Agile Radio Frequency Geolocation for Urban Surveillance

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Currently, the warfighter's access to real-time situational awareness (SA) information related to the surrounding radio frequency (RF) sources is limited. Response times by military units to active RF signals in today's dynamic environments are requiring that signal intelligence (SIGINT) functionality be co-located at fixed site stations that are near the units of action along with mobile response teams that are ready to counter hostile forces based on real-time electronic support measures (ESM) data. As a result, the Army is requiring that small, portable geolocation units be developed to counter the enemy in situations where it is difficult to determine who the hostile forces are and where they are located. The quantity of necessary units for this requirement also mandates that the units be low cost, reliable, and easy for warfighters to operate.

Lockheed Martin Advanced Technology Laboratories (LM ATL) and Intelligence and Information Warfare Directorate (I2WD) are providing a potential solution to the new requirement with a novel, organic SA capability for the geolocation of RF sources in harsh environments. The software-based solution uses LM ATL's Agile RF Geolocation for Urban Surveillance (ARGUS) algorithms. This technology is an excellent candidate for Non-Line-of-Sight (NLOS) urban operations and provides localization of both local wideband and narrowband and low-power RF emitters from a network of fixed and mobile ground and air sensors. This geolocation method yields good performance based solely on a statistical algorithm that operates only on RF power levels of the signal of interest (SOI) as measured over the network of mobile or fixed geo-referenced sensors.

In this effort, the team is focusing on demonstrating the benefits of this network-centric solution for various concepts of operations (CONOPS) in different environments and configurations

including on-the-move (OTM) forces, and dismounted operations, with a mix of fixed and mobile nodes. The other focus of this work is the real-time control protocols for the management of the distributed processing and sensing assets in the ARGUS network. ARGUS is complimentary to other RF geolocation techniques, such as time difference of arrival (TDOA), frequency difference of arrival (FDOA), or direction finding (DF), because it works where these do not (in NLOS, severe multipaths, narrowband sources, and on-the-move with variable baselines). ARGUS works well where other methods are seriously degraded or do not work at all. The benefits of this method are: (a) on-the-move RF geolocation, where the required accuracy in the location of the sensors not linked to the SOI wavelength; (b) NLOS geolocation; (c) indoor functionality in urban and rural environments; (d) use of simple whip antennas by sensors, which make the dismounted applications feasible; and (e) eradication of spatial aliasing (ambiguities) created by the sparseness of the sensor network. Comparable performance has been recorded over a wide range of carrier frequencies and signal types from wideband orthogonal frequency division multiplexing (OFDM), narrow band frequency modulation (FM) push-to-talk (PTT), wideband FM, frequency shift keying (FSK), and multiple phase shift keying (MPSK) waveforms. Overall, ARGUS-Network Protocol (NP) will offer a low-cost, small-size, network-centric solution for new, organic SA capabilities at the soldier level. Warfighters will have direct access to useful and timely information that will allow them to more effectively perform their duties with less exposure to harm.