

Chapter XVII

Development of an Intelligent Patrol Routing System Using GIS and Computer Simulations

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ABSTRACT

Patrolling in a nonrandom, but focused manner is an important activity in law enforcement. The use of geographic information systems, the emerging real-time data sets (spatial and nonspatial) and the ability via global positioning systems to identify locations of patrol units provide the environment to discuss the concept and requirements of an intelligent patrol routing system. This intelligent patrol routing system will combine available data utilizing Map Algebra and a data structure known as a Voronoi diagram to create a real-time updatable raster surface over the patrolling area to identify destination locations and routes for all patrol units. This information system will allow all patrol units to function “in concert” under a coordinated plan, and make good use of limited patrolling resources, and provide the means of evaluating current patrol strategies. This chapter discusses the algorithmic foundation, implications, requirements, and simulation of a GIS based intelligent patrol routing system.

INTRODUCTION

Information systems, both spatial and nonspatial, are successfully utilized by law enforcement officials. These systems often perform fundamental data processing techniques such as storage and query (e.g., fingerprint or DNA), whereas information systems that collect vast amounts of data and perform deterministic tasks to assist in decision-making are deemed intelligent systems. The strongest evidence of police effectiveness in reducing crime and disorder is found in the case of geographically focused police practices (Weisburd & Eck 2004). As police patrols constitute an important element in the implementation portion of any geographic-focused crime-fighting plan, this chapter will discuss work in progress in the development and simulation of an intelligent patrol routing system. Such a system will allow all patrol units to function under a coordinated plan, as opposed to *N* individual patrols locked in predefined wards or patrol areas by determining the destination, routes and spatial dispersion of all patrol units. This approach will allow patrols to be an improved tool within a problem oriented policing or other focused crime fighting approaches. One of the goals of the proposed system is to ensure that individual patrols are working in concert, where the system will allow the big picture to be seen. This routing system will be both probabilistic and deterministic by incorporating existing digital data sets (spatial and nonspatial), which will determine and direct the real-time routes for each unit within a given patrol.

There is a pressing need, when dealing with large volumes of data, to whittle down automatically these vast amounts of data for this type of complex event processing to get VIRT or “Valued Information at the Right Time” (Denning, 2006). With the ever increasing sophistication of GIS, growing amounts of relevant, timely and accessible digital data, increasing power of computer systems to create real-time solutions, and increasing use of GPS, the environment is

well suited for the development of an intelligent routing system to facilitate the routing and assignments of patrols.

BACKGROUND

Routine activities and lifestyle theories explain situational opportunities that enabled criminal events to take place (Cohen & Felson 1979; Hindelang, Gottfredson, & Garafalo 1978). These very similar theories are often conceptualized as subsets of a broader *opportunity model* perspective (Cohen, Kluegel, & Land 1981; Cornish & Clarke, 1986). In essence, these opportunity models of crime describe the coming together of motivated offenders and suitable targets in a time and place that is lacking capable guardianship. Therefore, these opportunity perspectives focus attention on facilitators of criminal events rather than causes of criminality. Police have historically been local government’s best attempt at providing capable guardianship to its citizens. The traditional method of police patrols often spatially divides the space to protect into “static” or unchanging regions (i.e., patrol wards, or “beats”) and then assign units to patrol within each region in the hope that response times will be minimized, and with the additional increase of guardian presence, a reduced opportunity for criminal activity would occur.

The manner in which actual patrols are carried out can increase the effectiveness of patrols. Studies have demonstrated, for example, that focusing police patrols on crime hot spots is more effective than simple random patrol (Sherman & Weisburd 1995; Sherman, Gartin, & Buerger, 1989). Generally, traditional policing practice assumes that standard strategies (e.g., preventative patrol, rapid response, investigations, and increasing numbers of police) can be uniformly applied across geographical space with little concern for variations in crime levels, crime types or other factors (Weisburd & Eck 2004).

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