Appendix C

# DETECTING SNIPERS

A representative selection of the most advanced countersniper systems available in the Free World, and the phenomena they are designed to detect, is shown in Figure C.1. All the manufacturers are located in the United States or Western Europe. The phenomena detected include muzzle blast and flash; the shock wave, vortex, and thermal signature of the bullet in flight; and retro-reflection from the sniper's optical sight.

*Muzzle blast* and *flash* are the acoustic and infrared (IR) signatures associated with the ejection of the bullet from the sniper's rifle.[1] The muzzle blast can be detected with acoustic sensors at ranges from several hundred meters out to more than a kilometer. The muzzle flash can be detected with IR sensors out to a kilometer or more, but the sensors must have line of sight to the weapon, and the flash can be suppressed.

The *bullet's shock wave* is a mini–sonic boom resulting from the bullet traveling at speeds faster than sound.[2] It can be detected acoustically at ranges from hundreds of meters out to more than a kilometer. If the sniper uses a fire suppressor to slow the bullet to subsonic speed, the acoustic signature of the bullet in flight is hard to detect.

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[1]S. Moroz et al., "Airborne Deployment of and Recent Improvements to the Viper Counter Sniper System," *Proceedings of the IRIS Specialty Group on Passive Sensors,* Vol. 1, 1999, pp. 99–106.

[2]L. S. Miller, "Counter Sniper Technology," *Proceedings of the 5th Battlefield Acoustics Symposium,* Ft. Meade, Md., September 23–25, 1997, pp. 681–692.

However, this countermeasure reduces the sniper's ability to penetrate armor.

Like most aerodynamic bodies, the bullet sheds vortices in flight, creating disturbances in atmospheric pressure along its trajectory. These vortices produce gradients in the atmosphere's refractive index that can be detected, in principle, with laser radars. None of the systems in Figure C.1 is designed to detect this signature.

The thermal signature of the bullet in flight can be detected with IR sensors out to several kilometers in range. Since the bullet is much hotter than "room temperature," it is detected most effectively in the medium-wave infrared (MWIR) band, with wavelength between 3

**RAND** *MR1187-C.1*

| Name | Manufacturer | Muzzle Blast | Bullet Shock Wave | Muzzle Flash | Bullet in Flight (IR) | Optics Laser Reflection |
|---|---|---|---|---|---|---|
| *Prototype* | Sanders | X | X | | | |
| Bullet Detection Indicator | GD Associates | | X | | | |
| Bullet Ears | BBN | X | X | | | |
| PD Cue | AAI Corporation | | X | | | |
| Pilar | Metravib | X | X | | | |
| VIPER | Maryland Advanced Development Lab | | | X | | |
| *Prototype* | Hughes Aircraft | X | | | X | |
| Integrated Sniper Location System | Sanders, LMIIS, and Sentech | X | X | | X | |
| Sight Laser Detector (SLD) | Cilas | | | | | X |
| Target Observation and Locating System | Sanders | | | | | X |
| Sniper Acoustic Detection Sensor | Rafael | X | | | | |
| SECURES | Alliant Techsystems | X | | | | |
| Sentinel Sniper Location System | SAIC | X | X | | | |
| Fast IR Sniper Tracker | Thermo Trex | | | X | | |
| Lifeguard | LLNL | | | | X | |

**Figure C.1—Free-World Countersniper Systems**

and 5 μm. However, long-wave infrared (LWIR)-based systems operating in the wavelength band between 8 and 10 μm—e.g., the Integrated Sniper Location System prototype—can also detect such signatures.

The object of detecting signatures of the bullet in flight is to estimate the bullet's trajectory and backtrack to find the location of the sniper. Acoustic sensors are passive. Taken singly, they can measure angles to the acoustic source, but not the range. To establish a track of the bullet requires that an array of acoustic sensors be deployed.[3] One alternative approach is to obtain an approximate direction to the sniper from the acoustic information, then to cue an IR sensor to backtrack the bullet more precisely. A second alternative is to detect the muzzle flash with a wide-field-of-view IR sensor, which then initiates an IR track of the bullet, resulting in a backtrack to the sniper.

Urban noise and glare make all of the systems that depend for initial cues on muzzle flashes or blasts subject to high false-alarm rates. For this reason, there is a trend toward multiple-phenomenology systems, which look for coincident detections of acoustic and IR events.

The backtracking process in the city is complicated by buildings, which may obstruct the view of the sniper's window. If much of the bullet track is visible, it is feasible to use the urban models discussed in Chapters Five and Six to complete the backtrack in the virtual world of the computer. This procedure could provide GPS coordinates for a weapon delivered from a UAV.

Laser systems that illuminate potential hiding places, or "hides," and detect retro-reflections from the sniper's scope are referred to as *optical augmentation systems.* These systems have the advantage of possibly detecting the sniper before he fires his weapon. The downside is that the sniper can employ antireflection filters that selectively block the wavelength of the laser. Tunable lasers may reduce the effectiveness of blocking filters in the future.

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[3]E. Page, "The SECURES Gunshot Detection and Localization System, and Its Demonstration in the City of Dallas," *Proceedings of the 5th Battlefield Acoustics Symposium,* Ft. Meade, Md., September 23–25, 1997, pp. 693–716.