPlayback.wrl
Go
Links
REMUS mission search, from above
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study
plan
pan
turn
roll
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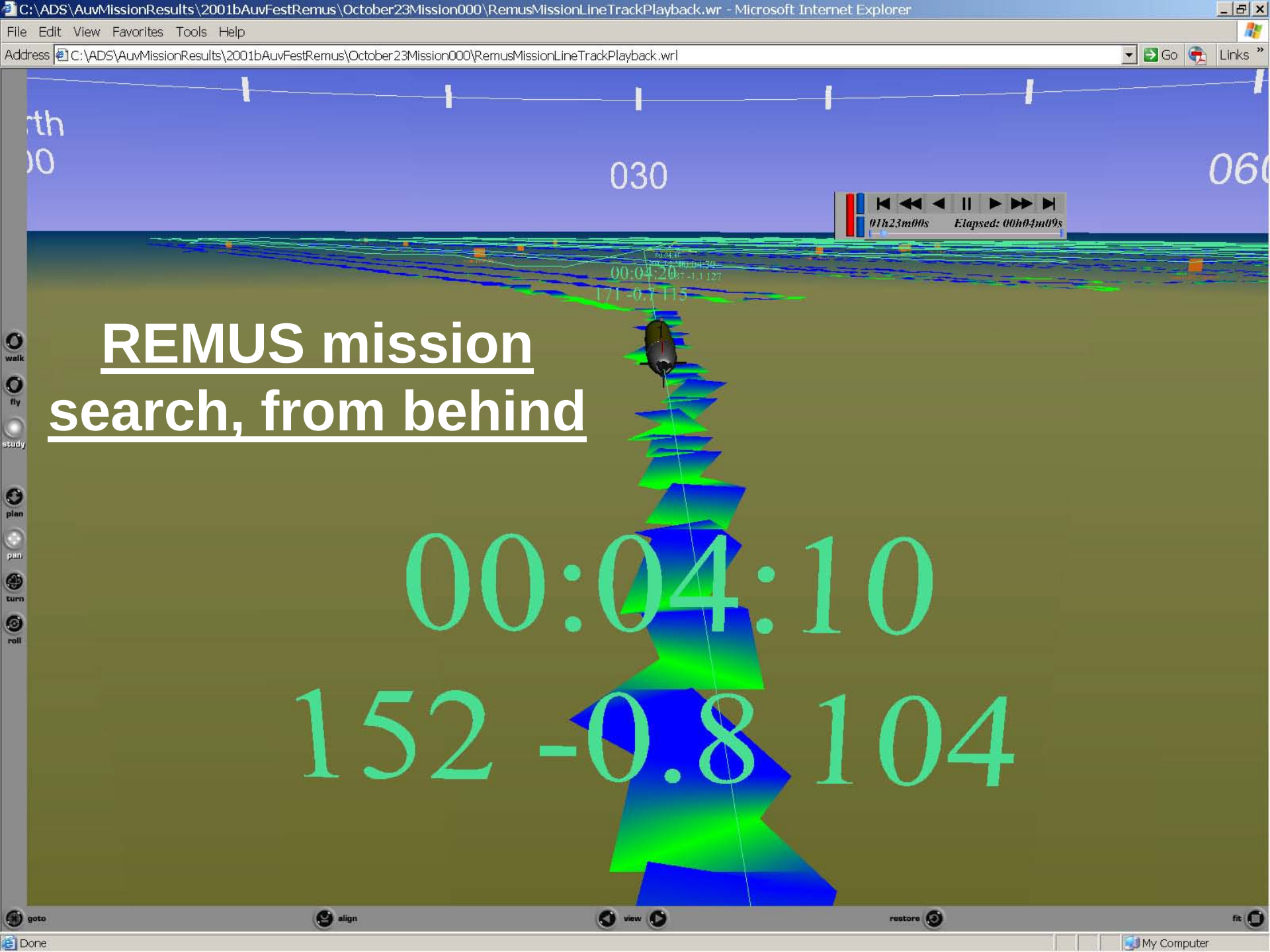
align
view
restore
fit
Done
My Computer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Go
Links
030
01h23m00s
Elapsed: 00h04m09s
REMUS mission search, from behind
00:04:10
152 -0.8 104
walk
fly
study
plan
pan
turn
roll
goto
align
view
restore
fit
Done
My Computer

Group development support

- Open standards throughout
- Open source Java for software
- All data structured as XML
- Website https://savage.nps.edu/AuvWorkbench
- XMSF Bugtracker
- Email list with hypermail archive
- Online autoinstallers

NPS Autonomous Unmanned Vehicle (AUV) Workbench

Information

- Flyer, poster, and latest slidesets
- Presentations, papers, theses, dissertations
- Autonomous Vehicle Command Language (AVCL)
- SAVAGE Modeling and Analysis Language (SMAL)

Tutorial (abstract and slides) presented at Unmanned Untethered Submersibles Technology (UUST) Symposium, 19-22 August 2007, Durham New Hampshire

Installation and open-source software development

- Autoinstall software
- Mailing list and mailing list archive
- XMSF Issue Tracker for bug reports and feature requests
- Version control: SVN source archive with SVN Web view of source files
- AUV Workbench AutoUpdate Control for manual control of automatic nightly server-side software updates (available to system administrators only)

Example missions

- AUV Workbench Robot Telemetry: Savage Archives
- AUV Workbench Robot Telemetry: SavageDefense Archives (password protected)

Example Auto Generated Post-mission Report

- Generic Auto Generated Post-mission Report

Related resources

- Extensible 3D (X3D) Graphics (also X3D Help, X3D-Edit, X3D examples, X3D Earth and X3dGraphics.com)
- Scenario Authoring and Visualization for Advanced Graphical Environments (Savage) and Savage Defense X3D model archives

XMSF Bugtracker

Actions

- Search existing bug reports
- Enter a new bug report
- Summary reports and charts

- Change password or user preferences
  Logout brutzman@nps.navy.mil
- Add to Sidebar (Requires Mozilla or Netscape 6)

Enter a bug # or some search terms:
Show [Help]

Supported projects

- NPS Autonomous Unmanned Vehicle (AUV) Workbench
- Extensible Modeling and Simulation Framework (XMSF)

Help references

- Bugzilla Guide
- Bugzilla documentation page
- Bugzilla version 2.18rc2
- Don McGregor's guides to Concurrent Version System (CVS), Using CVS with SSH Tunnels and Ant

Actions: New | Search | Find bug # | Reports | My Requests | My Votes | Sanity check | Log out brutzman@nps.navy.mil
Edit: Prefs | Parameters | Users | Products | Flags | Groups | Keywords
Saved Searches: My Bugs | Active bugs | All bugs | attachments | auvw | calendar | FOUO | license | new | P1 | savage | sonar | usw-xml | waterside-protection | xj3d

AuvWorkbench -- NPS AUV Workbench software development. Open, unmoderated, archived.

About AuvWorkbench

Mailing list support

English (USA)

The NPS Autonomous Unmanned Vehicle (AUV) Workbench is used for rehearsal, real-time control and replay of AUV/UAV missions. Physics-based hydronamics/aerodynamics and sensor propagation/interaction are used to test robot software in realistic ways. X3D graphics, DIS networking and XMSF web services are integral components. This software and associated models are open source, use open standards, and are available for shared use. Open, unmoderated, archived.

Further information regarding the NPS AUV Workbench is available at http://www.movesinstitute.org/xmsf/xmsf.html#Projects-AUV.

The large (80MB) autoinstaller is available at http://terra.cs.nps.navy.mil/AUV/workbench.

Bugs and improvements in the NPS AUV Workbench are viewable on the XMSF Bugtracker pages.

To see the collection of prior postings to this mailing list, visit the AuvWorkbench Archives.

Using AuvWorkbench

To post a message to all the list members, send email to auvworkbench@MovesInstitute.org.

You can subscribe to the list, or change your existing subscription, in the sections below.

Subscribing to AuvWorkbench

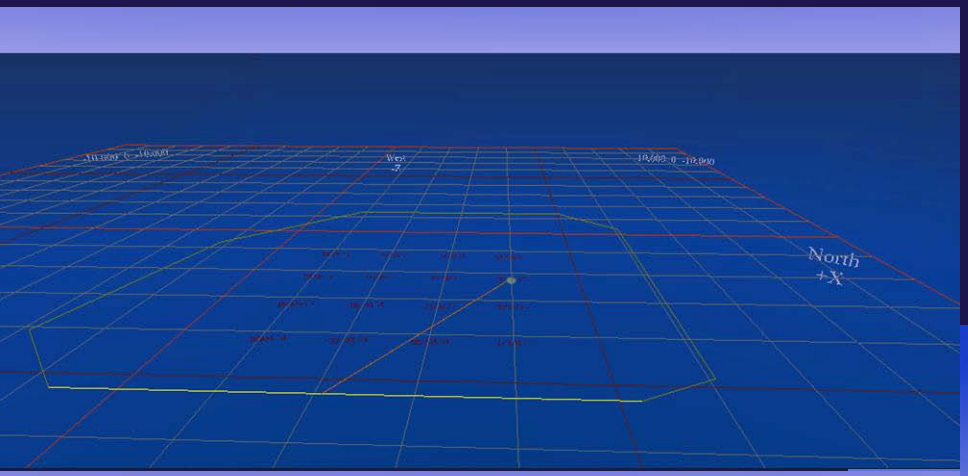
Environmental data inputs

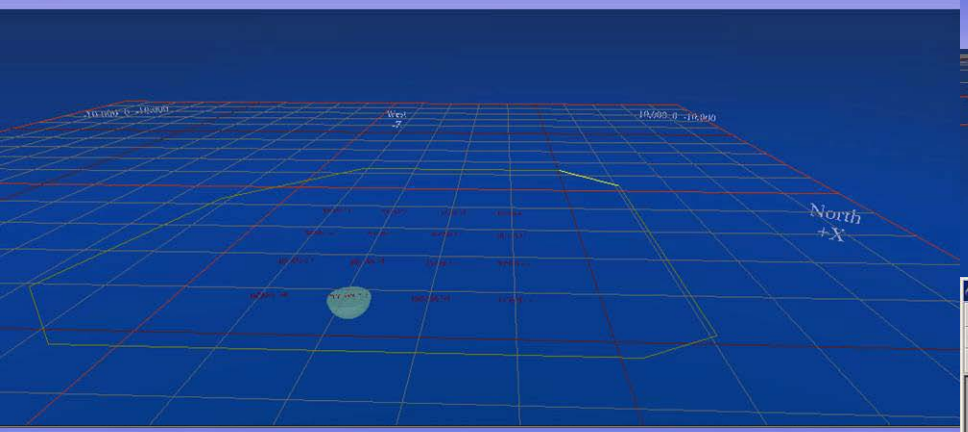
- Constant vectors for ocean current, wind
- NetCDF environmental data developed by NAVO/NRL Stennis supercomputer models
- FNMOC web-services query to live/projected meteorological sources using Joint Metoc Brokering Language
  - Worked briefly but was a moving target…
- Other inputs welcome

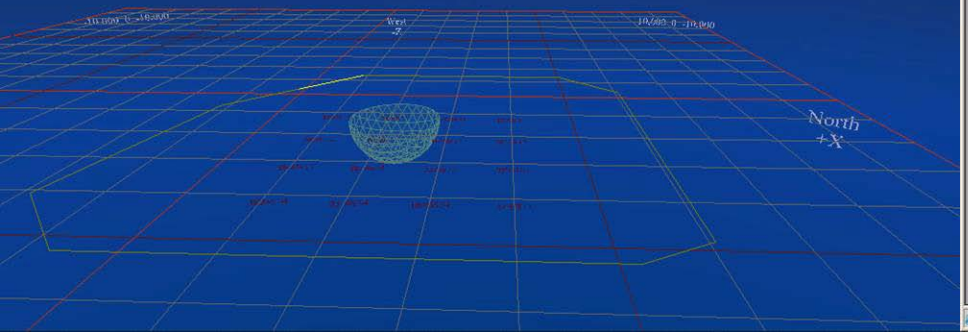
Goal Outcomes: sonar-vis project

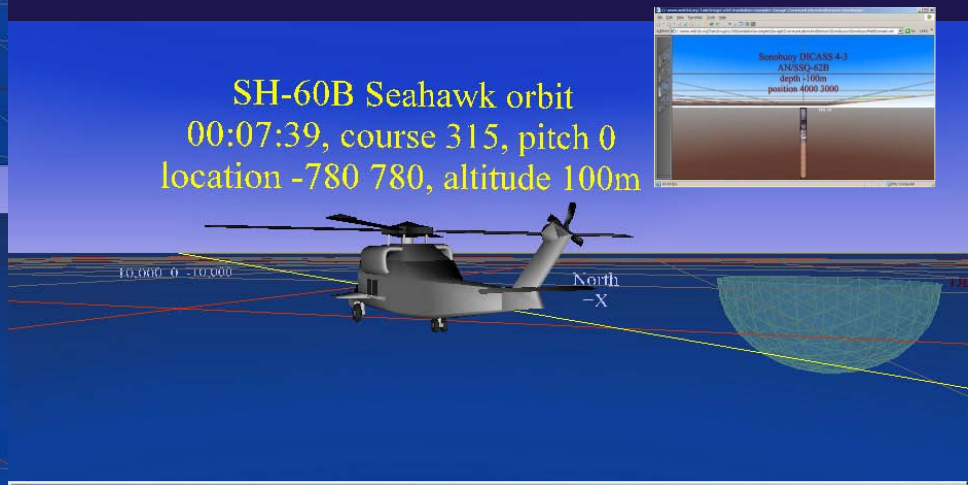
- Sonar and battlespace visualization
- Link aircraft, ship and HPCC computing
  - Similar interfaces, with/without connectivity
  - “Tactical Supercomputing” refrigerator box
- Support shared situational awareness
  - Candidate technologies for spiral development
  - Continue to lead usw-xml working group for USN NAVSEA

