Content-Based Spatial Query Retrieval by Spiral Web Representation

Lau Bee Theng  
School of Information Technology and Multimedia  
Swinburne University of Technology (Sarawak Campus)  
blau@swinburne.edu.my

Wang Yin Chai  
Faculty of Computer Science and Information Technology  
Universiti Malaysia Sarawak  
ycwang@fit.unimas.my

Abstract - Information acquisition with the availability of modern information technology has become easier. We rely on various information systems in our daily lives. Geographical information systems and spatial query retrieval become more and more important in vehicle navigation, robot automation, and satellite signal processing. Spatial query is made easy with the handheld technology like PDA and sketching device. However, powerful query methodology needs powerful retrieval techniques to produce the desired output. Content based spatial query retrieval is one of the best resorts for spatial query retrieval. Structural spatial query retrieval is in content based retrieval family that is also an active research area in spatial databases. Structural spatial query retrieval assesses similarity by its structural arrangement, known as configuration similarity. This research developed an enhanced structural spatial query retrieval model for spatial databases.

Keywords: Content based retrieval, structural spatial query, configuration similarity, and spatial retrieval

1. Research rationale

This research developed a Structural Spatial Query Retrieval Model for spatial databases by Spiral Web representation. The Spiral Web representation model is able to represent the unique relations among query objects in a structural spatial query like neighborhood relation, relative distance, and direction and object geometry. The Spiral Web representation has also eliminated the conventional multi measures used in structural similarity assessment and replaced it with single measure. On top of this, it proposed an improved way of associating objects in a query and eliminated the object approximations used in existing models. In short, the model was proven to be more effective than existing models in three main areas that are single similarity measure, improved reduced object association, and object approximation free. This research has been successful in proving the proposed model as a feasible and practical model for structural spatial query and retrieval of spatial information from spatial databases. The representation and similarity assessment proposed in the model has been tested and compared with the two main streams in structural spatial query that are the generic and Blaser(2000) model. The testing results have proven the applicability and practicability of the model. Furthermore, the model produced better results in overall situations. On top of these, the proposed model and its prototype have laid a platform for many other researches in the domain of structural spatial similarity.

2. Framework of the model

Blaser (2000) constructed a structural similarity model with multi measures consists of topology, direction and metrics. Papadias and Delis (1997) dealt with the structural similarity with multi relations as well. Papadias et. al. (1998b) also constructed a model for structural similarity with multi constraints. Papadias et. al. (1998a) proposed spatial query retrieval with multi fuzzy relations structural similarity like direction, distance and topology. These researches have one common concept that is multi spatial relations like direction, distance and topology are essential for structural similarity assessment.

It is clear that there is no single measure that can substitute these multi relations as to date of this research. The invention of a single similarity measure is essential as it reduces processing time, effort and complexity. Furthermore, the issues of integration and calibration of multi measures can be resolved. However, the single measure structural similarity must be able to substitute the existing multi measures without sacrificing or trading off the efficiency of spatial query retrieval.

In order to obtain such a structural similarity model, this research proposed a framework in Table 1. The generic framework for configuration similarity includes all major types of spatial relations and also handles the fuzziness of the spatial relations in a query. It consists of multi relations defined in binary strings for topology, direction and distance, encoding of binary relations using conceptual neighborhood and algorithm to compute similarity for the binary relations. The claimed advantages of the generic framework are the expressiveness of the binary string encoding when given a binary string, a spatial configuration can be easily inferred, and vice versa; the efficient automatic calculation of neighborhoods and relation distance, and the uniform representation of all three types of relations (topological, directional, distance) in various resolution levels.