Howler Experiment

Innovation brings success to coordinated Autonomous Vehicle Operators. Maritime Security Specialist **Marianne Molchan of Molchan Marine Sciences** takes a look at Howler.

Today the US Navy is experimenting with smaller, faster, more adaptive vessels in mine countermeasures (MCM) and maritime security operations to deal with an unpredictable adversary. To maximize the effectiveness and accelerate the mission performance timeline a whole new technological and operational Command & Control approach to warfare is being employed.

The Office of Naval Research and the Office of Force Transformation have been supporting the development of this technology. Join Marianne Molchan (NOAA and US Navy Diver and Maritime Security Specialist) as she provides insight into one company's innovation process leading up to and during the support of an MCM experiment.

Technology Systems Incorporated (TSI) was one of several industry teams that supported an operational Experiment, entitled Howler, in May 2006. TSI is a leading innovator with a 25-year track record in software integration of emerging technology. TSI is currently working on a number of commercial and U. S. Department of Defense contracts involving marine navigation, maritime security, mine countermeasure operations, autonomous vehicle planning, and improvised explosive device (IED) avoidance tools.

TSI brought several critical tactical capabilities to the experiment that made a difference in operational effectiveness of multiple platforms, including:

- Augmented Reality Visualization of the Common Operational Picture (ARVCOP)
- Integrated Bridge System aboard an 11 meter Rigid Hull Inflatable Boat (RHIB)
- Robust and Capable Communications Suite for land and sea assets

Each of these capabilities can be adapted to multiple mission areas and are the focus of this article.

The Heart of Innovation: Practical to Tactical

TSI is a leader in Augmented Reality applications. For reference, Augmented Reality geo-registers information as overlays on a real world view. It is the technology that places a first down line on an American football game TV broadcast or strike zone on a baseball game.

In late June 2006 Marianne Molchan met with TSI's President, Tom Zysk, Owner, Chuck Benton, and Operations Manager, Marli Hagen at TSI's headquarters in Brunswick, Maine. A month earlier they supported a Mine Countermeasures Experiment (Howler) with Naval Special Clearance Team ONE (NSCT-1) in Coronado, California. During this experiment, Stiletto performed as a Command and Control (C2) and launch platform. From this platform multiple manned and unmanned air, and underwater vehicles operated in (under and above) a simulated mined environment.

Admiring their new office spaces and location overlooking the Androscoggin falls (A stripper fishing hot spot) Marianne walked to the corner office which included two large picture windows. TSI prides itself in employing a complimentary mix of bright, and creative staff, (including new, eager graduates, and seasoned civilian and military veterans from the commercial and Defense industries). Chuck Benton asked if Marianne would like to see one of the office "Unmanned Aerial Vehicles" (UAV), take flight inside the (two story tall) office spaces. For most companies it might seem unorthodox to have a table of several "UAVs" lined up for spontaneous testing, not for TSI.

As the airplane took flight, what became clear, to Marianne, was that this is the heart of innovation. How else does a company in the midst of developing, planning and evaluation visualization tools for multiple Autonomous platforms understand the variables and constraints of operators of these autonomous vehicles, than to practice operating them? Clearly this company produces tangible solutions and enjoys its work. Innovation is not a

Figure 2: Office sized UAVs ready for Flight at TSI

Figure 1: Stiletto, an Experimental USN Hull Form used in Howler

Figure 3: Chuck Benton, TSI Owner launching Office UAV

Figure 4: Recorded Track of 11m RHIB (10m spacing) in Cross Current, Low Visibility Conditions. The screen shows the Gods Eye View in the main display with the AR image in the lower portion. These Displays can be swapped between both screens.

buzz word it's a work ethic here.

Within seconds of the launch, the airplane took flight, and then it gracefully (and unexpectedly) landed on the light fixture 15 feet above the floor. Jim Begley, Program Manager (and occasional lunchtime fisherman) quickly came to the rescue with his fishing rod. He snagged the UAV, reeling it to the ground. Could the previously mentioned visualization tool be programmed to prevent the operator from making such an unexpected landing by providing pre-calculated safe launch angles or vehicle re-location capabilities for night-ops? These are the questions that are being asked AND answered at TSI.