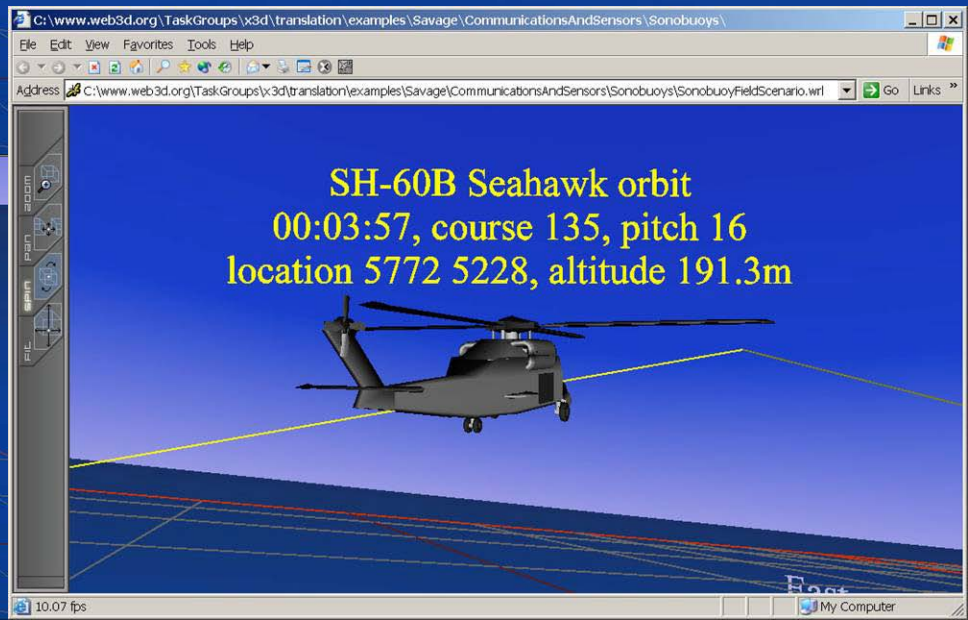
Sonobuoy field visualization



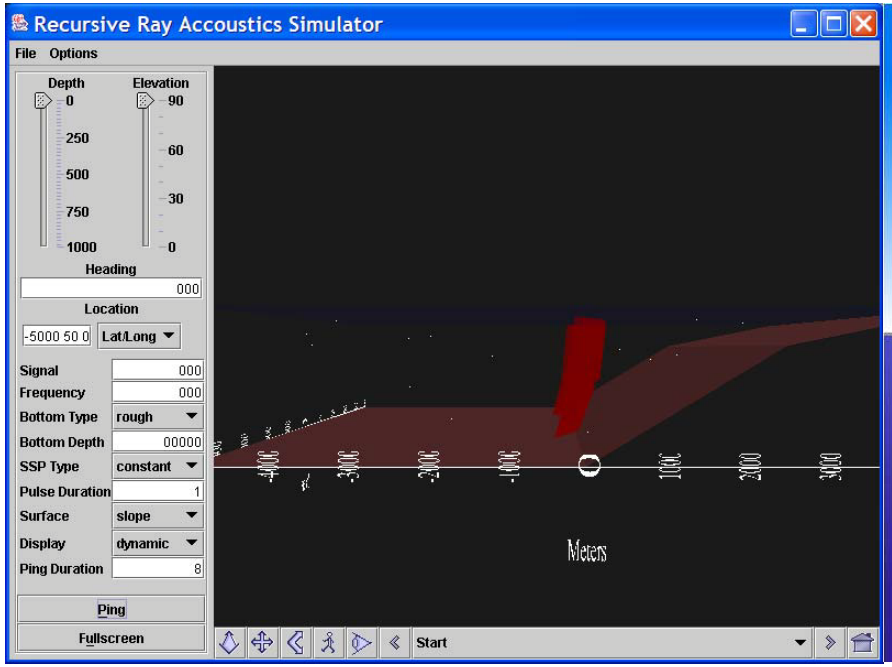


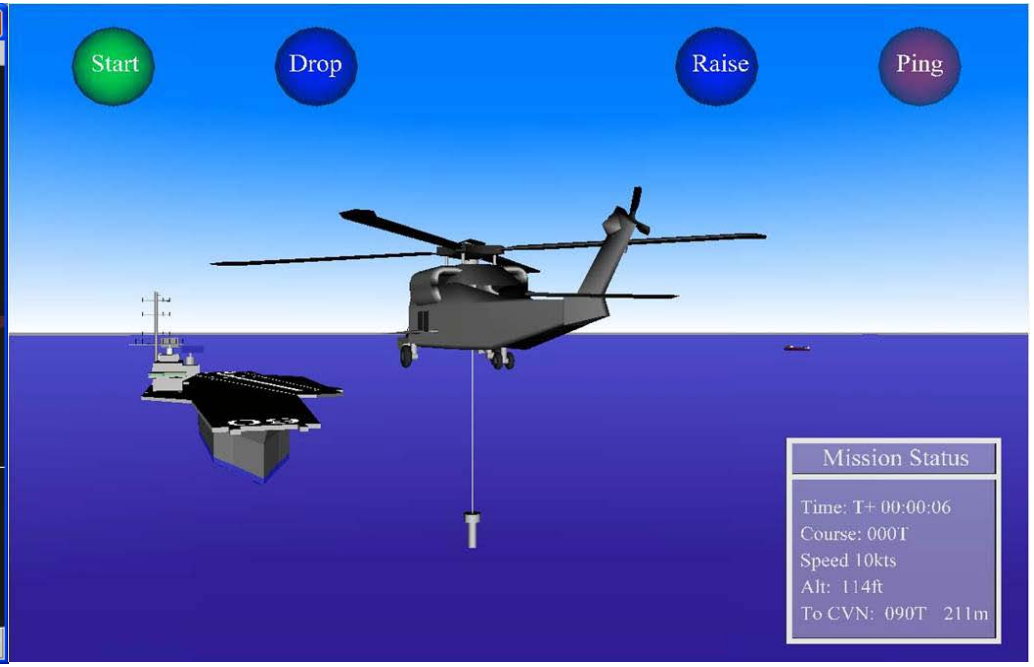






Integrating 2D/3D interfaces with Web Services





sonar-vis Project Description

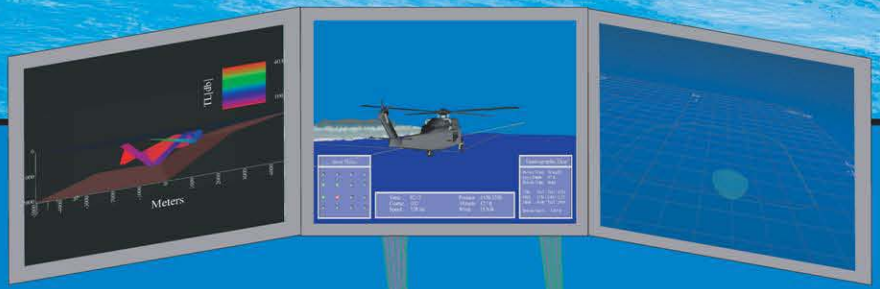
- Visualize multipath 3D sonar propagation
  - Situational awareness, sensitivity analysis
  - Multiple models: path, transmission loss, P_D ...
  - Operator familiarization, training, experience
- Enhance TDAs for at-sea operators
  - Reachback using Web services messaging, accessing both computational and data assets
  - Open source open standards: Java, X3D, XML

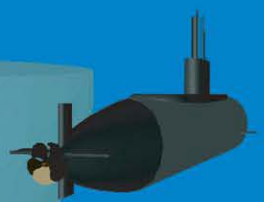
Sonar Visualization

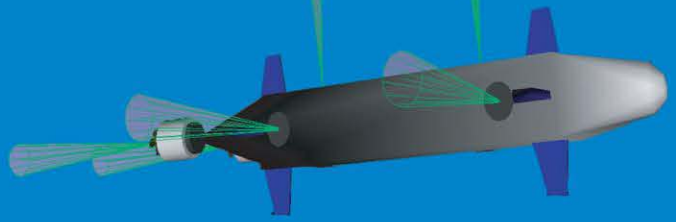
NAVAIR Naval Air Systems Command
SONALYSTS
The MOVES Institute
Naval Postgraduate School
NPS

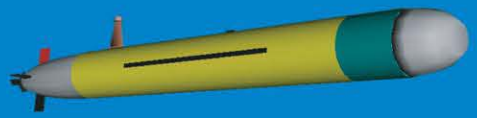
X3D Real-time Analysis with

Recursive Ray Acoustics





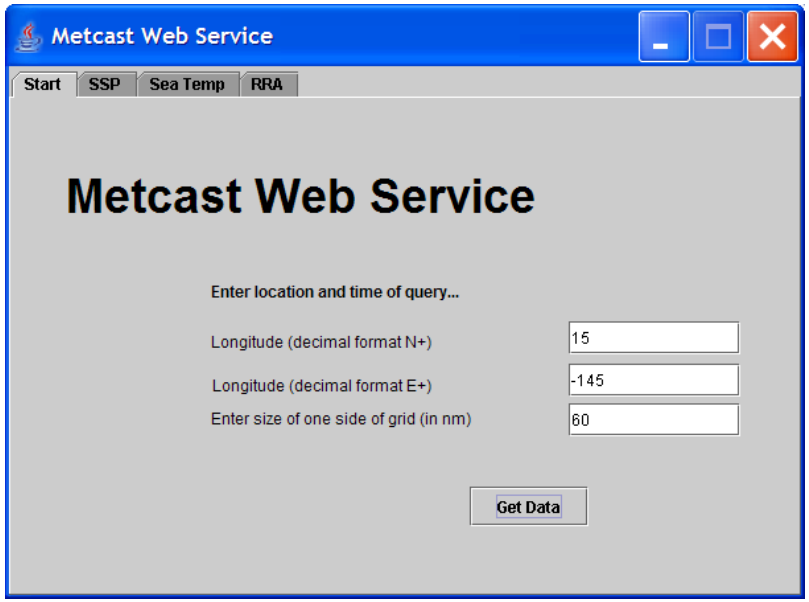


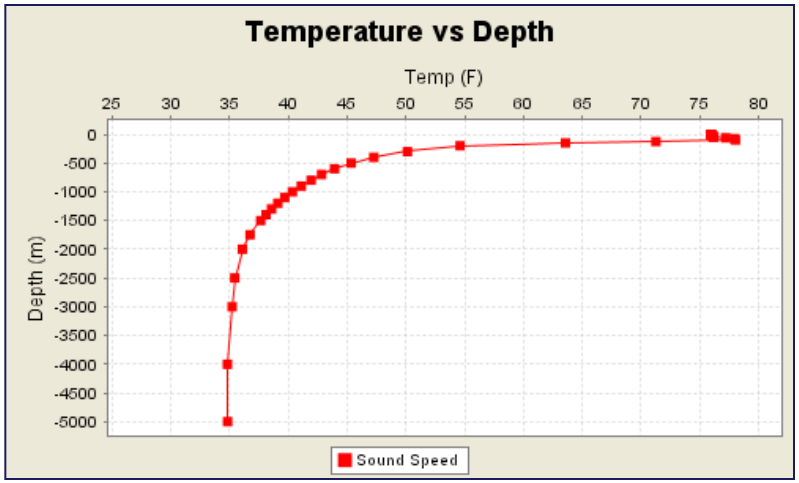


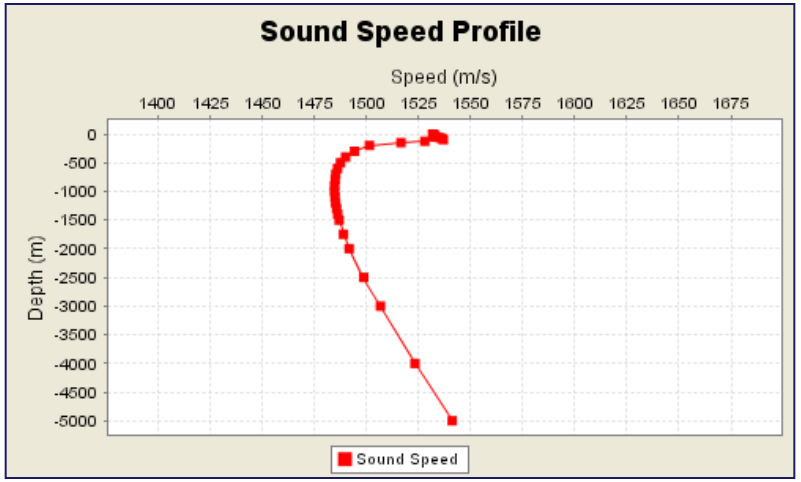
LT Scott Rosetti USNR
xmsf-contact@MovesInstitute.org

XML web services for METOC data 1

- Query panel and plotted response







XML web services for METOC data 2

- Monitoring initial query/response sequence

TCP Tunnel/Monitor: Tunneling localhost:80 to localhost:8080

From localhost:80

```
POST /soap/servlet/rpcrouter HTTP/1.0
Host: localhost:80
Content-Type: text/xml; charset=utf-8
Content-Length: 560
SOAPAction: ""

<?xml version='1.0' encoding='UTF-8'?>
<SOAP-ENV:Envelope xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:xsd="http://www.v
<SOAP-ENV:Body>
<ns1:makeRequest xmlns:ns1="urn:FnMOC:MetcastServer" SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/">
<latitude xsi:type="xsd:double">15.0</latitude>
<longitude xsi:type="xsd:double">-145.0</longitude>
<size xsi:type="xsd:double">1.0</size>
</ns1:makeRequest>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

From localhost:8080

```
HTTP/1.1 200 OK
X-Powered-By: Servlet/2.4
Set-Cookie: JSESSIONID=DFBBD129E072E1AA73A2734F3AD40D8E; Path=/soap
Content-Type: text/xml; charset=utf-8
Content-Length: 11250
Date: Wed, 14 Apr 2004 20:21:46 GMT
Server: Sun-Java-System/JWSDP-1.3
Connection: close

<?xml version='1.0' encoding='UTF-8'?>
<SOAP-ENV:Envelope xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:xsd="http://www.v
<SOAP-ENV:Body>
<ns1:makeRequestResponse xmlns:ns1="urn:FnMOC:MetcastServer" SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/">
<return xsi:type="xsd:string">&lt;?xml version=&apos;1.0&apos; encoding=&apos;UTF-8&apos;?&gt;
&lt;MetcastResponse&gt;
        &lt;Time&gt;Wed Apr 14 13:21:46 PDT 2004&lt;/Time&gt;
        &lt;Location&gt;
                &lt;Latitude&gt;15.0&lt;/Latitude&gt;
                &lt;Longitude&gt;-145.0&lt;/Longitude&gt;
        &lt;/Location&gt;
        &lt;SoundSpeed model = &apos;OTIS_GLOBAL&apos; units = &apos;m/s&apos; levelType = &apos;dpth_sfc&apos; levelUnits = &apos;m&apos;&gt;
                &lt;SoundSpeedLevels&gt;0.0 2.5 7.5 12.5 17.5 25.0 32.5 40.0 50.0 62.5 75.0 100.0 125.0 150.0 200.0 300.0 400.0 500.0 600.0 700.0 800.0 900
                &lt;SoundSpeedValues&gt;1532.5228 1532.5665 1532.6497 1532.7443 1532.8457 1532.976 1533.1409 1533.4364 1533.6415 1535.0869 153
        &lt;/SoundSpeed&gt;
        &lt;SeawaterTemperature model = &apos;OTIS_GLOBAL&apos; units = &apos;K&apos; levelType = &apos;dpth_sfc&apos; levelUnits = &apos;m&apos;&gt;
                &lt;SeawaterTemperatureLevels&gt;0.0 2.5 7.5 12.5 17.5 25.0 32.5 40.0 50.0 62.5 75.0 100.0 125.0 150.0 200.0 300.0 400.0 500.0 600.0 700.0
                &lt;SeawaterTemperatureValues&gt;297.64282 297.6426 297.64124 297.64352 297.6482 297.64932 297.66162 297.72046 297.7328 298.171
        &lt;/SeawaterTemperature&gt;
        &lt;WindComponent_U model = &apos;NOGAPS&apos; units = &apos;m/s&apos; levelType = &apos;ht_sfc&apos; levelUnits = &apos;m&apos;&gt;
                &lt;WindComponent_ULevels&gt;10.0 &lt;/WindComponent_ULevels&gt;
                &lt;WindComponent_UValues&gt;-7.297595 &lt;/WindComponent_UValues&gt;
        &lt;/WindComponent_U&gt;
        &lt;WindComponent_V model = &apos;NOGAPS&apos; units = &apos;m/s&apos; levelType = &apos;ht_sfc&apos; levelUnits = &apos;m&apos;&gt;
                &lt;WindComponent_VLevels&gt;10.0 &lt;/WindComponent_VLevels&gt;
                &lt;WindComponent_VValues&gt;-1.6233099 &lt;/WindComponent_VValues&gt;
        &lt;/WindComponent_V&gt;
        &lt;SignificantWaveHeight model = &apos;WW3_GLOBAL&apos; units = &apos;m&apos; levelType = &apos;surface&apos; levelUnits = &apos;&apos;&gt;
                &lt;SignificantWaveHeightLevels&gt;0.0 &lt;/SignificantWaveHeightLevels&gt;
                &lt;SignificantWaveHeightValues&gt;2.0740802 &lt;/SignificantWaveHeightValues&gt;
        &lt;/SignificantWaveHeight&gt;
        &lt;Bathymetry model = &apos;ETOPO2&apos; units = &apos;m&apos; Reference = &apos;hr&apos; Resolution = &apos;0.03333333333333333&apos;&gt;
                &lt;BathymetryValues&gt;-5327.0 -5373.0 -5386.0 -5342.0 -5273.0 -5223.0 -5214.0 -5214.0 -5219.0 -5262.0 -5311.0 -5318.0 -5254.0 -5135.0 -5
4825.0 -4873.0 -4921.0 -4946.0 -4952.0 -4953.0 -4957.0 -4959.0 -4960.0 -4969.0 -4983.0 -4996.0 -5003.0 -5016.0 -5040.0 -5067.0 -5074.0 -5044.0 -4985.0 -5370.0 -502
        &lt;/Bathymetry&gt;
&lt;/MetcastResponse&gt;</return>
</ns1:makeRequestResponse>

