

REMOTE CONTROLLED IMPROVISED EXPLOSIVE DEVICE DETECTION IDENTIFICATION & CLASSIFICATION ALGORITHMS (RADICAL)

Technology in Development:

- AFRL Phase I SBIR awarded June 2007

General Description:

Improvised explosive devices (IEDs) are often enabled by consumer-grade electronic devices. Commodity wireless devices have made possible completely decentralized communications among adversaries. At the same time, areas of interest to operators have shifted from jungles and deserts to primarily urban settings, where elevated electronic noise and dense multipath are more the rule than the exception.

GIRD Systems, in collaboration with L-3 Communications Nova Engineering, is developing a SIGINT system solution designed to pinpoint the very weak RF signals that are typical of the unintentional radiated emissions from electronic devices and receivers. Building on Nova and GIRD's successes with the Army's Digital Direction Finding (DDF) and Handheld Emitter Detector (HED) programs, the proposed concept will provide emitter mapping, even in dense urban areas, with a single sensor platform, using a bearings-only target tracking algorithm. The system applies recent developments in array signal processing to overcome the limitations imposed by operating in multipath-rich urban environments. The system design will include hardware and software development aimed at demonstrating a full system prototype in Phase II.

Multipath Mitigation and Source Association:

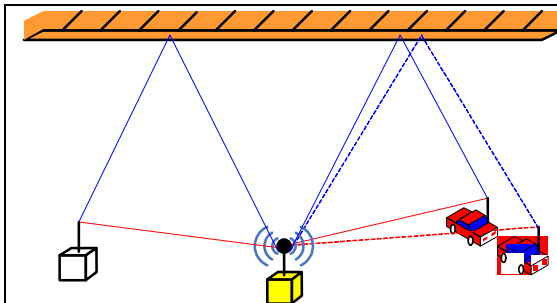


Figure 1: Multipath Mitigation: The LOS and reflected paths of stationary emitter-receiver have fixed lengths. Those of a moving receiver have time-varying lengths that are different for the LOS and reflected paths.

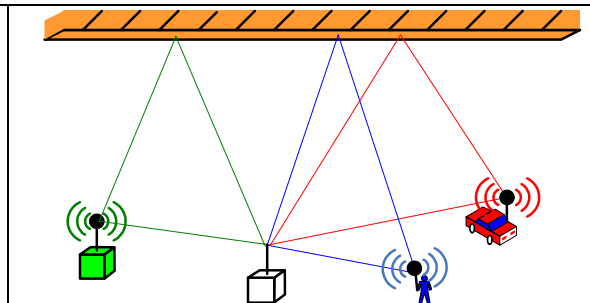


Figure 2: Source Association: All paths of each source need to be associated together, thus identifying the number of sources and the number of paths in each source.

Example Hardware Performance Objectives:

- Emitter localization using a single, vehicular mounted platform
- Operation in urban areas, including rich multipath
- Emitter position fix in three dimensions: Spherical error probable (SEP) < 10 m
- Platform operating velocity: < 60 mph (27 m/s)
- Probability of detection: > 0.9
- Operating frequency range: 20-3,000 MHz
- Minimum signal strength for position fix: -140 dBm
- Position fix improves with increased time on target, degrades gracefully with increased distance to target, reduced signal level, and reduced time on target
- 3 or more simultaneous emitters tracked
- Instantaneous $BW_{min} = 20$ Hz; $BW_{max} = 10$ MHz
- Time to first fix < 10 s;
- Low profile antenna sizes: < 3 cm high; Receiver size < 20 cubic inches
- HMI resides on a notebook PC inside vehicle