Weeks before Marianne's visit to TSI, during Howler, the US Navy tested new concepts to accelerate the mine countermeasures mission execution timeline thru the use of innovative technology. TSI was amongst a small number of select companies which provided innovative navigation command control and communication capabilities to Naval Special Clearance Team ONE during the experiment. These capabilities not only allowed for more robust and real-time communications between multiple platforms such as an 11 meter Rigid Hull Inflatable Boat (RHIB) and the command platform (Stiletto), but their unique Augmented Reality application enabled RHIB operators to tow a sensitive underwater sonar fish while maintaining pre-planned 10 meter spaced navigational tracks projected on the operator's screen. Using the ARVCOP system, the operator was able to easily maintain 3 meter track accuracy despite cross-currents and, at times, low visibility conditions.

TSI Team's Contribution at The Howler Experiment

Augmented Reality Visualization of the Common Operating Picture (ARVCOP)

TSI has developed a navigational display system for Navy ships that augments the Common Operational Picture by integrating Global Positioning System, Digital Nautical Charts, the US Navy's Mine Warfare Environmental Data Aids Library (MEDAL) and the Expeditionary Decision Support System (EDSS) with real time camera images.

Figure 5: Real Time Track Overlays Provide Unique Conning Guidance to the Craft Operator

This system was installed on both Stiletto and an 11m RHIB, along with a simple but robust communications suite to improve situational awareness, providing a unique Common Operational Picture to multiple platforms during the Experiment.

A Robust and Capable Communications Suite

TSI and Science Applications International Corporation (SAIC) provided the Howler Experiment secure satellite communications, entitled SKYCAP, which allowed for robust data transfer and communications capabilities. Due to the electronic hull configuration on Stiletto, the same communications suite was available within multiple spaces aboard Stiletto. The TSI team provided MEDAL / SKYCAP stations in three locations:

- C2 Tactical Operations Center (TOC) on land
- Stiletto C2 TOC
- 11 m RHIB

Additionally, ARVCOP work stations (including camera, monitor, and computer) were provided in two locations:

- Stiletto
- 11m RHIB (NSCT-1, Delta Platoon)

Figure 8: MEDAL / SKYCAP / ARVCOP Configuration shows the communication links provided by the TSI team during the Howler Experiment. SKYCAP is an emerging Government Off The Shelf software data control solution developed by SPAWAR and supported by SAIC. SKYCAP enable an Internet Protocol (I/P) interface on multiple

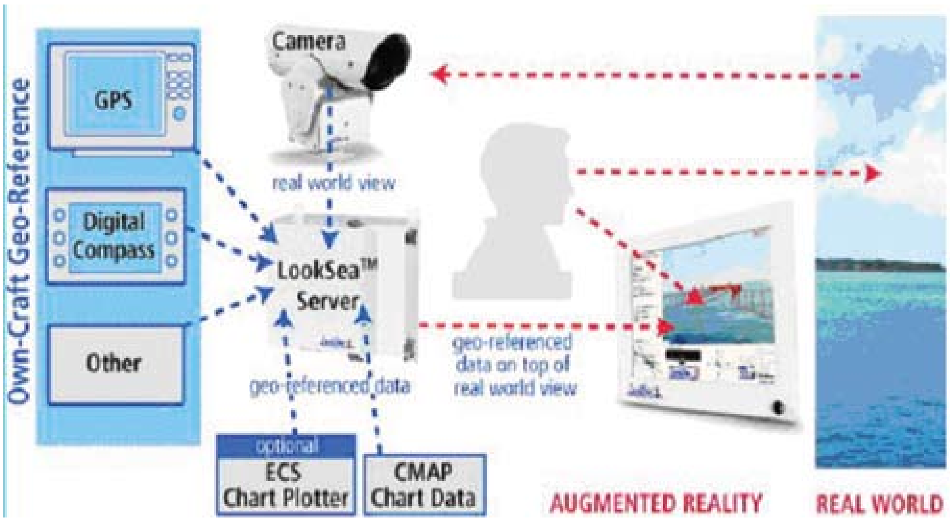

Figure 6: ARVCOP Components shows the components involved in creating a common operational visual image. Add to that image MEDAL data which may include the boundaries of a cleared lane, as shown in, Figure 7: Left MEDAL representation of cleared lanes (Q Routes) Right-ARVCOP heads-up display of Q Route, location of the mines, bottom type, underwater plumes (if detected) and a host of other information types.

