Detecting Structural Patterns In Road Traffic Using Dynamic Subgraph Isomorphism

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Résumé

Traffic pattern detection is a very well studied field for the development of Intelligent Transportation Systems (ITS). Understanding traffic patterns helps in proposing innovative methods for traffic management and predicting traffic flow. However, most of the research conducted in this field focuses on statistical patterns, i.e., those detected in the acquired traffic data. Pattern Recognition community has proposed various methods which exploit structural information for pattern detection. Detecting structural patterns in case of road traffic requires a novel point of view for its formalization. The structure of road traffic is defined using a dynamic graph G whose nodes represent different real-world objects like vehicles, buildings, pedestrians, traffic signs etc. which affect traffic flow in an urban environment, while its edges represent spatial relations such as topological relations, relative orientation relations, qualitative distance, directional relations etc. between these objects. The dynamics of the graph take into account the spatio-temporal variation in road traffic. Using such formalization, a traffic pattern could also be defined using a dynamic graph H, which could represent, for example, a vehicle crossing an intersection or a pedestrian crossing a street. The objective of proposing such patterns is to be able to understand the behaviour of different traffic participants and to recognize dangerous traffic situations. The problem of detecting such patterns in road traffic graph G becomes the problem of subgraph isomorphism for dynamic graphs. To this effect, we propose an algorithm which finds all subgraphs of G which match with the given pattern graph H. Our algorithm is based on another algorithm for subgraph isomorphism, called VF3, proposed for static graphs. The experimental results demonstrate the runtime of our algorithm using different graph parameters like size, density, number of node classes and number of graph snapshots for both pattern and target graphs.

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