</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

XML web services for METOC data 3

C:\Documents and Settings\Administrator\Desktop\Metcast Ideal.xml - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Search Favorites Media

Address C:\Documents and Settings\Administrator\Desktop\Metcast Ideal.xml

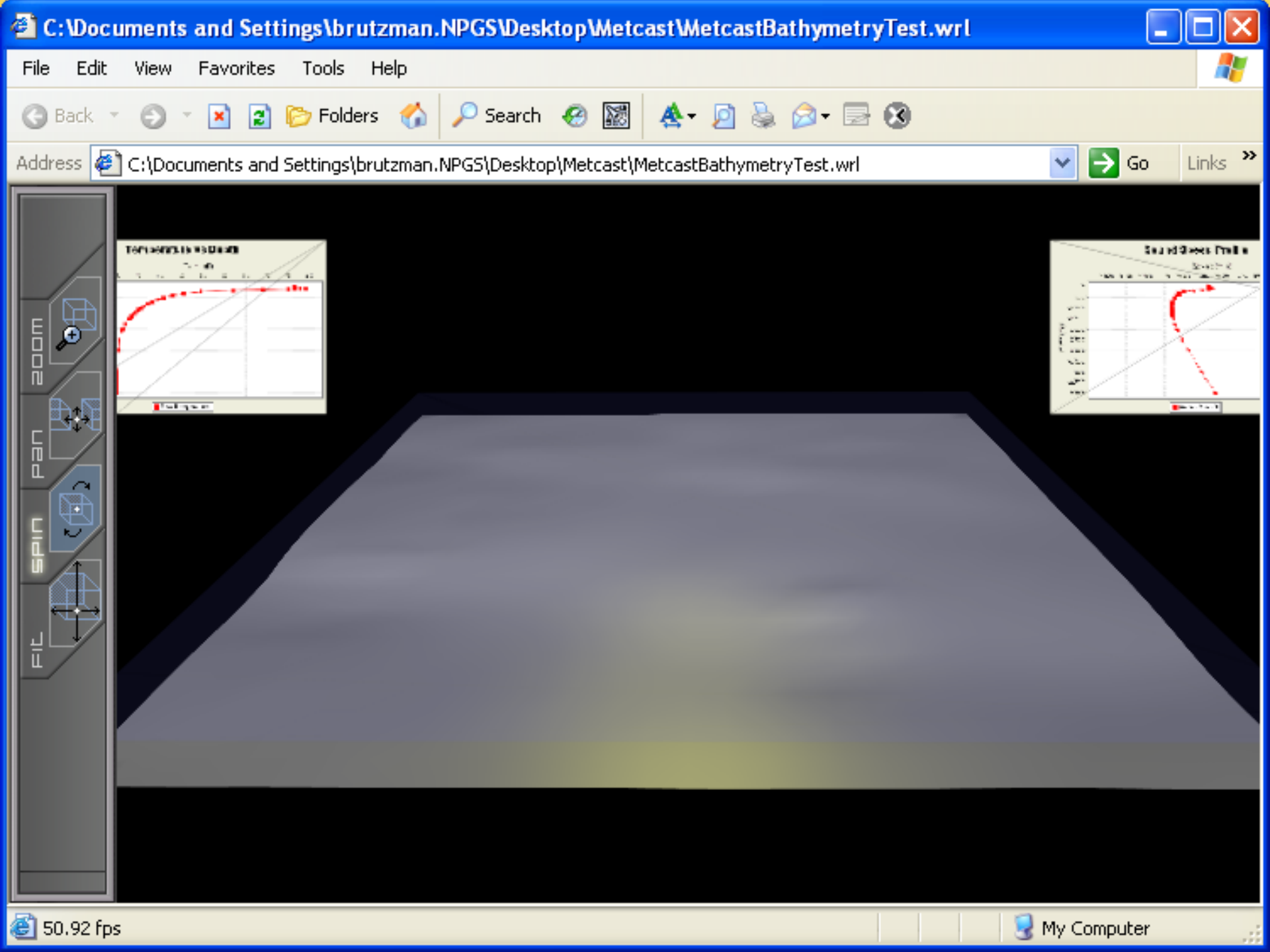
Go Links

Server-side supercomputer response


```
<?xml version="1.0" encoding="UTF-8" ?>
- <MetcastResponse>
  <Time>Tue Apr 13 16:08:22 PDT 2004</Time>
  - <Location>
    <Latitude>15.0</Latitude>
    <Longitude>-145.0</Longitude>
  </Location>
  - <SoundSpeed model="OTIS_GLOBAL" units="m/s" levelType="dpth_sfc" levelUnits="m">
    <SoundSpeedLevels>0.0 2.5 7.5 12.5 17.5 25.0 32.5 40.0 50.0 62.5 75.0 100.0 125.0 150.0 200.0 300.0 400.0 500.0 600.0 700.0 800.0 900.0 1000.0 1100.0 1200.0 1300.0 1400.0 1500.0 1750.0
      2000.0 2500.0 3000.0 4000.0 5000.0</SoundSpeedLevels>
    <SoundSpeedValues>1533.2368 1533.2837 1533.3651 1533.4594 1533.5604 1533.6907 1533.8578 1534.1521 1534.3506 1535.683 1537.0082 1536.3484 1530.2184 1519.5878 1502.3767
      1494.4065 1490.1472 1487.5873 1486.1252 1485.2205 1484.8405 1484.6147 1484.6167 1484.802 1485.142 1485.5953 1486.1825 1486.853 1488.9436 1491.6838 1498.6909 1506.7856
      1523.3649 1541.2067</SoundSpeedValues>
  </SoundSpeed>
  - <SeawaterTemperature model="OTIS_GLOBAL" units="K" levelType="dpth_sfc" levelUnits="m">
    <SeawaterTemperatureLevels>0.0 2.5 7.5 12.5 17.5 25.0 32.5 40.0 50.0 62.5 75.0 100.0 125.0 150.0 200.0 300.0 400.0 500.0 600.0 700.0 800.0 900.0 1000.0 1100.0 1200.0 1300.0 1400.0 1500.0
      1750.0 2000.0 2500.0 3000.0 4000.0 5000.0</SeawaterTemperatureLevels>
    <SeawaterTemperatureValues>297.9258 297.92657 297.92444 297.92657 297.93106 297.9321 297.9453 298.00403 298.0136 298.41357 298.81738 298.3377 295.6533 291.57425 285.8262
      283.10498 281.5089 280.4141 279.62283 278.98135 278.47726 278.0146 277.6101 277.25177 276.9304 276.63718 276.375 276.13318 275.6275 275.2732 274.91293 274.7876 274.56995
      274.5751</SeawaterTemperatureValues>
  </SeawaterTemperature>
  - <WindComponent_U model="NOGAPS" units="m/s" levelType="ht_sfc" levelUnits="m">
    <WindComponent_ULevels>10.0</WindComponent_ULevels>
    <WindComponent_UValues>-8.53225</WindComponent_UValues>
  </WindComponent_U>
  - <WindComponent_V model="NOGAPS" units="m/s" levelType="ht_sfc" levelUnits="m">
    <WindComponent_VLevels>10.0</WindComponent_VLevels>
    <WindComponent_VValues>-3.744018</WindComponent_VValues>
  </WindComponent_V>
  - <SignificantWaveHeight model="WW3_GLOBAL" units="m" levelType="surface" levelUnits="">
    <SignificantWaveHeightLevels>0.0</SignificantWaveHeightLevels>
    <SignificantWaveHeightValues>2.0074282</SignificantWaveHeightValues>
  </SignificantWaveHeight>
  - <Bathymetry model="ETOPO2" units="m" Reference="hr" Resolution="0.03333333333333333">
    <BathymetryValues>-5327.0 -5373.0 -5386.0 -5342.0 -5273.0 -5223.0 -5214.0 -5214.0 -5219.0 -5262.0 -5311.0 -5318.0 -5254.0 -5135.0 -5004.0 -4920.0 -4922.0 -4972.0 -5017.0 -5052.0 -5089.0 -
      5114.0 -5109.0 -5089.0 -5078.0 -5073.0 -5057.0 -5048.0 -5050.0 -5053.0 -5116.0 -5278.0 -5277.0 -5255.0 -5218.0 -5189.0 -5186.0 -5206.0 -5216.0 -5238.0 -5284.0 -5325.0 -5330.0 -5264.0 -
      5134.0 -4984.0 -4883.0 -4878.0 -4940.0 -4996.0 -5026.0 -5081.0 -5128.0 -5124.0 -5093.0 -5082.0 -5083.0 -5064.0 -5083.0 -5074.0 -5043.0 -5132.0 -5236.0 -5216.0 -5188.0 -5157.0 -5156.0 -
      5190.0 -5218.0 -5234.0 -5249.0 -5274.0 -5309.0 -5318.0 -5260.0 -5138.0 -5003.0 -4916.0 -4907.0 -4957.0 -5003.0 -5040.0 -5111.0 -5160.0 -5164.0 -5104.0 -5081.0 -5111.0 -5091.0 -5124.0 -
      5068.0 -4991.0 -5066.0 -5201.0 -5177.0 -5167.0 -5161.0 -5172.0 -5193.0 -5211.0 -5213.0 -5200.0 -5210.0 -5248.0 -5270.0 -5232.0 -5136.0 -5047.0 -4998.0 -4984.0 -5005.0 -5024.0 -5043.0 -
      5130.0 -5182.0 -5167.0 -5088.0 -5044.0 -5096.0 -5115.0 -5106.0 -5043.0 -5002.0 -5038.0 -5219.0 -5208.0 -5209.0 -5203.0 -5187.0 -5168.0 -5170.0 -5151.0 -5110.0 -5111.0 -5148.0 -5177.0 -
      5160.0 -5113.0 -5084.0 -5078.0 -5065.0 -5054.0 -5059.0 -5062.0 -5133.0 -5169.0 -5123.0 -5066.0 -5005.0 -5030.0 -5071.0 -5054.0 -5000.0 -4977.0 -5015.0 -5295.0 -5283.0 -5273.0 -5243.0 -
      5183.0 -5094.0 -5053.0 -5035.0 -5005.0 -5020.0 -5062.0 -5086.0 -5059.0 -5051.0 -5087.0 -5127.0 -5120.0 -5074.0 -5067.0 -5071.0 -5112.0 -5149.0 -5147.0 -5130.0 -5083.0 -5075.0 -5074.0 -
      5041.0 -4990.0 -4966.0 -5001.0 -5402.0 -5377.0 -5348.0 -5297.0 -5216.0 -5094.0 -4994.0 -4954.0 -4951.0 -4970.0 -5037.0 -5077.0 -5027.0 -5024.0 -5081.0 -5129.0 -5111.0 -5042.0 -5009.0 -
      5033.0 -5119.0 -5189.0 -5203.0 -5192.0 -5155.0 -5130.0 -5099.0 -5058.0 -5018.0 -4997.0 -5013.0 -5457.0 -5430.0 -5392.0 -5358.0 -5315.0 -5252.0 -5197.0 -5102.0 -5023.0 -5007.0 -5049.0 -
      5092.0 -5059.0 -5048.0 -5079.0 -5099.0 -5063.0 -4985.0 -4932.0 -4968.0 -5085.0 -5182.0 -5195.0 -5163.0 -5126.0 -5099.0 -5079.0 -5060.0 -5044.0 -5040.0 -5044.0 -5369.0 -5373.0 -5362.0 -
      5361.0 -5324.0 -5315.0 -5350.0 -5271.0 -5163.0 -5109.0 -5086.0 -5086.0 -5072.0 -5072.0 -5098.0 -5107.0 -5060.0 -4965.0 -4894.0 -4901.0 -4972.0 -5049.0 -5075.0 -5054.0 -5021.0 -5003.0 -
      5009.0 -5036.0 -5057.0 -5077.0 -5088.0 -5181.0 -5233.0 -5221.0 -5228.0 -5193.0 -5262.0 -5378.0 -5342.0 -5266.0 -5191.0 -5136.0 -5108.0 -5092.0 -5102.0 -5159.0 -5193.0 -5141.0 -5045.0 -
      4960.0 -4907.0 -4917.0 -4968.0 -4988.0 -4969.0 -4933.0 -4914.0 -4934.0 -4995.0 -5054.0 -5100.0 -5123.0 -5020.0 -5050.0 -5034.0 -5053.0 -5074.0 -5194.0 -5324.0 -5305.0 -5240.0 -5175.0 -
      5138.0 -5130.0 -5106.0 -5119.0 -5251.0 -5340.0 -5297.0 -5225.0 -5151.0 -5081.0 -5047.0 -5040.0 -5024.0 -4987.0 -4935.0 -4901.0 -4909.0 -4967.0 -5039.0 -5090.0 -5114.0 -4934.0 -4922.0 -
      4917.0 -4942.0 -4988.0 -5070.0 -5152.0 -5161.0 -5126.0 -5099.0 -5086.0 -5116.0 -5080.0 -5104.0 -5286.0 -5385.0 -5388.0 -5360.0 -5318.0 -5274.0 -5213.0 -5150.0 -5116.0 -5083.0 -5028.0 -
```


Done

My Computer


C:\Documents and Settings\brutzman.NPGS\Desktop\Metcast\MetcastBathymetryTest.wrl
File Edit View Favorites Tools Help
Back Folders Search
Address C:\Documents and Settings\brutzman.NPGS\Desktop\Metcast\MetcastBathymetryTest.wrl
Go Links
zoom
pan
spin
fit
50.92 fps
My Computer

Technologies

- Extensible Markup Language (XML)
  - Validatable data, binary compression
  - Web Services for message exchange
- Enhance current sonar-model engines
  - Recursive Ray Acoustics (RRA) sonar computation
  - PC-IMAT/STAPLE/STDA(ASPECT) primary targets
  - Environmental data from FNMOC via Web services
- Extensible 3D (X3D) Graphics
  - Open-standard open-source interactive visualization

XML in 10 Points

http://www.w3.org/XML/1999/XML-in-10-points

- XML is for structuring data
- XML looks a bit like HTML
- XML is text, but isn't meant to be read
- XML is verbose by design
- XML is a family of technologies
- XML is new, but not that new
- XML leads HTML to XHTML
- XML is modular
- XML is basis for RDF and the Semantic Web
- XML is license-free, platform-independent and well-supported

400+ member companies & institutions in World Wide Web Consortium (W3C) already understand the business case

Extensible Modeling & Simulation Framework (XMSF)

- Web services for all manner of M&S
- A composable set of standards, profiles, and recommended practices for web-based M&S
- Foundational precepts: Internet network technologies, Extensible Markup Language (XML)-based languages, and service-oriented architectures for simple messaging
- Enable a new generation of distributed M&S applications to emerge, develop, interoperate with tactical systems
- Many easily repeatable exemplars using Web Services

http://www.MovesInstitute.org/xmsf

What is **3D**?

