RESEARCH PROFILE AND PUBLICATIONS

My research scope can broadly be classified into three main areas briefly outlined, with selected publications (some are cross-listed), as follows:

1. Analysis of Uncertain Spatial Phenomena and Processes

This line of research focuses on uncertainty analysis in general and imprecision analysis in particular. Fuzzy sets and fuzzy logic approach to the analysis of imprecision/fuzziness induced geographical problems has long been in my research agenda over the years. Fundamental concepts of fuzzy boundary, fuzzy region, fuzzy spatial optimization, etc. have been proposed and analyzed. Methods for spatial inference based on fuzzy logic have also been formulated. By integrating probability, statistics, fuzzy sets, rough sets and granular computing in novel ways, a comprehensive and rigorous framework has been developed for the analysis of uncertainty due to randomness and/or fuzziness and/or information granularity. In particular, a specific series of investigations has been carried out on error analysis and propagation in geographical information.

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2. Geographical Information Systems and Intelligent Spatial Decision Support Systems

This research stream attempts to solve basic conceptual problems in geographical information systems. In particular, a rigorous statistical framework for the analysis and propagation of errors in geographical information systems has been developed. It corrects some ambiguous and erroneous concepts in current analyses of uncertainty in spatial information systems, and provides powerful algorithms for exact and approximate computations. The research on intelligent spatial decision support systems capitalizes on the power of artificial intelligence, geographical knowledge and machine efficiency to model highly complex data and to mimic human reasoning through the integrated employment of methods in artificial intelligence, mathematics, statistics, non-linear analysis and information theory.

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3. Spatial Analysis and Spatial Data Mining

This area of research involves the development of novel ideas and methods to analyse complicated spatial structures and processes. The theoretical formulations and algorithms developed can effectively unravel, for example, seismic belts, active seismic episodes, temperature variations, tropical cyclone movements, spatial and temporal outbreaks of infectious diseases from the spatial and temporal data. Identification of land covers, physical features and natural resources hidden in remote sensing and geo-referenced data can also be accomplished. Furthermore, the research has constructed novel neural network and evolutionary computation models for effective pattern recognition, classification of remotely sensed images, and optimization of transportation and communication networks; multifractal models for the study of scaling behaviour and long-range dependency of spatial and temporal processes across multiple scales.

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