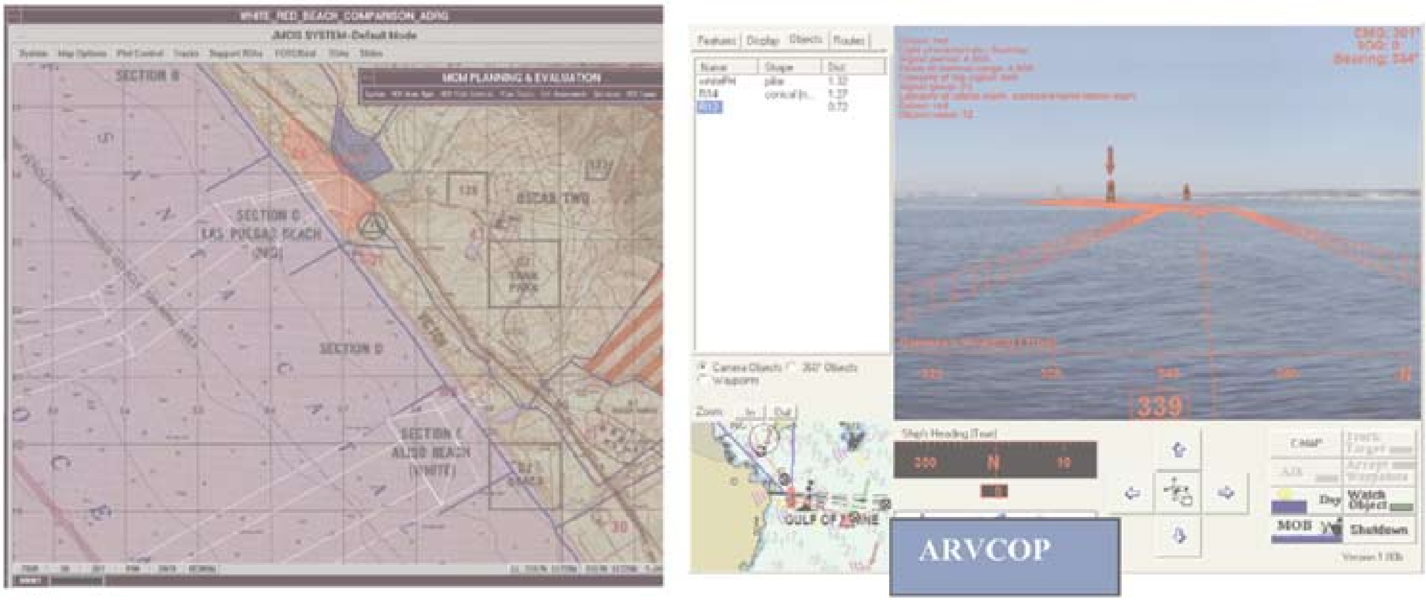

Figure 7: Left MEDAL representation of cleared lanes (Q Routes) Right-ARVCOP heads-up display of Q Route.

communication channels allowing even the small RHIBS to use segment data from the Global Command Control System Marine (GCCS-M). SKYCAP was ideally suited to address NSCT-ONE's requirement for simultaneous communications between multiple platforms. The MEDAL / SKYCAP / ARVCOP capability allowed for real-time in-stride changes to operations to be communicated to all three parties (Tactical Operations Center, RHIB, and Stiletto) with no disruption to operations.

There were multiple operational highlights associated with the intuitive Augmented Reality display installed on both the 11m RHIB and Stiletto, including:

- Ingress/Egress navigational accuracy (Route from Dock to Mined Area)
- Reduced Navigational Risk
- Electronic Plotting of MEDAL survey lines on Real-World View of Survey Area
- Increased operational effectiveness running 10 m spacing for mine clearance