- 2½D works for chart-oriented displays
- 3D gives “fly-thru” freedom of viewpoint
  - View physically based propagation paths
  - View depth separation
  - View bottom, surface interactions
  - View multiple overlapping sensors
- Augment (not replace) existing displays

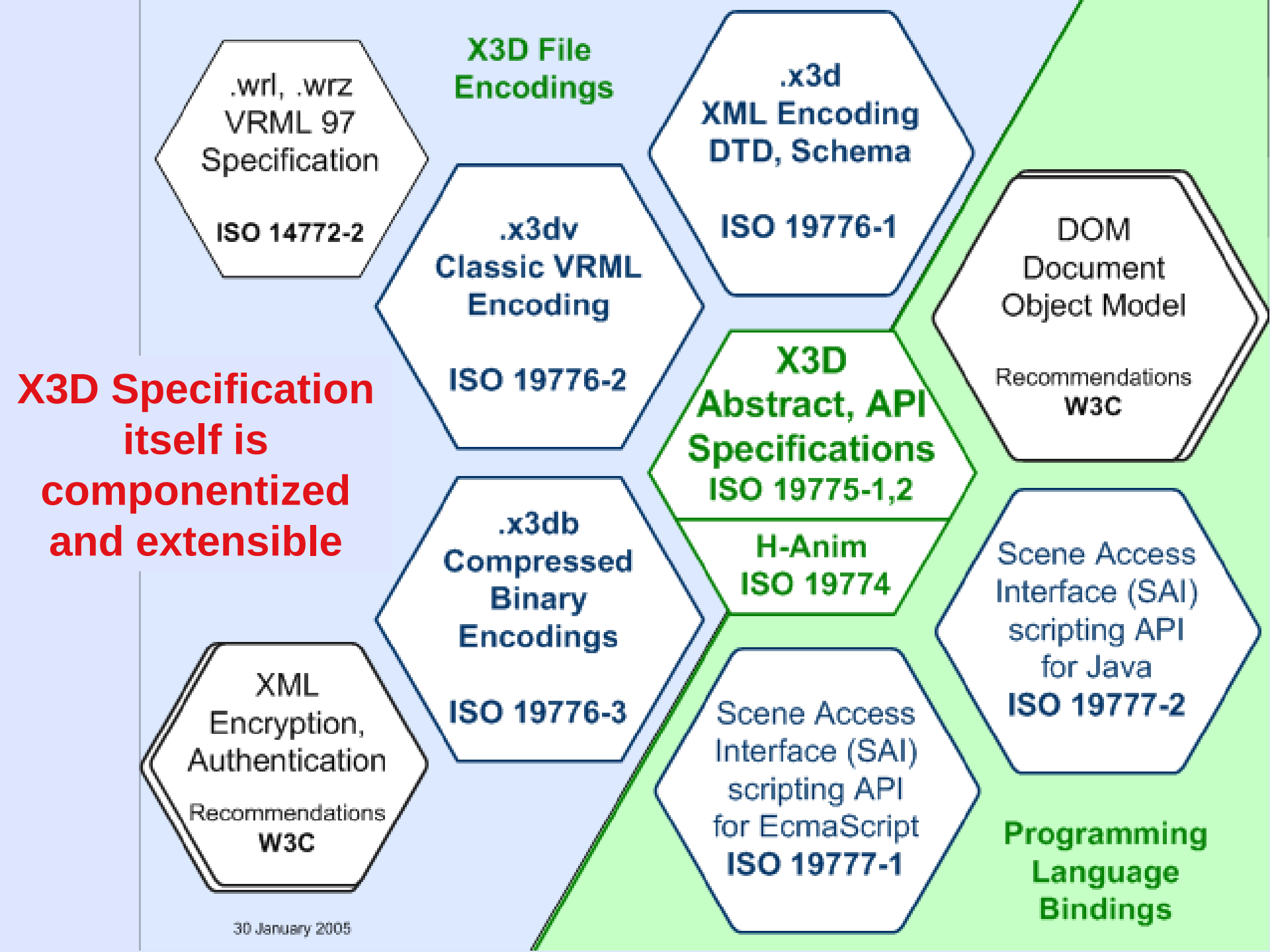
What is **X3D**?

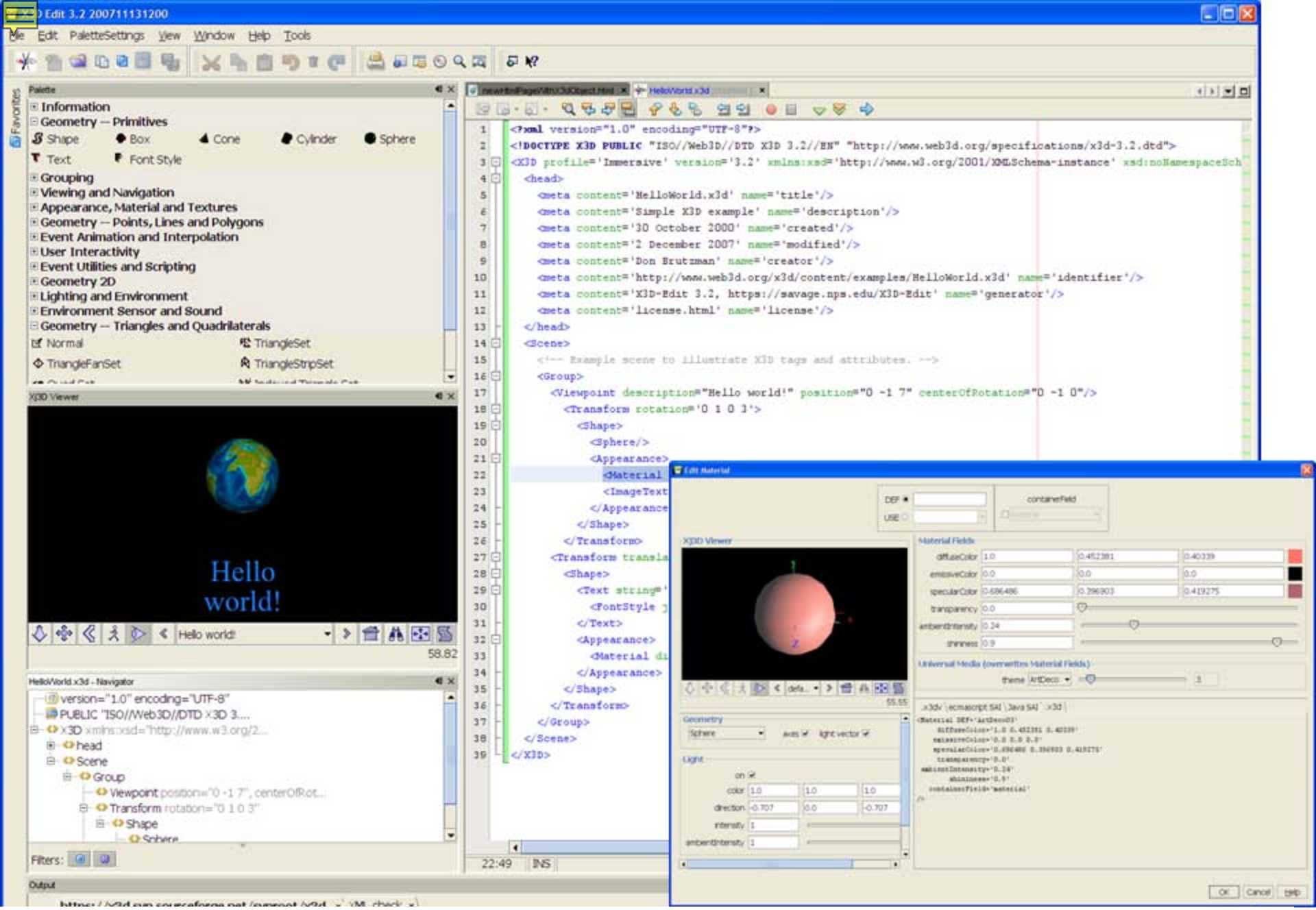
- Extensible 3D (X3D) Graphics
  - Virtual Reality Modeling Language (VRML) updated
  - Third-generation ISO specification
  - Compatible XML .x3d and Classic VRML .wrl encodings
- Deliverables
  - Specification updates, with compatible XML tagset
  - Multiple implementations, including open-source
  - Scene Access Interface (SAI) strongly typed API
  - Conformance suite and examples
  - Authoring capability: X3D-Edit, using XML for XML…

Further X3D motivations

- Authoring is hard, “Content is King”
  - X3D is not competing with specialty formats, instead provide common interoperability/interchange
  - Strong validation checks eliminate most authoring errors before content escapes
  - Plays well with next-generation Web languages

“3D hardware problem” is already solved ☺


X3D Specification itself is componentized and extensible
.wrl, .wrz
VRML 97
Specification
ISO 14772-2
X3D File Encodings
.x3d
XML Encoding
DTD, Schema
ISO 19776-1
.x3dv
Classic VRML
Encoding
ISO 19776-2
.x3db
Compressed
Binary
Encodings
ISO 19776-3
XML
Encryption,
Authentication
Recommendations
W3C
X3D
Abstract, API
Specifications
ISO 19775-1,2
H-Anim
ISO 19774
DOM
Document
Object Model
Recommendations
W3C
Scene Access
Interface (SAI)
scripting API
for Java
ISO 19777-2
Scene Access
Interface (SAI)
scripting API
for EcmaScript
ISO 19777-1
Programming
Language
Bindings
30 January 2005



Context-sensitive, self-validating, multi-lingual editing tools

Savage

Scenario Authoring and Visualization for Advanced Graphical Environments

The Scenario Authoring and Visualization for Advanced Graphical Environments (SAVAGE) project is a large archive of dynamic 3D military models and authoring tools, all open source and built using Extensible 3D (X3D) graphics.

Lots of models!

Zip archive

31 Sections, 198 Chapters, 1225 Models

X3D Resources

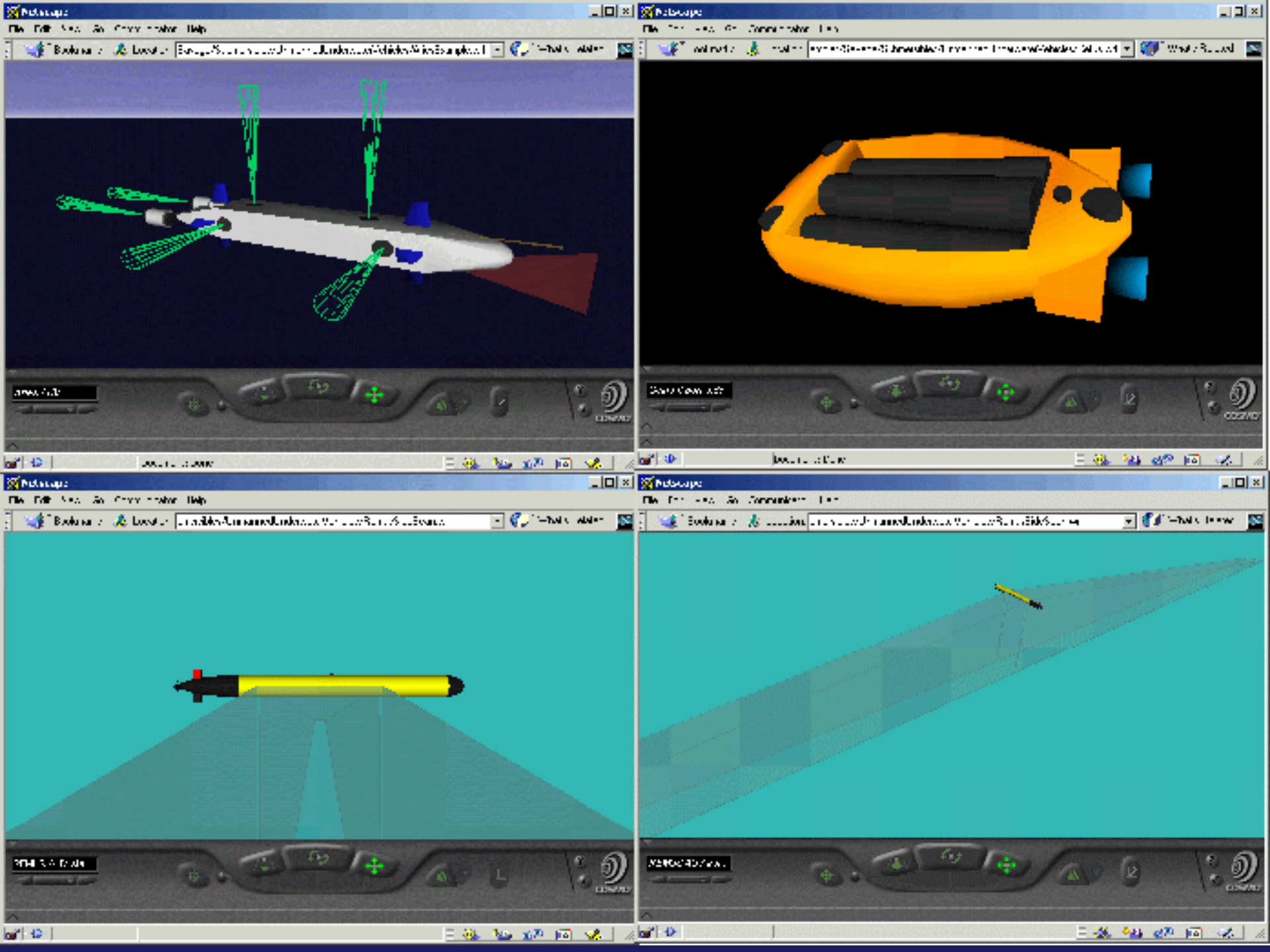
Aircraft Fixed Wing | Aircraft Helicopters | Aircraft Miscellaneous | Amphibious Vehicles | Auv Workbench | Avatars | Biologics | Buildings | Communications And Sensors | Environment | Ground Vehicles | Harbor Equipment | Harbors | Locations | Model Detailing | Offshore Structures | Robots | Scenarios | Ships Civilian | Ships Military | Space | Submarines | Tools | Weapons

Aircraft Fixed Wing

AV 8 B - Harrier - United States
B 52 H - Strategic Bomber - United States
Bear - Russia
Boeing - 747 - Tunisia
C 130 - Hercules - Tunisia
Catalina
Euro Fighter
F 16 - Fighting Falcon - Turkey
F 18 - Blue Angel - United States
F 18 - Superhornet - United States
Jhl Heavy Lift - NPS
Mv 22 - Osprey - United States
P 3 - Orion - United States

Aircraft Helicopters

AH 1 Super Cobra - United States
AH 1 W - United States
AH 64 DApache Longbow - United States
CH 46 E - Sea Knight - United States
CH 53 - United States
Helicopter - United States
Helix - Russia
Jhl Heavy Lift - NPS
MH 53 ESea Dragon - United States
OH 58 D - Kiowa Warrior - United States
SH 60 - Seahawk - United States
SH 60 B - Seahawk - United States



Forward error correction (FEC)

- Added redundancy allows receiver-side detection & correction of message errors
  - Many military channels are noisy RF links
  - Avoids “retry until you die” on acoustic links
  - Big help on long-latency, low-bandwidth links!
- Hamming FEC is one technique of several
  - Re-exploring Stephen Reimers 1995 thesis “Towards Internet Protocol (IP) over Seawater”

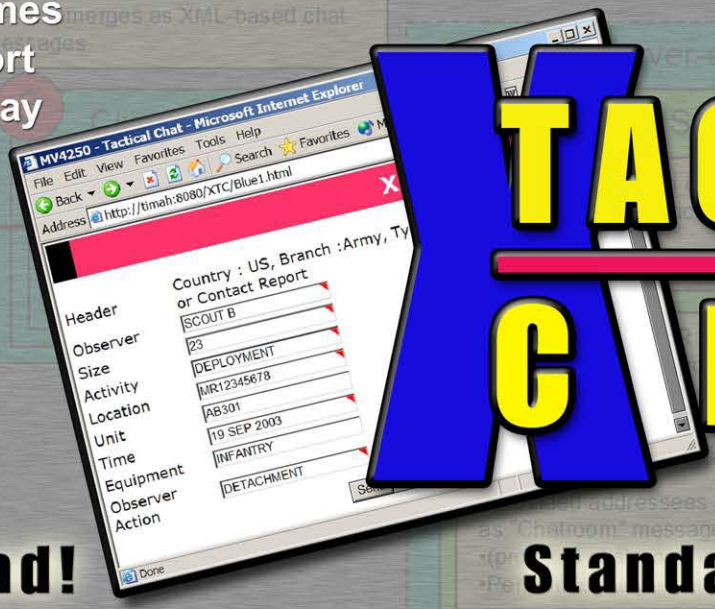
XTC Tactical Chat

Must-Have Capabilities

http://www.jabber.org

The MOVES Institute
Naval Postgraduate School

- Faster Response Times
- Collaboration Support
- Used In OIF and Today
- Net-Centric Warfare
- Single-person or Group Messaging



TACTICAL CHAT

Proprietary: Bad!

