EXPERIMENTS WITH SCENE SIMILARITY METRICS IN MOBILE IMAGERY ANALYSIS

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EXTENDED ABSTRACT

Motion imagery is becoming increasingly important for geospatial applications. Examples of motion imagery include:

- datasets collected by sensors on-board unmanned aerial vehicles (UAVs) flying over an area,
- imagery collected by hand-held sensors captured as one roams in an urban environment, or even
- imagery collected by a fixed sensor monitoring a scene.

The imagery may be available at video rates, or even as select frames captured a few seconds (or minutes) apart. The information captured in motion imagery datasets is by definition spatiotemporal: objects change position due to their own motion or the motion of the sensor monitoring them.

In this paper we report on experiments with motion imagery using our scene similarity metric introduced in Agouris et al., (2000). Our scene similarity metric was a variation of the integrated model presented by Goyal and Egenhofer (2001) and Blaser (2000). According to this model, a global scene similarity metric (S_{met}) between two scenes I and Q is provided as a weighted sum of individual metrics expressing similarity in shape, topology, orientation, and distance of objects and object combinations within a scene:

$$S_{met}(Q,I) = S_{sh}(Q,I)\cdot w_{sh} + S_{top}(Q,I)\cdot w_{top} + S_{or}(Q,I)\cdot w_{or} + S_{dist}(Q,I)\cdot w_{dist}$$

where:

- S_{sh} is a function measuring the degree/percentage of shape similarity between the objects in Q and the corresponding objects in I. For example, assuming that $obj_1, ..., obj_n$ indicate the n objects in Q,, then $S_{sh}(Q,I) = [\Sigma\ match\%(obj_i)]/n$, where $math\%(obj_i)$ is the matching percentage between object obj_i in Q and the corresponding object in I.
- S_{top} is a function measuring the degree/percentage of similarity between the set of topological relations characterizing the set of objects in Q and the topological relations among the corresponding objects in I.
- S_{or} is a function measuring the degree/percentage of similarity between the set of orientation relations characterizing the set of objects in Q and the orientation relations among the corresponding objects in I.
- S_{dist} is a function measuring the degree/percentage of similarity between the set of distance relations characterizing the set of objects in Q and the distance relations among the corresponding objects in I.

The uniqueness of our approach (termed *varying baselines approach*) was on deriving metrics for orientation (S_{or}) and distance (S_{dist}) similarity that are independent of scale and cardinality (Agouris et al 2000). This allowed us to overcome the dependency on preset scale and cardinality values that was part of the commonly available scene similarity metrics. Our metrics and models were initially developed to support image queries, considering static information as input to compare a scene in an image to a similar scene in another. In this paper we will analyze the use of our scene similarity metrics in motion imagery applications.

Our objective in this paper is to examine the gradients of the above metrics with respect to time, in order to identify critical points in spatiotemporal events. These critical points correspond to instances when the spatial relationships between objects change abruptly. As such they indicate instances where the sensor is at a location where it can obtain a substantially different view of a scene, or the configuration of objects monitored by a fixed sensor has changed substantially. Accordingly, they produce a generalization of both the sensor's trajectory and the scene's content. This information complements our work on the generalization of individual object spatiotemporal trajectories presented in Partsinevelos et al (2001).

In the paper and presentation we will present an overview of our scene similarity metrics, and extensive experimental results.

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