

HUNTING

Geographic profiling is a proven technique that police investigators use to search for serial criminals. It helps to define where a criminal might live or work, based on the locations of the crimes committed and other evidence collected about the crimes.

Human spatial behavior in many forms can be analyzed and profiled, including where victims were picked up or dropped off, where phone calls were made, credit card and ATM use, where graffiti or posters appear, and where supplies were purchased.

Geographic profiling uses these and other factors to formulate a “hunting ground” as well as the most likely locations of a criminal within the hunting ground. Geographic profiling has been effective even when criminals are aware of the technique and attempt to behave randomly.

For these and other reasons, geographic profiling has significant potential as a tool for counter-insurgency. The U.S. National Technology Alliance (NTA) completed an evaluation of whether these types of analysis tools would be useful to aid in the hunt for insurgents, weapons caches and sources of bomb materials, thereby reducing civilian and military casualties.

The NTA is a federal program designed to motivate commercial firms to address national technology challenges in product development. Rosettex Technology & Ventures Group, supported by more than 70 partners, translates technologies that address broad national security needs into solutions using a unique business model.

The software evaluated was Rigel, which was developed by Environmental Criminology Research Inc. and based on the work of Kim Rossmo, the originator of geographic profiling for police investigation (see www.geoplace.com/gw/1999/0399/399crim.asp).

How Does Geographic Profiling Work?

According to Rossmo, the core of geographic profiling is an algorithm that analyzes a pattern of events (such as attacks by insurgents) within the context of transportation routes, topography and local geography. Rigel receives as input the locations of evidence in various forms, permits users to establish links among evidence in a variety of

ways and generates a probability map that prioritizes a list of suspect locations or geographic areas. Investigators can use the probability map to narrow the search for perpetrators, attempt displacement of perpetrators or otherwise reduce harm from criminal activities.

Evidence that doesn't at first seem to be spatial still can be useful. For example, an investigator may know what type of weapon and ammunition was used in a crime. Such information can be combined with a geographic profile of gun shops and the types of ammunition they carry to prioritize shops for further investigation.

How Was the Evaluation Conducted?

The NTA evaluation assumed that geographic profiling would be of some use in investigations of insurgency. The unanswered questions centered on its strengths and weaknesses, whether military use bore special requirements, whether results were reliable enough to use them to prioritize investigations and whether modifications

Geographic Profiling Adds a New Weapon

were required to suit military needs.

An evaluation team was formed with staff from the U.S. Army Topographic Engineering Center; the U.S. Marine Corps Intelligence Estimates Branch; and the Bureau of Alcohol, Tobacco and Firearms.

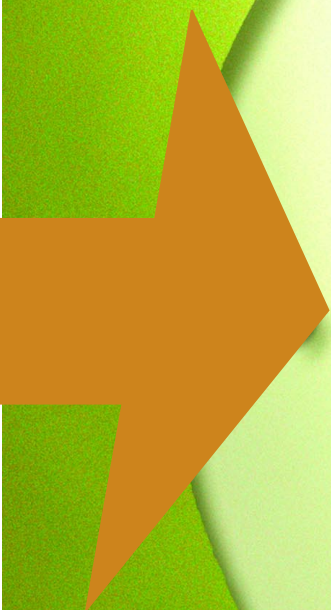
Actual data from Iraq were acquired to examine the use of geographic profiling for a range of purposes, and this article describes two test cases.