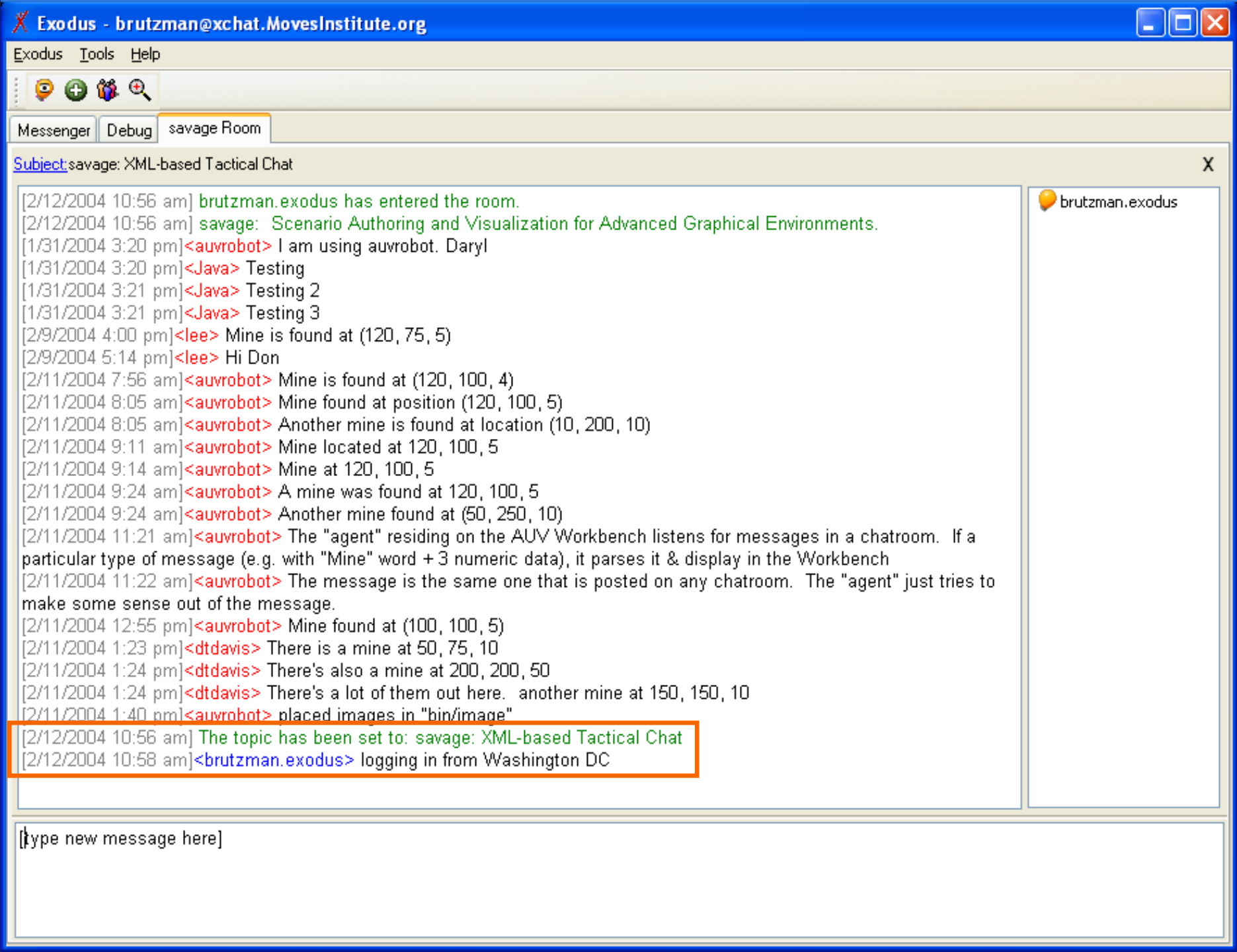
- Can't Inspect Binary Messages
- Costly Licenses, Unpredictable Support
- Not Interoperable
- Can't Verify Source Code is Secure
- Not Allowed Across Network Boundaries

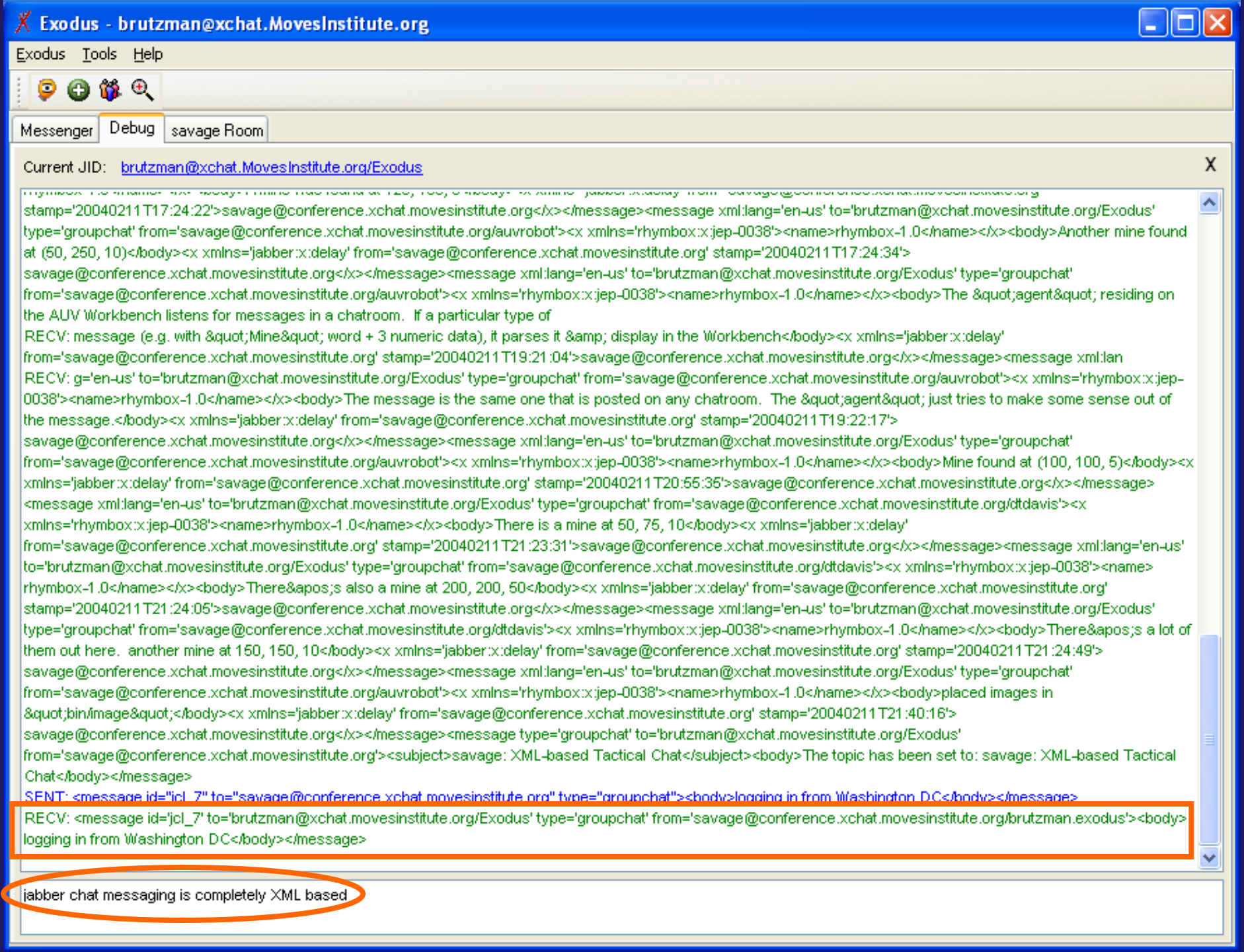
Standards: Good!

- XML messaging, Web Ready
- Jabber: Free Software, Open Standards
- Can Bridge Multiple Protocols
- Open Source: Inspect, Modify, Improve
- Firewall Friendly, Many Applications

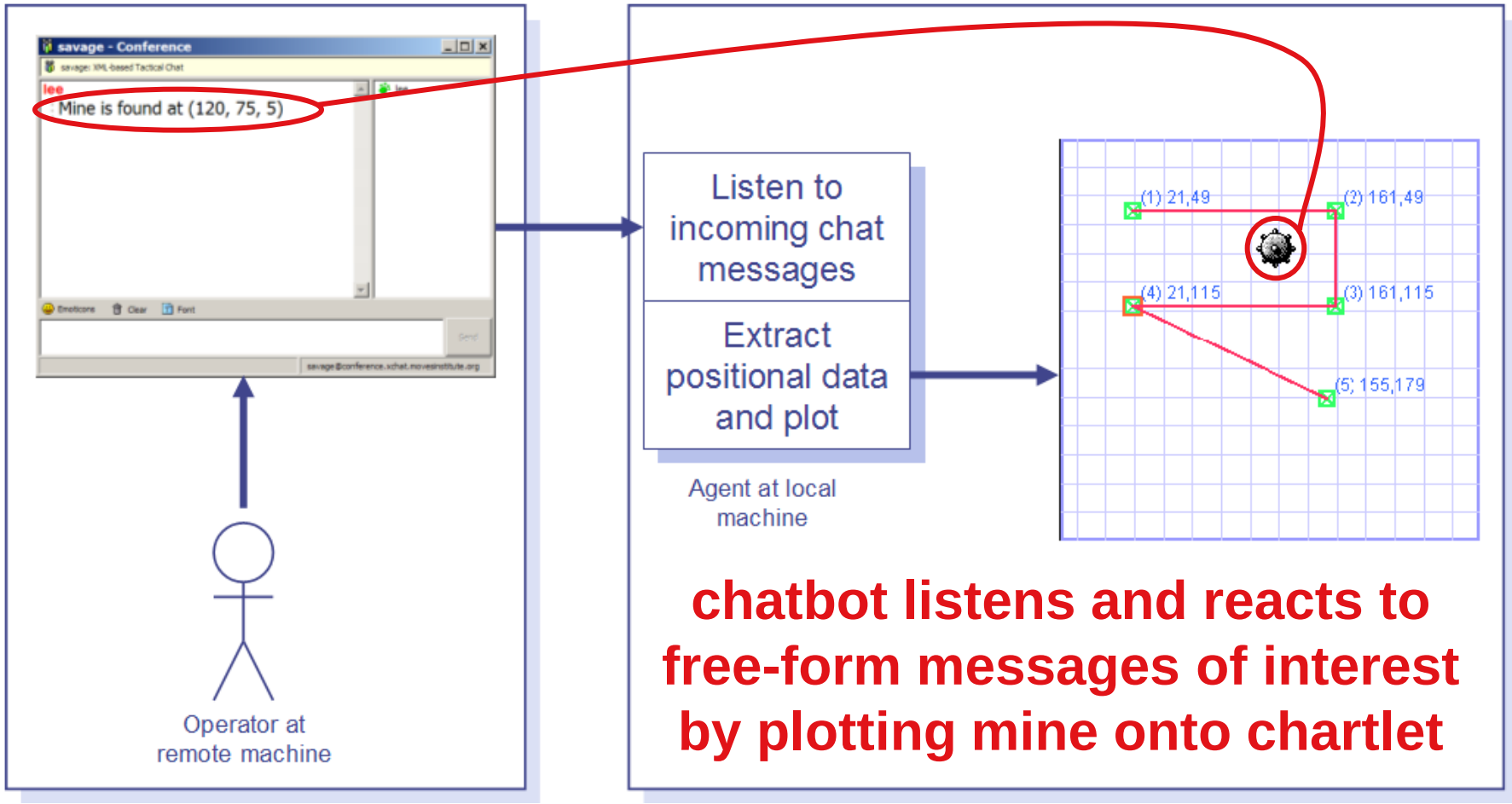
JID: savage@conference.xchat.MovesInstitute.org

mailto:xmsf-contact@MovesInstitute.org


Exodus - brutzman@xchat.MovesInstitute.org
Exodus Tools Help
Messenger Debug savage Room
Subject: savage: XML-based Tactical Chat
X
[2/12/2004 10:56 am] brutzman.exodus has entered the room.
[2/12/2004 10:56 am] savage: Scenario Authoring and Visualization for Advanced Graphical Environments.
[1/31/2004 3:20 pm]<auvrobot> I am using auvrobot. Daryl
[1/31/2004 3:20 pm]<Java> Testing
[1/31/2004 3:21 pm]<Java> Testing 2
[1/31/2004 3:21 pm]<Java> Testing 3
[2/9/2004 4:00 pm]<lee> Mine is found at (120, 75, 5)
[2/9/2004 5:14 pm]<lee> Hi Don
[2/11/2004 7:56 am]<auvrobot> Mine is found at (120, 100, 4)
[2/11/2004 8:05 am]<auvrobot> Mine found at position (120, 100, 5)
[2/11/2004 8:05 am]<auvrobot> Another mine is found at location (10, 200, 10)
[2/11/2004 9:11 am]<auvrobot> Mine located at 120, 100, 5
[2/11/2004 9:14 am]<auvrobot> Mine at 120, 100, 5
[2/11/2004 9:24 am]<auvrobot> A mine was found at 120, 100, 5
[2/11/2004 9:24 am]<auvrobot> Another mine found at (50, 250, 10)
[2/11/2004 11:21 am]<auvrobot> The "agent" residing on the AUV Workbench listens for messages in a chatroom. If a particular type of message (e.g. with "Mine" word + 3 numeric data), it parses it & display in the Workbench
[2/11/2004 11:22 am]<auvrobot> The message is the same one that is posted on any chatroom. The "agent" just tries to make some sense out of the message.
[2/11/2004 12:55 pm]<auvrobot> Mine found at (100, 100, 5)
[2/11/2004 1:23 pm]<dtdavis> There is a mine at 50, 75, 10
[2/11/2004 1:24 pm]<dtdavis> There's also a mine at 200, 200, 50
[2/11/2004 1:24 pm]<dtdavis> There's a lot of them out here. another mine at 150, 150, 10
[2/11/2004 1:40 pm]<auvrobot> placed images in "bin/image"
[2/12/2004 10:56 am] The topic has been set to: savage: XML-based Tactical Chat
[2/12/2004 10:58 am]<brutzman.exodus> logging in from Washington DC
brutzman.exodus
[type new message here]