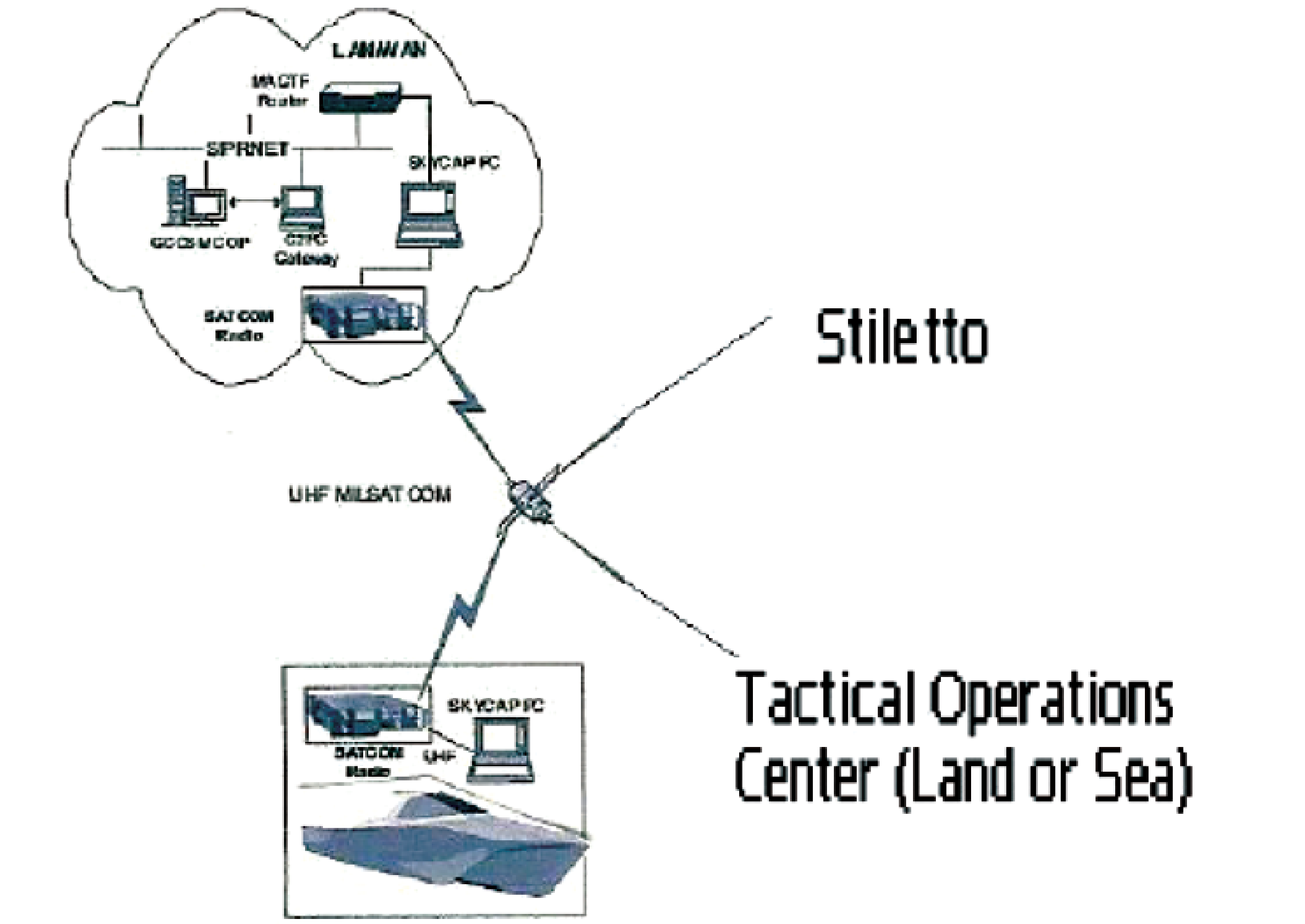

Figure 8; MEDAL/SKYCAP/ARVCOP Configuration

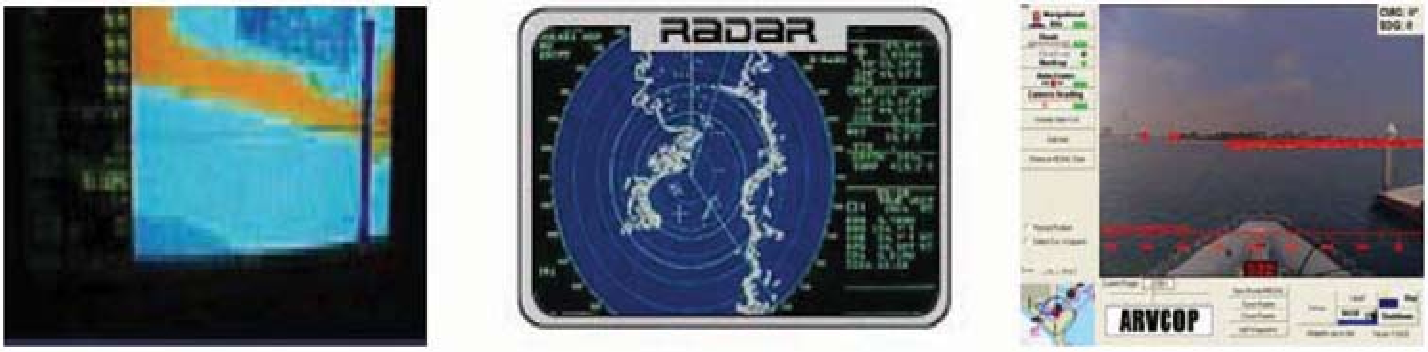

Figure 9: ECPINS, Radar, ARVCOP Stiletto Bridge Displays shows the three bridge displays

which also allowed narrower Q routes

- Plotting of Time Critical Information Electronically on the ARVCOP Screen
- Accurate marking and display of mine like object locations available to multiple platforms