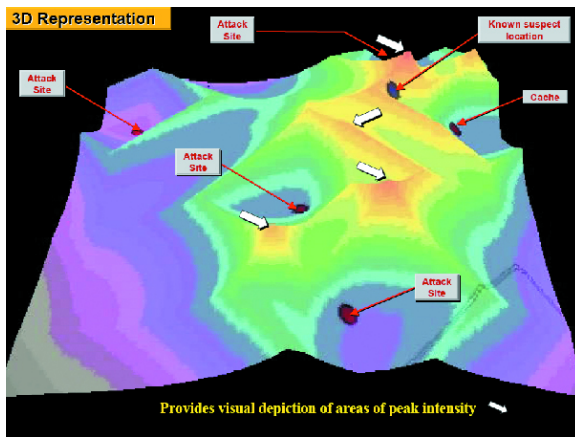
Test Case One

The first test case uses data that describe a series of Improved Explosive Device (IED) attacks linked by forensic evidence. The incidents occurred in a two-square-mile section around Baghdad during five months in 2004. Specific locations and times are known, and extensive corroborating evidence is available from a variety of sources. A potential suspect was identified.

The corroborating evidence includes 50 incidents of interest in the geographic area and timeframe. The process of geographic profiling included the following

INSURGENTS





● **Figure 1. A geographic profile for a test case didn't include the suspect's location as part of the profile.**

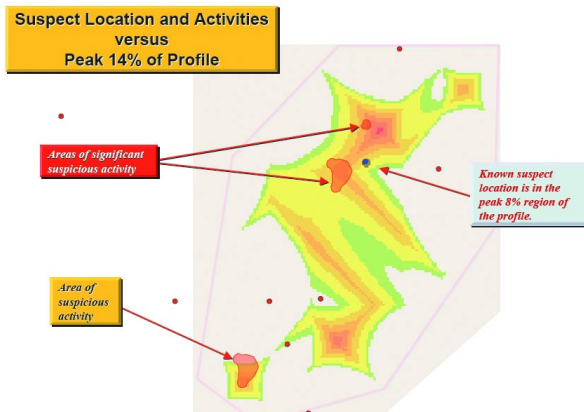
activities:

- Track migration of similar events (temporal flow).
- Identify demographics along with temporal flow (identify activity space). Demographics include religious, ethnic, neighborhood, tribal and external factors.
- Analyze temporal patterns and trends of key activities.
- Analyze patterns and trends in actions and reactions among friendly and enemy activity.

Multiple intelligence sources were accessed to acquire all possible forensic data. This was a realistic test of military usage, because the intelligence came from active combat units rather than developed specifically for software tests and evaluation. The acquisition of data from active combat units delayed the evaluation, but it added authenticity to the results.

Examining Evidence

The first step in analysis was to select which of the 50 incidents of interest were candidates for a geographic profile. Eight candidate event sites were selected from the 50 incidents of interest—seven attack sites and one cache site. Selection factors included the timing of the events, accessibility of the locations, ingress and egress routes, degree



● **Figure 2. An image depicts the peak area of a geographic profile.**

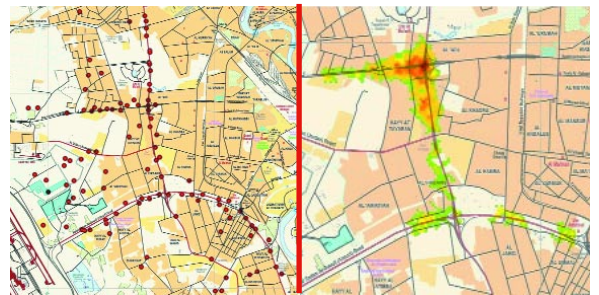
of apparent neighborhood knowledge, and likely significance of the sites to perpetrators. Considerable training and experience are required to make such judgments.

The forensic evidence that linked the eight candidate event sites was considered definitive, although it was impossible to know whether a single person or group was responsible. Three of the candidate event sites were ultimately excluded from the geographic profile.

Two of the excluded sites were second attacks on the same day, which means that they may not have been the result of independent journeys. A third excluded site was close to previous attacks, and its exclusion improved overall spatial diversity. Decisions to include or exclude sites are judgments based on training and experience.

Figure 1 shows the resulting geographic profile. The area covered is 2.04 square miles. The “high” locations, where the center of operations is likely to be found, cover 13.9 percent of the area—approximately 0.28 square miles. The suspect's location wasn't one of the model's inputs.