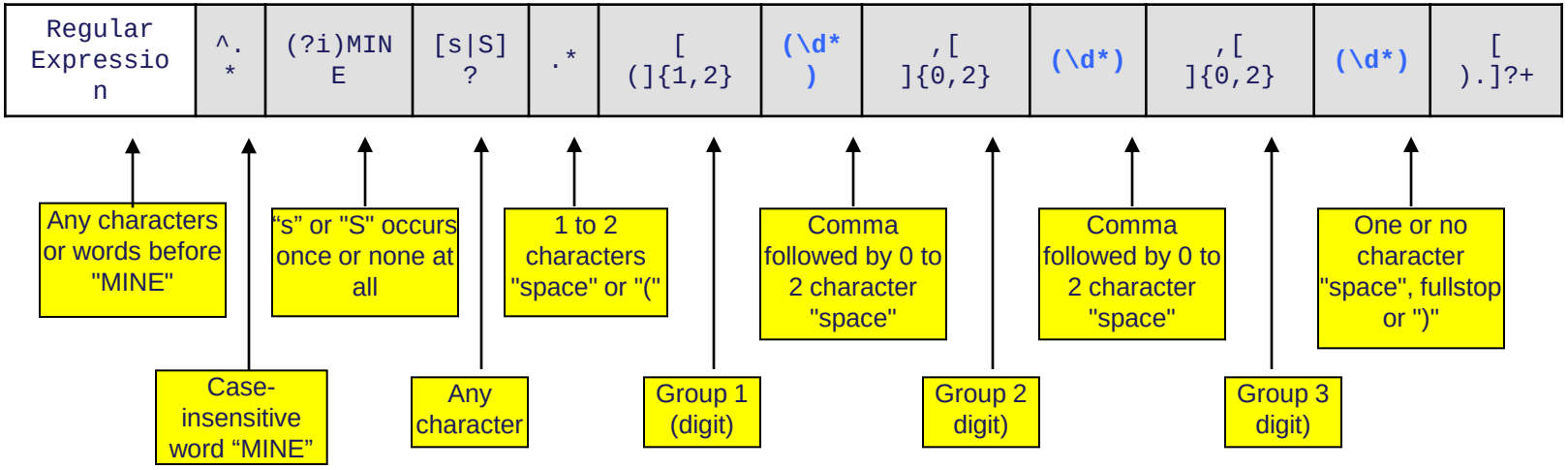

Exodus - brutzman@xchat.MovesInstitute.org
Exodus Tools Help
Messenger Debug savage Room
Current JID: brutzman@xchat.MovesInstitute.org/Exodus
X
stamp='20040211T17:24:22'>savage@conference.xchat.movesinstitute.org</x></message><message xml:lang='en-us' to='brutzman@xchat.movesinstitute.org/Exodus' type='groupchat' from='savage@conference.xchat.movesinstitute.org/auvrobot'><x xmlns='rhymbox:x:jep-0038'><name>rhymbox-1.0</name></x><body>Another mine found at (50, 250, 10)</body><x xmlns='jabber:x:delay' from='savage@conference.xchat.movesinstitute.org' stamp='20040211T17:24:34'>
savage@conference.xchat.movesinstitute.org</x></message><message xml:lang='en-us' to='brutzman@xchat.movesinstitute.org/Exodus' type='groupchat' from='savage@conference.xchat.movesinstitute.org/auvrobot'><x xmlns='rhymbox:x:jep-0038'><name>rhymbox-1.0</name></x><body>The "agent" residing on the AUV Workbench listens for messages in a chatroom. If a particular type of
RECV: message (e.g. with "Mine" word + 3 numeric data), it parses it & display in the Workbench</body><x xmlns='jabber:x:delay' from='savage@conference.xchat.movesinstitute.org' stamp='20040211T19:21:04'>savage@conference.xchat.movesinstitute.org</x></message><message xml:lan
RECV: g='en-us' to='brutzman@xchat.movesinstitute.org/Exodus' type='groupchat' from='savage@conference.xchat.movesinstitute.org/auvrobot'><x xmlns='rhymbox:x:jep-0038'><name>rhymbox-1.0</name></x><body>The message is the same one that is posted on any chatroom. The "agent" just tries to make some sense out of the message.</body><x xmlns='jabber:x:delay' from='savage@conference.xchat.movesinstitute.org' stamp='20040211T19:22:17'>
savage@conference.xchat.movesinstitute.org</x></message><message xml:lang='en-us' to='brutzman@xchat.movesinstitute.org/Exodus' type='groupchat' from='savage@conference.xchat.movesinstitute.org/auvrobot'><x xmlns='rhymbox:x:jep-0038'><name>rhymbox-1.0</name></x><body>Mine found at (100, 100, 5)</body><x xmlns='jabber:x:delay' from='savage@conference.xchat.movesinstitute.org' stamp='20040211T20:55:35'>savage@conference.xchat.movesinstitute.org</x></message>
<message xml:lang='en-us' to='brutzman@xchat.movesinstitute.org/Exodus' type='groupchat' from='savage@conference.xchat.movesinstitute.org/dtdavis'><x xmlns='rhymbox:x:jep-0038'><name>rhymbox-1.0</name></x><body>There is a mine at 50, 75, 10</body><x xmlns='jabber:x:delay' from='savage@conference.xchat.movesinstitute.org' stamp='20040211T21:23:31'>savage@conference.xchat.movesinstitute.org</x></message><message xml:lang='en-us' to='brutzman@xchat.movesinstitute.org/Exodus' type='groupchat' from='savage@conference.xchat.movesinstitute.org/dtdavis'><x xmlns='rhymbox:x:jep-0038'><name>rhymbox-1.0</name></x><body>There's also a mine at 200, 200, 50</body><x xmlns='jabber:x:delay' from='savage@conference.xchat.movesinstitute.org' stamp='20040211T21:24:05'>savage@conference.xchat.movesinstitute.org</x></message><message xml:lang='en-us' to='brutzman@xchat.movesinstitute.org/Exodus' type='groupchat' from='savage@conference.xchat.movesinstitute.org/dtdavis'><x xmlns='rhymbox:x:jep-0038'><name>rhymbox-1.0</name></x><body>There's a lot of them out here. another mine at 150, 150, 10</body><x xmlns='jabber:x:delay' from='savage@conference.xchat.movesinstitute.org' stamp='20040211T21:24:49'>
savage@conference.xchat.movesinstitute.org</x></message><message xml:lang='en-us' to='brutzman@xchat.movesinstitute.org/Exodus' type='groupchat' from='savage@conference.xchat.movesinstitute.org/auvrobot'><x xmlns='rhymbox:x:jep-0038'><name>rhymbox-1.0</name></x><body>placed images in "bin/image"</body><x xmlns='jabber:x:delay' from='savage@conference.xchat.movesinstitute.org' stamp='20040211T21:40:16'>
savage@conference.xchat.movesinstitute.org</x></message><message type='groupchat' to='brutzman@xchat.movesinstitute.org/Exodus' from='savage@conference.xchat.movesinstitute.org'><subject>savage: XML-based Tactical Chat</subject><body>The topic has been set to: savage: XML-based Tactical Chat</body></message>
SENT: <message id="jcl_7" to="savage@conference.xchat.movesinstitute.org" type="groupchat"><body>logging in from Washington DC</body></message>
RECV: <message id='jcl_7' to='brutzman@xchat.movesinstitute.org/Exodus' type='groupchat' from='savage@conference.xchat.movesinstitute.org/brutzman.exodus'><body>logging in from Washington DC</body></message>
jabber chat messaging is completely XML based

Event monitoring via instant messaging



Java regular expression parser on chat:

Breakdown of regular expression pattern:



Meaningful messages can be extracted from chat text, thus enabling automatic structure for user support

Related work: usw-xml

- The usw-xml working group is improving Undersea Warfare (USW) interoperability using Extensible Markup Language (XML) tagsets for system data interchange.

- Cooperative collaboration between many stakeholders is needed to achieve good interoperability.

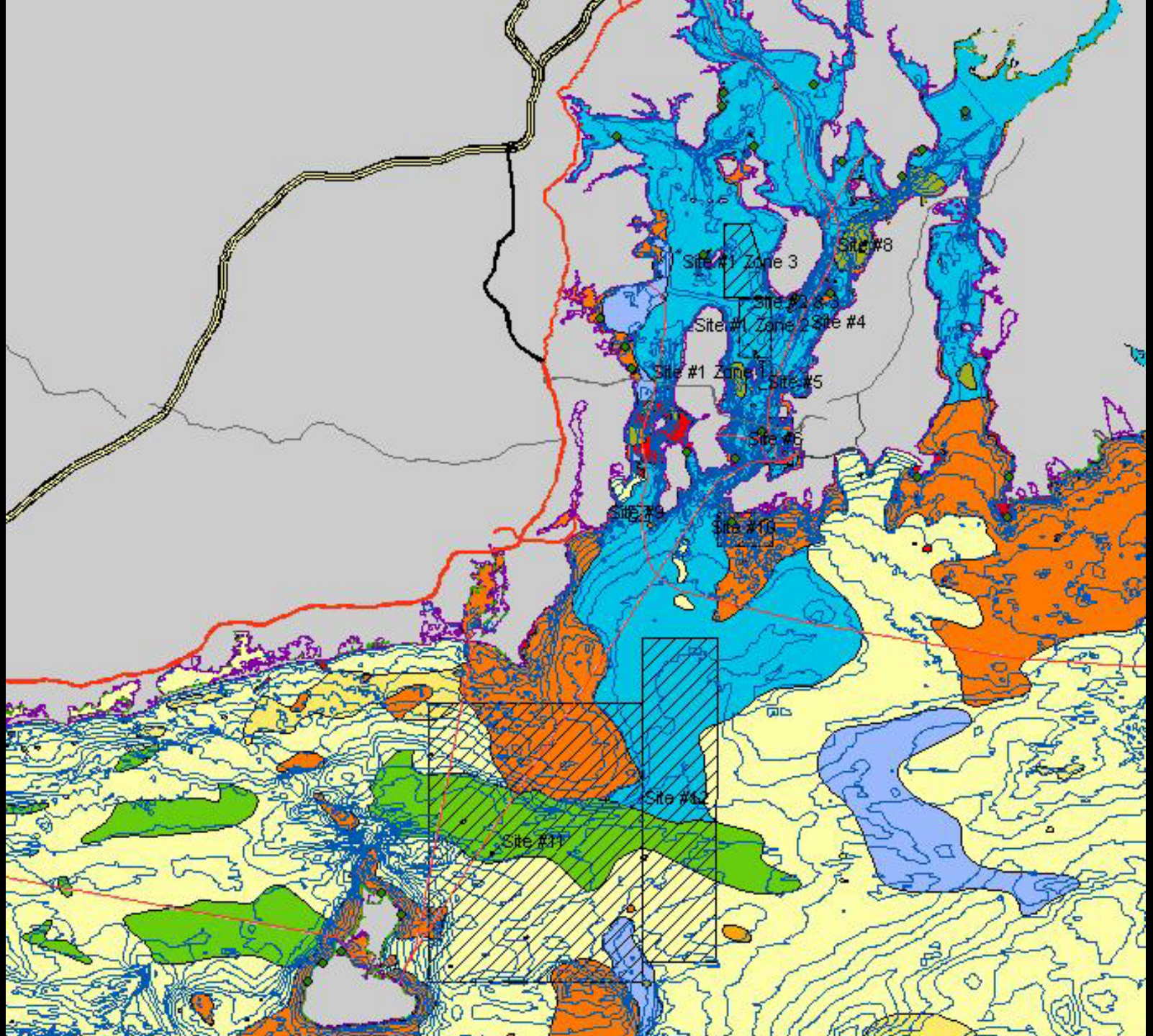
Motivation

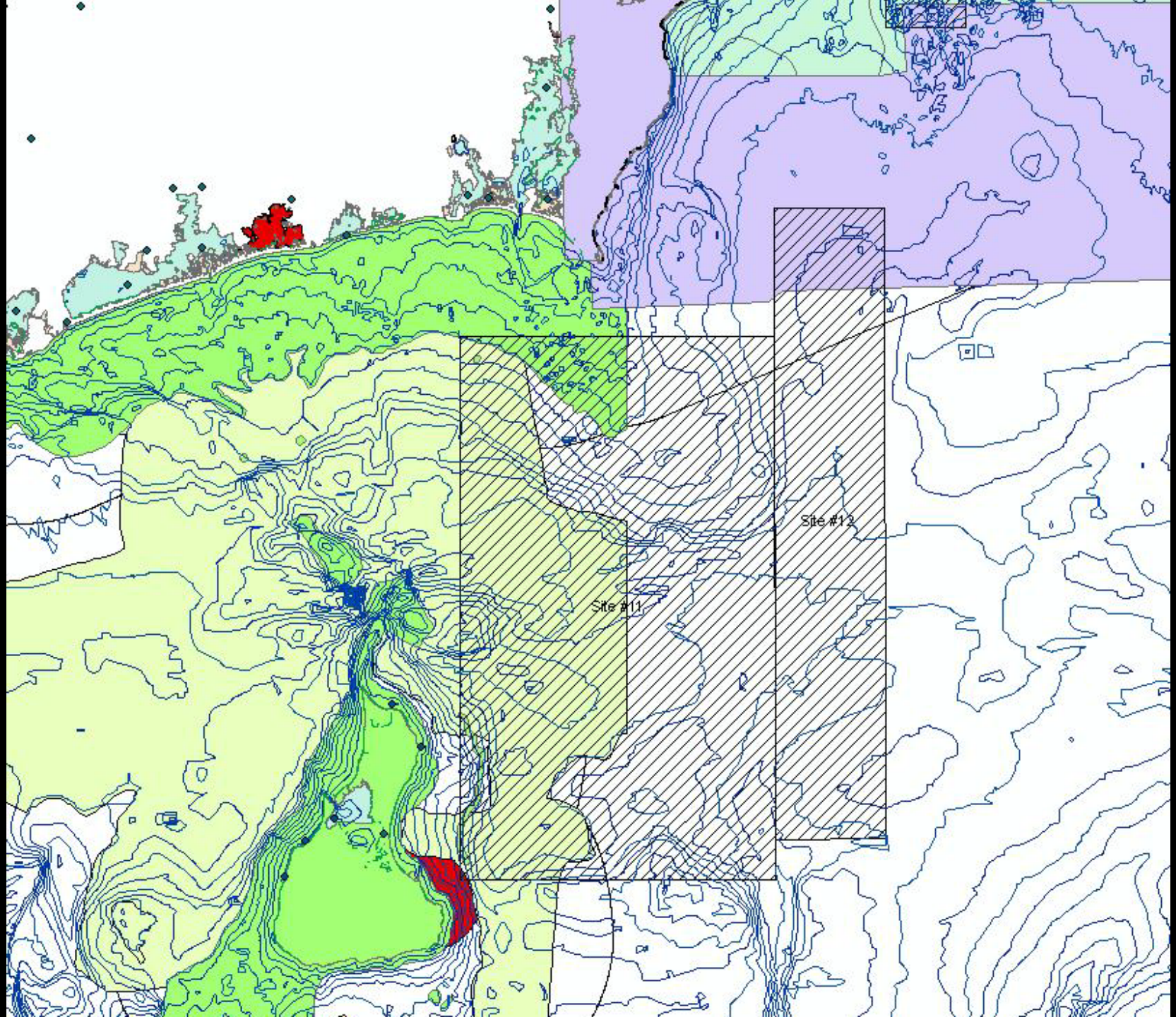
- Many XML technical capabilities enable significantly improved capabilities for
  - USW system interoperability
  - Connecting legacy systems, diverse partners
  - USW Decision Support System, other projects

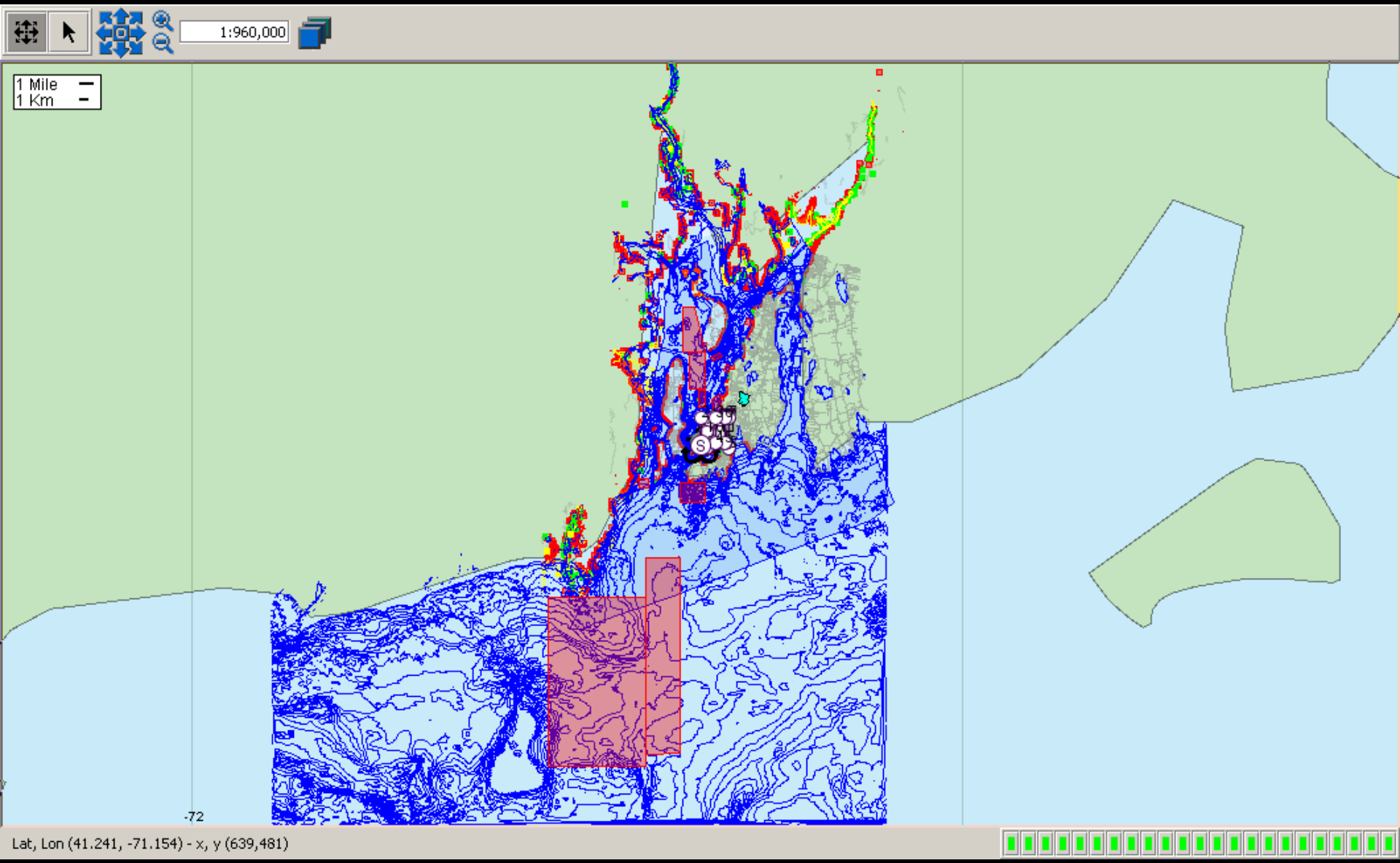
- We expect this work to broadly benefit the Navy, industry and scientific community.

