Efficient battlespace visualization and remote control of electronic warfare payloads

Patricia Kirsch and David Tremper

A system for use with unmanned vehicles facilitates rapid operator interpretation of radio frequency threats while conserving bandwidth.

Unmanned vehicles (UVs) play a significant and continually expanding role in military operations. Long used in intelligence, surveillance, and reconnaissance (ISR), they are now finding applications across the full operational spectrum, from counter-mine warfare to border security. Today, one area generating significant interest is electronic warfare (EW). Due to their relative expendability, unmanned platforms provide an EW host with the prospect of using stand-in jamming (SIJ) against threat radar systems and drawing fire away from manned platforms. Traditionally, SIJ missions have been considered too risky for manned aircraft.

A practical EW control interface must provide the operator with the means to interpret unseen radio frequency (RF) threats. Individual electronic support (ES) payloads can provide lines of bearing, but the large number of RF signals in the environment makes it imperative to avoid operator overload. A capable yet streamlined interface for payload control is required. In addition to control and data collection benefits, effective operations require communications efficiency. Traditional links offering payload control from offset locations are simple to implement. However, it is also important to consider the potential effects of command and control on bandwidth. A strained bandwidth jeopardizes the efficiency of both data transmissions and critical mission data that may share the same communication links.

In consideration of these various factors, our Special Projects Group (SPG) began development of a jammer control station (JCS) with a set of specific goals. These included remote control of multiple payloads, 3D visualization of developing battlespaces (including platform telemetry and RF detection), rapid reaction capability, and communication links between operator interface and payload, unburdened by excessive bandwidth requirements. These goals are summarized in Table 1.

We have succeeded in building the JCS by leveraging a visualization tool and text-based message sets. SIMDIS, a government off-the-shelf software kit, provides a 3D display of live and post-processed simulation, and test and operational data. The JCS employs it together with dialog boxes to create a graphical user interface with built-in situational awareness. SIMDIS used in this way allows development to focus on operator interface and the communication aspects of a remote controlled package. Operators should be able to quickly interpret the state of assets and current RF picture in the mission environment.

Using information provided by line of bearing and type of signal, the JCS operator makes a basic assessment of the threat level

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Table 1. Objectives of the jammer control station for unmanned vehicle (UV) electronic warfare (EW) payloads.

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<td>1</td>
<td>Allow remote control of multiple EW payloads onboard multiple UVs</td>
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<tr>
<td>2</td>
<td>Display 3D visualization of the developing battlespace, including platform telemetry and RF detection</td>
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<td>3</td>
<td>Provide operators with rapid reaction capability through streamlined payload control</td>
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<td>4</td>
<td>Limit bandwidth requirements of communication link between the operator interface and the EW payload</td>
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Figure 2. Point-and-click platform and beam selection provides the payload operator with streamlined control.

and determines what action, if any, should be taken to deal with the detected emission. Figure 1 shows a screenshot from a representative RF hostile environment. Threat beams are indicated in red while friendly and neutral detections are blue and white, respectively. The detection picture implies three shore-based threat radar systems, one neutral emission, and two friendly radars.

Instantaneous geolocation of the specific threat can be determined by combining the angle of arrival measurements from each of the distributed payloads. The operator can already visually perceive these locations, which appear on the JCS screen as downrange intersections of bearing strobes from ES payloads. Basic specific emitter identification of detected signals enables resolution of the visual ambiguities created from coincidental intersections (shown in Figure 1 as red circles), with hostile emitter positions automatically calculated and displayed. The JCS also enables the payload operator to select beams of interest by pointing and clicking through the SIMDIS interface (see Figure 2). Eliminating the need for menu and option selections speeds time-critical operator responses associated with commanding the payload to track and jam hostile emissions.

Finally, availability of bandwidth is a limiting factor in the use of unmanned and remote systems in the operational environment. The increasing number of RF-controlled systems puts a strain on both asset and warfighter communications. Because JCS is primarily concerned with the nonvisible RF region, it has no distinct advantage in leveraging video transmissions. Instead, the JCS employs text-based messaging for data sharing with available payloads. As a result, it has little impact on available communications bandwidth.

The JCS meets the necessary design objectives for a remote EW payload control interface. It combines mission data from physical assets with visible representations of nonvisible RF emissions to create a single situational awareness picture. The significance of RF threats with respect to distributed assets can be quickly deduced from the combined data, effectively streamlining response. More recent work involved integration and testing with coordinate control systems for multiple UVs. Future work is likely to involve migration to a standard message set (JAUS or STANAG 4586).

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References