The next step was to verify the results. Going back to the original 50 incidents of interest, those that fell within the timeframe of the eight candidate events were analyzed,



● **Figure 3. A map (left) indicates the location of insurgent attacks on or near Airport Road in Baghdad, Iraq, for September 2004. A geographic profile (right) displays the top 2 percent probabilities for the locations of insurgent operations.**

and a strong correlation was found. Significant insurgent activity occurred within the peak areas of the profile.

Additional corroboration was provided by information about the suspect and his capture. The individual who was identified as a suspect had been recognized fleeing the site of one of the events and was tracked to the place where he was captured. The location of the capture was within the top 8 percent of the profile, which was consistent with the statistical prediction (see Figure 2).

This test case supports a conclusion that geographic profiling could help focus the military response to insurgent attacks, because it could help reduce the area searched for those responsible.

Test Case Two

The second test case analyzed a 30-day incident dataset that describes 2,368 attacks during a 30-day period in September 2004. The attacks involved 799 homemade

bombs, 664 mortars and rockets, 527 handguns and rifles, 272 rocket-propelled grenades, 40 vehicle bombs, 39 hand grenades, and 27 land mines. A total of 995 of the incidents occurred in and around Baghdad. The evaluators used the data to map 511 distinct incidents within Baghdad for analysis.

The spatial patterns suggest two types of attacks. The first type seems to be driven by spatial constraints in the surrounding area, particularly the route to the airport. The frequency of travel by U.S. military convoys likely is driving the pattern of attacks. Geographic profiling of this type of event is unlikely to reveal the location of insurgent bases, but it could indicate which intersections are used as access points (see Figure 3).

The second group of incidents appears to be less constrained by the street pattern or neighborhood. For example, the attacks within Sadr City appear to be better suited to geographic profiling, and the peak areas could potentially be targets for increased security (see Figure 4).

Insurgents often work in teams, which have a meeting place or a supply center for weapons or explosives. The geographic profile for a team is more likely to indicate possible sites of these types of locations, rather than the residences of individual insurgents.

The second test case showed the promise of geographic profiling for aspects of military intelligence that differ from police work. It also established the need for research to extend the approach to address specific challenges.

Challenges include a high volume of events; a large number of insurgents; the development of community expertise; and a need for information resources to describe geographic constraints, potential suspect locations, and cultural factors that affect hunting methods and travel-range limits.

Adopting Geographic Profiling Techniques

Military investigators need better tools to track down those who are kidnapping, maiming and killing U.S. forces, allies and civilians. These types of actions have parallels to serial crimes. Therefore, policing methods should become part of intelligence efforts in counterinsurgency. Geographic




● **Figure 4. A map displays the geographic profile (top 3 percent) for Sadr City insurgent events, Baghdad, Iraq, September 2004.**

profiling has been identified as one of the most promising new technologies for this purpose (see “Something Old, Something New—Guerrillas, Terrorists, and Intelligence Analysis,” *Military Review*, July-August 2004).

These evaluations indicate that the U.S. military can deploy geographic profiling software immediately to reduce casualties from insurgency in Iraq and elsewhere. Geographic profiling can provide an indication of the “anchor points” of attacks (e.g., headquarters of a cell, home of a cell leader, homes of those picking targets, locations where IEDs are constructed, etc.).

Using evidence collected during the course of an investigation, geographic profiling techniques can predict the most probable home base of serial criminals or terrorists based on the geographic pattern of crime sites. In addition, the existing software fits well into the software and data environments typically used by the intelligence community.

Plans are underway to “fast track” the use of a geographic profiling capability into operations with U.S. forces. Based on the results of this evaluation, a program of research and development is being defined to address the military’s specific needs in conjunction with the Center for Geospatial Intelligence and Investigation at Texas State University, San Marcos. 

Henry Kucera is a principal in Swiftsure Spatial Systems; e-mail: henry.kucera@swiftspace.com.

FPO
AD