Chapter 5
Two Real-World Geospatial Abduction Applications

Abstract In this chapter, we discuss two real-world applications of geospatial abduction problems (GAPs). While both applications deal with finding weapons caches that support improvised explosive devices used by insurgent terror groups, they operate in two different environments. SCARE (Spatio-Cultural Abductive Reasoning Engine) implements point-based geospatial abduction and was used to find IED weapons caches in Baghdad. In contrast, SCARE-S2 is an extension of SCARE to region-based geospatial abduction which has been used, with various modifications, to find high value targets (either large weapons caches or insurgent commanders) in certain provinces of Afghanistan. The accuracy of both systems has been tested on real-world data, and over 18 organizations have requested or used either SCARE or SCARE-S2.

5.1 Introduction

In this chapter, we describe the basic ideas behind two applications of geospatial abduction.

1. The Spatio-Cultural Abductive Reasoning Engine (SCARE [20]) implements point-based geospatial abduction as described in Chapter 2. SCARE tries to identify the locations of weapons caches in Baghdad. SCARE uses information about the cultural makeup of Baghdad, as well as information about the locations of natural features (e.g., the Tigris river) and coalition bases, to define a feasibility predicate. SCARE was tested for accuracy using 21 months of real-world open source data about attacks in Baghdad (and about discovery of weapons caches in Baghdad)—7 months of data was used for training SCARE, while 14 months of data was used as a blind test data set to check accuracy.

2. The SCARE-S2 system [23], on the other hand, has been applied to the problem of finding “high value targets” (or HVTs) in the Afghan provinces of Helmand and Kandahar. Again, using detailed information about the tribal geogra-
phy of these two provinces, we were able to define a feasibility predicate. Rather than Euclidean distances as used in SCARE, SCARE-S2 leveraged information about Afghan road networks to use “shortest path by road” distances. In addition, SCARE-S2 used region-based geospatial abduction as defined in Chapter 3 instead of point-based geospatial abduction. Finally, we used 6 months of real-world, open source data to train SCARE-S2 and to validate the accuracy of the system.

In the rest of this chapter, we describe the SCARE application (to IED cache detection) and SCARE-S2. We note that both systems can be applied to the other motivating examples presented earlier in this book if real-world data is available. This is apparent from the screenshots in the Introductory chapter which show SCARE being applied to examples such as the St. Paul, Minnesota church burglary scenarios, and the Tiger Detection application.

### 5.2 The Counter-IED Problem

The counterinsurgency environment provides a new set of challenges to the military commander, particularly at the tactical (Division, Brigade, Battalion, and lower) level. What von Clausewitz called the “fog of war” [1] is certainly present, but deceptive. Although the enemy in these contemporary conflicts often do not wear uniforms or operate out in the open, their actions in these complex environments are not entirely random. The enemy, or enemies, in a counterinsurgency typically have goals and strategies—not totally dissimilar to standard military units.

*As with terrorist tactics, guerrilla tactics are neither mindless nor random.* [2]

In the field of criminology, several theories exist that relate the geographic location of criminals with the locations of their crimes. *Pattern theory* [3] and *geographic profiling* [4] are extensively used. In the Army, intelligence professionals root their analysis in the process known as Intelligence Preparation of the Battlefield (IPB) [5, 25], which can also be extended to counter-insurgency operations [2]. However, traditionally, analysis of attacks in a counter-insurgency environment is to identify “hot spots” or places where attacks are likely to occur. In this chapter, we extend such analysis by examining techniques to locate sites used for enemy weapons caches based on attack data. We examine improvised explosive device (IED) attacks attributed to certain groups. We attempt to locate weapons cache sites based on attacks and on the locations of arrested enemy personnel using SCARE, the Spatial Cultural Abductive Reasoning Engine.