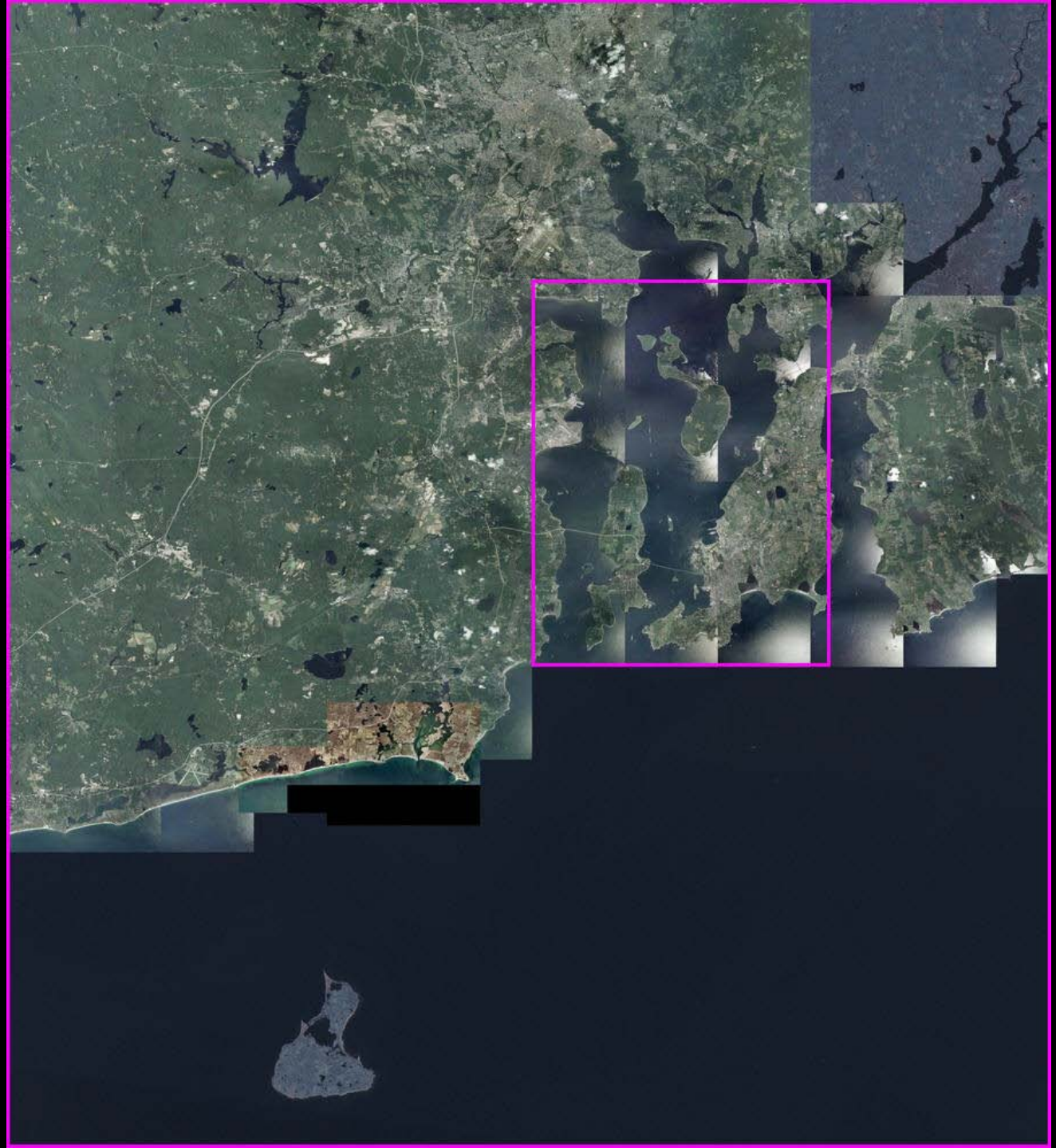
Prior work: AUV Fest 2008

- Naval Undersea Warfare Center (NUWC) Newport RI, 12-24 May 2008
- Sponsors: NOAA and ONR
- 17 underwater robots and various surface support craft exploring archaeological sites
- AUV Workbench supported data collection, reporting, visualization


Site #1 Zone 3
Site #8
Site #1 Zone 2
Site #4
Site #1 Zone 1
Site #5
Site #6
Site #9
Site #10
Site #12
Site #11


Site #12
Site #11


1:960,000
1 Mile
1 Km
-72
Lat, Lon (41.241, -71.154) - x, y (639,481)




Site #6

Current and Future Work

Multiple related projects

Major projects

- Automatic Report Generation
- Viskit Discrete Event Simulation (DES)
- Efficient XML Interchange (EXI)
  - Binary compression of XML, smaller + faster
- Open-DIS codebase
  - IEEE Distributed Interactive Simulation Protocol
- X3D Earth
  - X3D graphics models for terrain, bathymetry

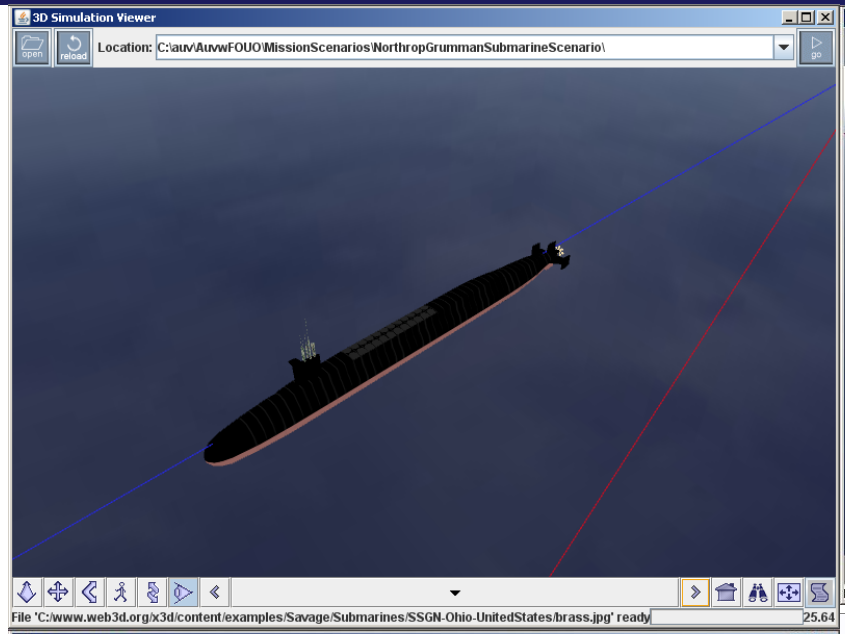
Physics modeling for the Web: Dissertation Work by Loren Peitso lepeitso@nps.edu

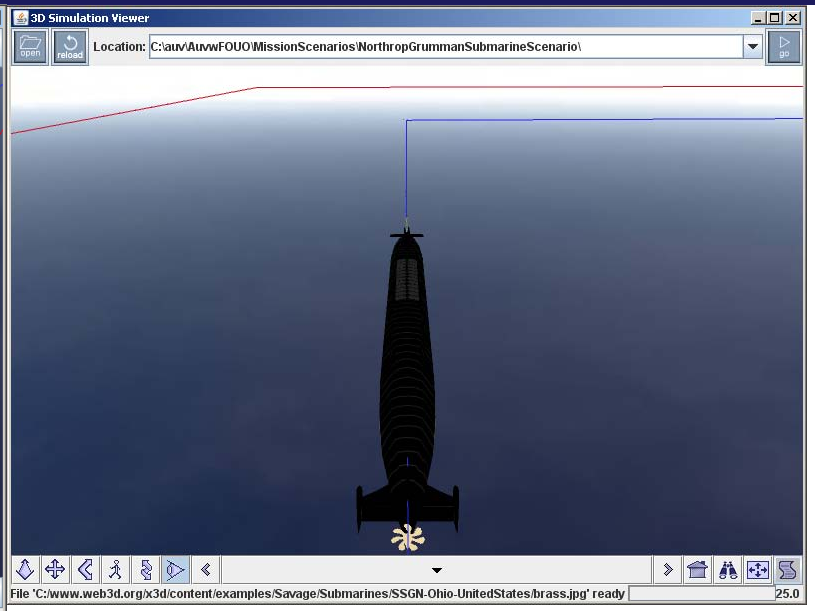
- Current physically based simulations do not scale well and do not take advantage of parallelization, distributed processing or composability in an extendable, scalable manner.
- Most simulations also restrict the domains of physics they evaluate, substituting constructive estimations for physical modeling. This precludes accurately simulating world-scale scenarios such as a theatre level battle space and simulations which are run yield results which are only as good as their radically simplifying assumptions allow.
- It is proposed that a hybrid high-fidelity, distributed, asynchronously evaluated discrete event multi-body dynamics simulation architecture will significantly increase scalability compared to current synchronously evaluated methods.
- This architecture also supports non-classical mechanics physics domains in the simulation, adding capability not presently found in state-of-the-art synchronously evaluated physically based simulations.
- We also propose that this architecture lends itself to increased component and scenario composability as well as re-use through standards-based approaches and published extendable interfaces. Performance comparisons are to be made between existing synchronous physics simulations and an implementation of this new architecture.

