RIPS 2009: LAPD Project Description

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Algorithm Development for Criminal Geographic Profiling

The land use patterns of urban criminal offenders display strong spatial and temporal regularities. In this project, we will develop and extend offender geographic profiling algorithms. The algorithms will be tested against historical crime data from Los Angeles. A preliminary software tool may also be constructed for use by the LAPD.

Geographic profiling makes use of the the spatial distribution of crimes committed by a serial offender to construct a probability surface measuring likely home, work or regular activity locations of the offender. Law enforcement officers use the resulting geoprofile map to narrow the spatial domain in which to deploy resources or, if information on the spatial distribution of suspects is available, the list of suspects to investigate.

The basis of geographic profiling is the empirical observation that offenders typically forage for suitable targets as a decreasing function of distance from their "base of operations". Crimes thus cluster in space around a known base of operations. Conversely, any point in space may be scored probabilistically as a suspected base of operations depending on whether crimes are maximally clustered around that point. The naïve algorithm for constructing a probability surface has shown mixed results in testing against known serial offender offense distributions. The reason for this mixed performance may have to do with use of inappropriate functional forms, inadequate consideration of noise in the system and inadequate consideration of how complex environmental heterogeneity may impact offender behavior.

We will attempt to extend the existing geographic profiling approach and develop new algorithms taking into account: (1) up-to-date information on offender spatial behavior; (2) how complex urban environments constrain or facilitate offender spatial behavior; and (3) new mathematical and simulation techniques. We also may explore how information about the temporal distribution of crimes may be fused with spatial information to produce geo-temporal profiles. Mathematically, geographic profiling is similar to inverse scattering problems in physics and self-exciting point processes in probability. Appropriate techniques may arise in these domains.

Profiling algorithms developed in this project will be tested against historically known serial offense data from Los Angles provided by the LAPD. The existing RIGEL geoprofiling tool will be used as a benchmark for comparing algorithm performance.

Computations will be done in Matlab. C, C++, Java or Fortran codes are also good, but should be integrated into Matlab to permit interactive analysis. Symbolic manipulations can be done in Mathematica or Maple. A software tool based on developed algorithms is desirable, but not required.

Key Milestones:

1. Evaluation of existing geoprofiling algorithm.
2. Geoprofiling with updated model of offender spatial behavior.
3. Geoprofiling with updated model of offender temporal behavior.
4. Incorporating environmental constraints.
5. Software Tool.
6. Presentation at LAPD.

References

Chainey, S., and Ratcliffe, J., 2005. GIS and Crime Mapping. John Wiley & Sons, Chichester.

Rossmo, D. K., 2000. Geographic Profiling. CRC Press, Boca Raton.