On the Stiletto Bridge, there were three navigation chart displays. From Left to Right (page 38) the displays are:

1. ECPINS-M (vectorized digital navigation system that can import Digital Nautical Charts (DNC), S-57 and NATO charts)
2. Radar and NavNet Navigation System
3. ARVCOP (visual navigation system that can accommodate multiple GIS systems and a variety of chart databases, MEDAL and EDSS and overlay information on a real-world camera view).

During the Howler Experiment, a live camera feed from a UAV was captured, added to the ARVCOP image and viewed from multiple locations.

Figure 10: Integrated Bridge System/Virtual Display Mock Up shows the type of information that can be displayed on an ARVCOP screen. Half of the screen shows a "God's eye view" of a Digital Nautical Chart (DNC) with the Radar and MEDAL overlays. The chart view includes soundings and the shoreline, oriented with the GPS position of a notional 11m RHIB in the center of the screen. A camera was affixed atop the RHIB console structure to show a forward looking real-world view for the RHIB operator. The positions of the mines from MEDAL are also shown in red. The cleared lane has been overlaid onto both the real-world video camera view as well as the electronic chart view. (both indicated in red) The boundaries of the cleared lane are shown in the upper left hand camera view not from an aerial vantage point (as in the lower image of the nautical chart) but from an "on the water" viewpoint. This provides the operator a more intuitive look at the navigational margin of error and where the lane is in relationship to other obstacles such as mines, other vessels, surf zones, shore markings and the like.

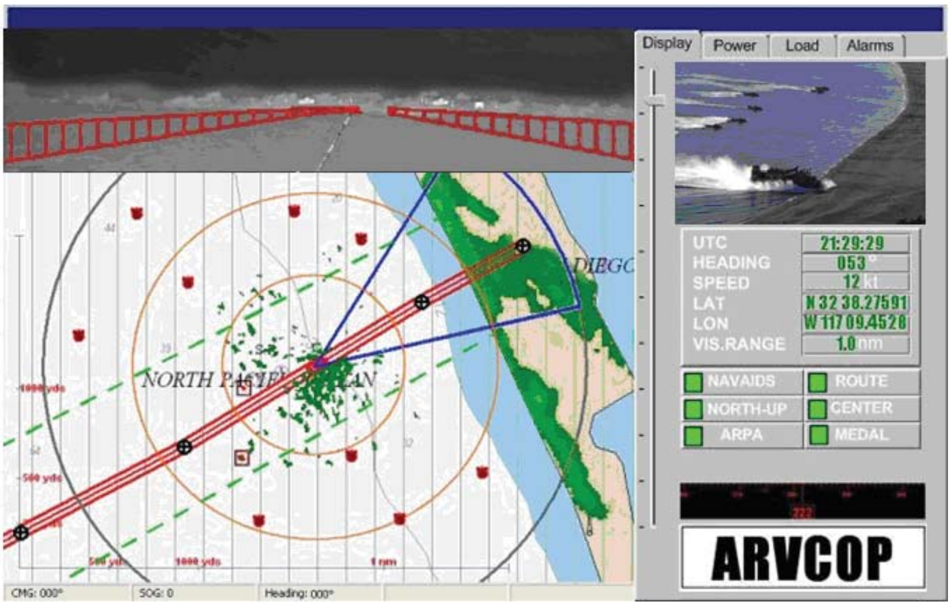

Figure 10: Integrated Bridge System/ Virtual Display Mock Up On the right hand side of the screen, an aerial view of the multiple landing craft coming ashore (from a UAV) has been included in the ARVCOP Bridge Display.

Mine Countermeasures Transformation during the Howler Experiment

Why is this operator view important? At the core of Mine Countermeasures Transformation is the desire to "shorten the timeline" of clearing a lane for safe passage in a mined area. Transformation involved shifting from a platform-centric operational emphasis to a capability-centric one. Improvements in Operational Effectiveness were achieved not only by improving the capabilities of the platforms (speed, rapid re-configuration, size) but more importantly, by providing an intuitive way in which critical information is displayed for the operator.

Marianne came away from the visit to TSI knowing how and why the precise mix of bright people in an innovative creative environment can provide just the right chemistry for Navy mission transformation.