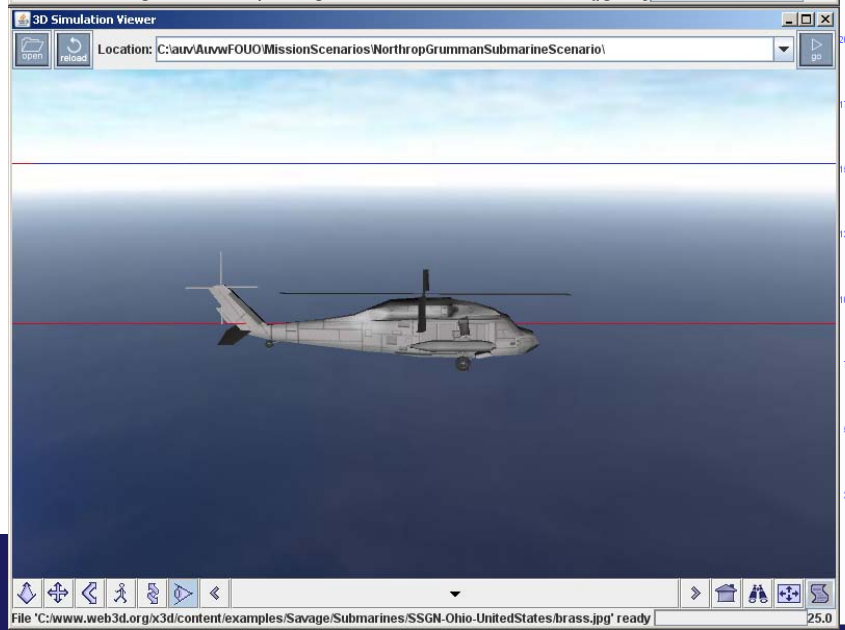
NAVAL POSTGRADUATE SCHOOL

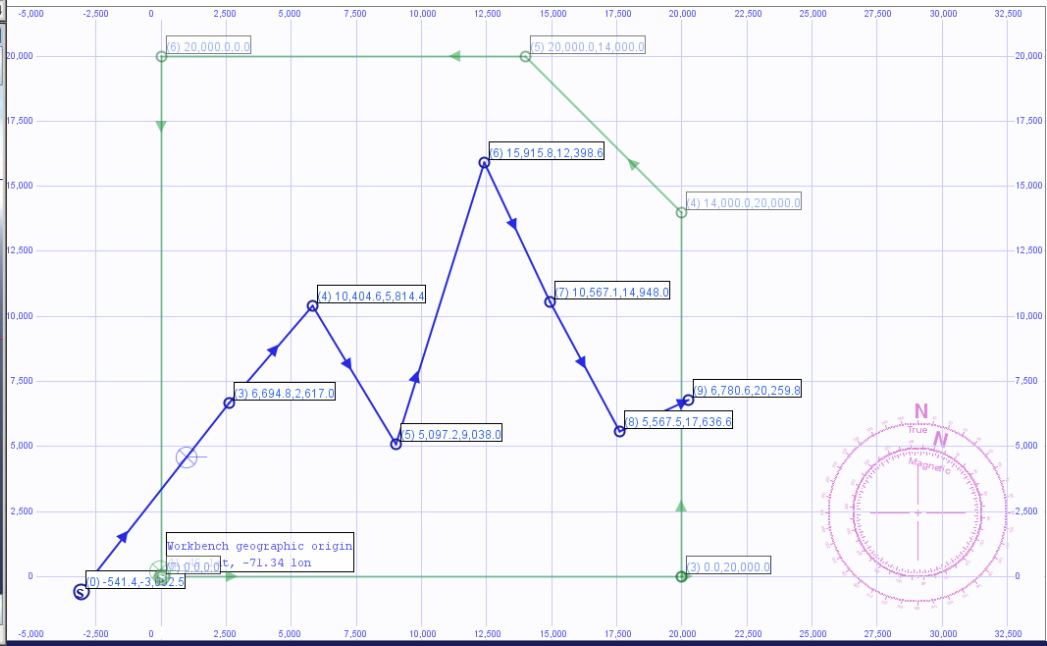
New scenarios under way

XMSF





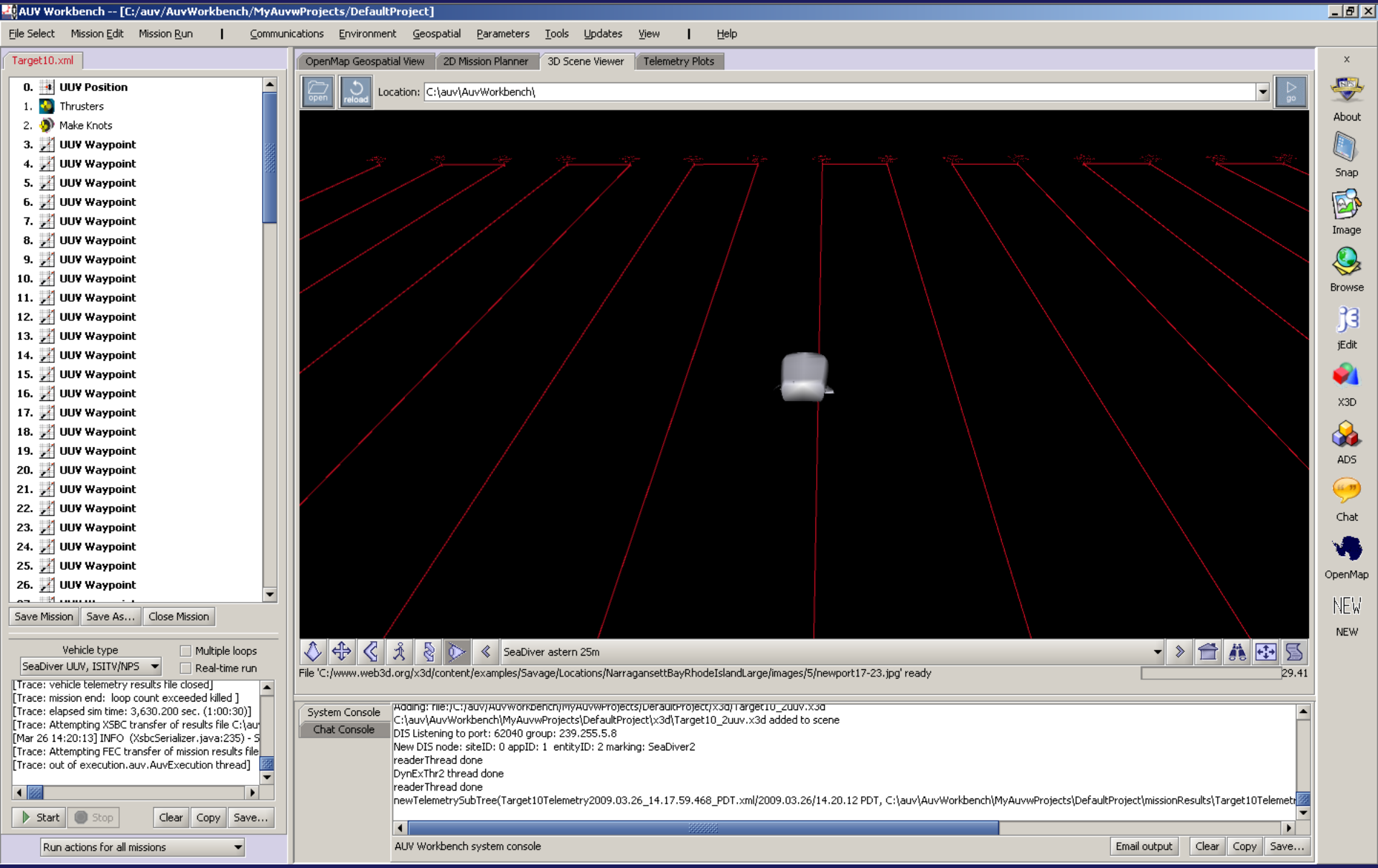




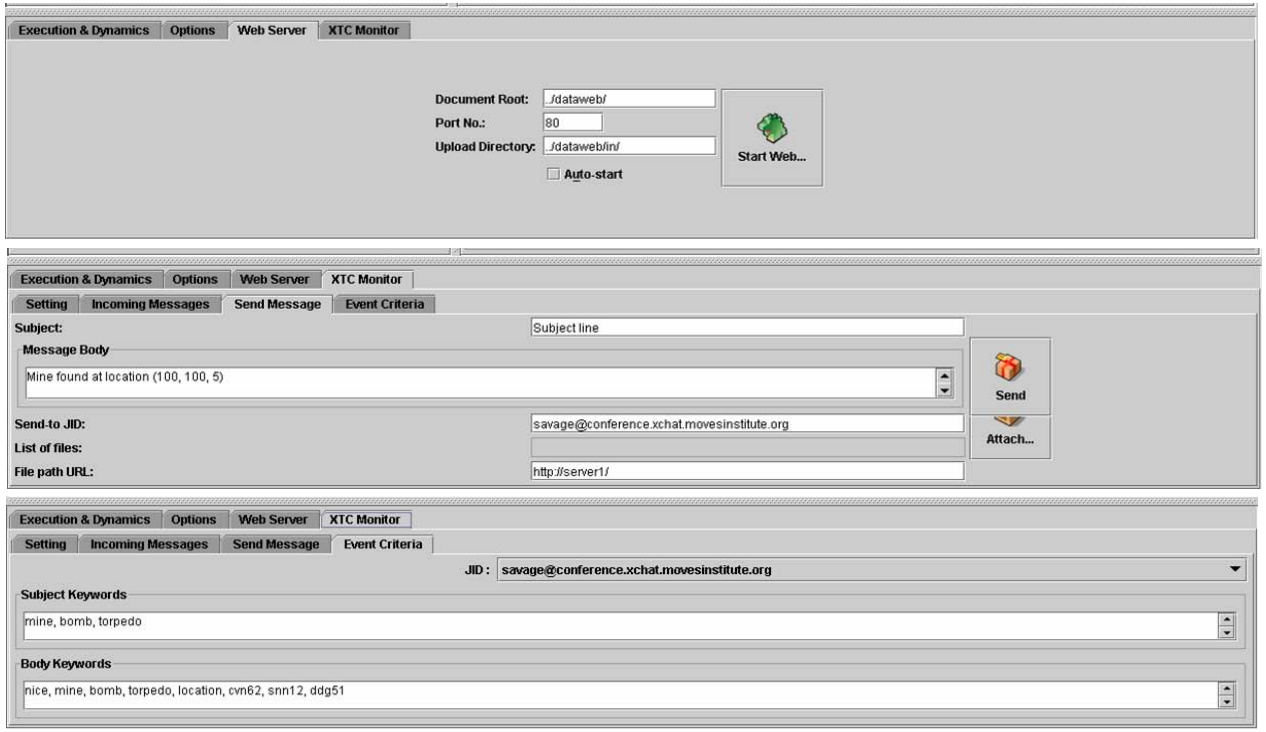
NAVAL POSTGRADUATE SCHOOL

SeaDiver search

XMSF



Automating server-side support



Work planned to automate upload and report generation

Technical metric: make it easy!

Recent and planned production work

Data-driven visualization

- Define visualization features of interest
- X3D examples collected in archive
- Prototypes for parameterized visualization
- Arbitrary data sources can be used as input
- Convert into relevant form of XML
- XSLT stylesheet for X3D prototype instance
- Integrate new model into master scene
- Visualize, annotate, publish/archive, repeat

Topics

- AUV Workbench overview
  - installation, operation, mission examples
  - Adding a vehicle
- X3D Graphics
  - X3D Showcase DVD, learning resources
  - Savage X3D model archives, X3D Earth
- Hands on
  - Building and testing a mission, add metadata

AUV Workbench projected work 1

- Mission report generation
  - from metadata, plots, related data sources
- Mission project archiving
  - More robot missions
  - KML export: GoogleEarth, NASA WorldWind
  - Collected assets pushed to server
  - Virtual environments archive of mission results
    - Virtual environments resource repository?

AUV Workbench projected work 2

- Efficient XML Interchange (EXI) compression
- Other media assets
  - Creation of 3D storyboards, playback
  - Render 3D visualizations to video files
- Provide data to other Navy systems
  - Track Data Conversion Hub provides translations between various XML-based, track-related data languages

AUV Workbench work list

- Weekly teleconference
  - Whenever sufficient demand exists
- Simplify addition of new vehicle types
- Clear up large backlog of bug reports
- Adding GIS files for other test sites
- AUV 2010 Conference, September Monterey
  - IEEE OES sponsor, MBARI + NPS host
  - 30 papers, 3 tutorials, ~80 attendees

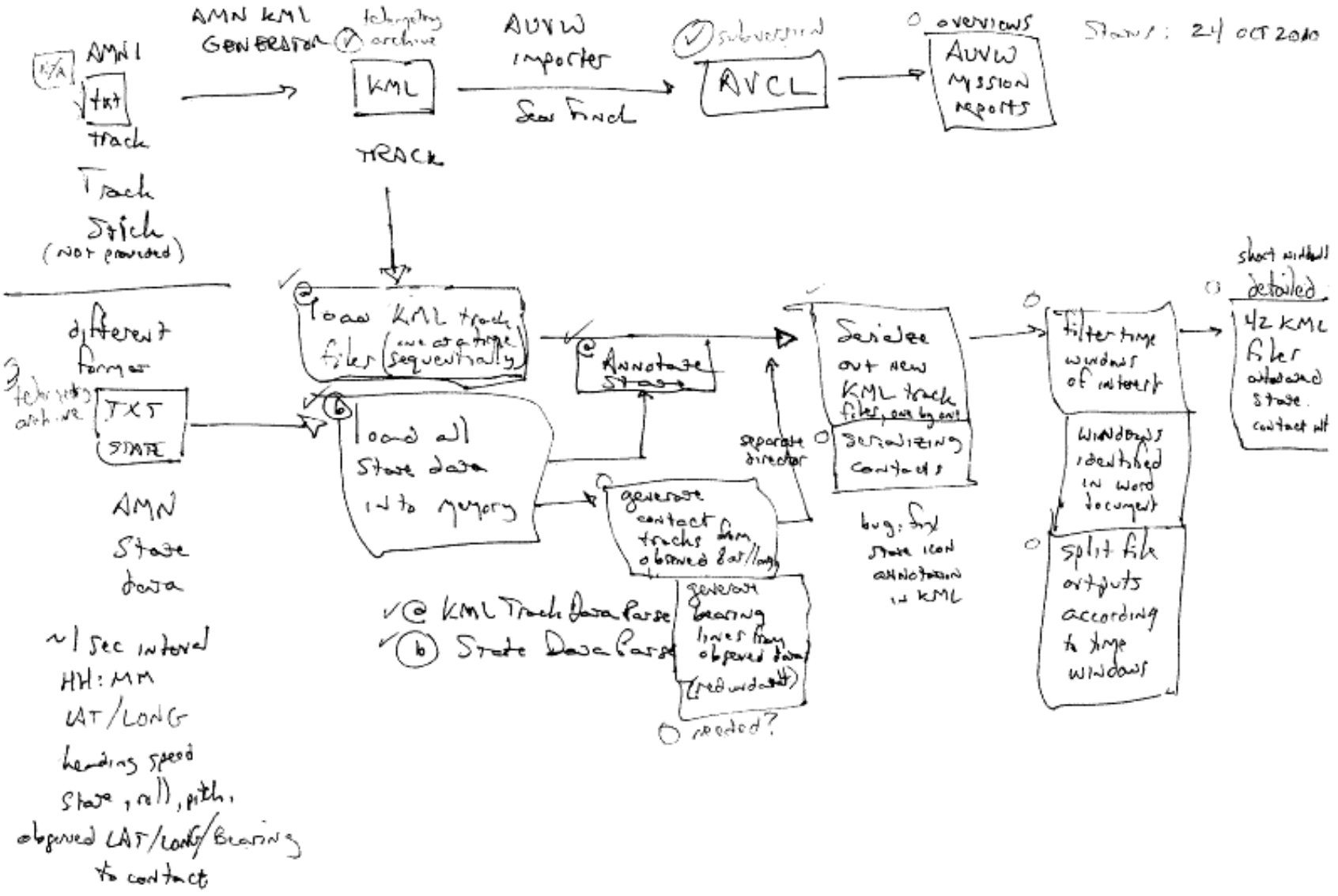
Case study: AMN, TW10

- Trident Warrior exercise TW20
- Autonomous Mobile Navigator (AMN) robots
- Multiple robots in cooperation, competition
- Evaluated track data with AUV Workbench
- Also evaluated track data with Google Earth using KML data outputs

Robot telemetry exercise data archives

- https://savage.nps.edu/RobotTelemetry
- https://savage.nps.edu/RobotTelemetry/TridentWarrior2010
- https://savagedefense.nps.navy.mil/RobotTelemetry
- https://savagedefense.nps.navy.mil/RobotTelemetry/AmnTridentWarrior2010
- AMN 2009 data under FOUO password protection https://savagedefense.nps.navy.mil/RobotTelemetry/AmnTridentWarrior2009
- Modifiable assets also placed under version control

AMN TW10 data conversion

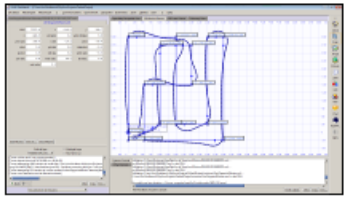
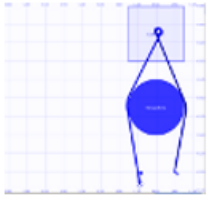
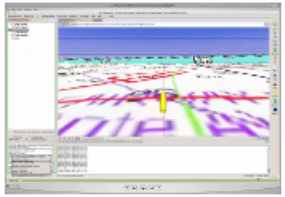


Video Archives production

Videos for AUV Workbench

https://savage.nps.edu/AuvWorkbench/videos/videos.html

This online videos archive provides large demonstration movies showing AUV Workbench operation.

Video	Title	Duration	Size	Description
	UAV Waypoint Mission 800x600 1024x768 1280x800	06:03	32 MB	The Unmanned Aerial Vehicle (UAV) Waypoint mission demonstrates many of the basic features of the AUV Workbench including the mission editor, OpenMap Geospatial display, 2D tactical display, X3D view, and telemetry plots. • Mission task commands are defined by the Autonomous Vehicle Command Language (AVCL). • Mission metadata editing is also shown. • Mission report generation lets users summarize key details for simulations and at-sea tests.
	Agenda Mission: Fisherman Flats Monitor Task 800x450 1024x768	08:04	25 MB	Agenda missions demonstrate the ability to plan paths for avoiding obstacles and conducting searches. Agenda missions also allow more sophisticated behaviors for goal planning and problem handling. Mission agenda commands and mission metadata define the agenda mission.
	Seahorse UUV, Panama City FL, May 2007 800x450 1920x1173	01:45	25 MB	This mission shows an earlier version of the AUV Workbench demonstrating robot missions off Panama City Florida. The X3D model for the Seahorse UUV is maintained in the SavageDefense (controlled access) archive.

Summary

- Significant collected AUV capabilities
  - Support rehearsal, reality, replay
- Integrated as tactical application
- Open standards: XMSF, X3D, chat, etc.
- Open source + commercial compatibility
- Improved messaging, net-centric exemplar
- We hope to add all possible vehicles!

Collaboration and questions welcome

Acronyms 1

- 3D: Three dimensional
- 6DOF: Six degrees of freedom (x y z, roll pitch yaw)
- AUV: Autonomous Underwater Vehicle
- AVCL: Autonomous Vehicle Control Language
- CD: Compact Disk
- CUP: Common Undersea Picture
- FEC: Forward Error Correction
- FNMOC: U.S. Navy Fleet Numerical Meteorological & Oceanographic Center
- HPCC: High-Performance Computing Center
- Java: programming language
- METOC: meteorological and oceanographic (data)
- NAVAIR: U.S. Naval Air Systems Command

Acronyms 2

- NPS: Naval Postgraduate School, Monterey California
- P_D: Probability of detection
- RF: radio frequency
- RRA: Recursive Ray Acoustics Sonar Propagation
- SBIR: Small Business Innovative Research
- TDA: Tactical Decision Aid
- USW: Undersea Warfare
- X3D: Extensible 3D Graphics Specification
- XML: Extensible Markup Language
- XMSF: Extensible Modeling and Simulation Framework
- XSBC: XML Schema-based Binary Compression
- XTC: XML Tactical Chat

Contact

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1.831.656.7599 fax