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Analysis and Modeling of Multi-Agent's Trajectories on Network Graph

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***Abstract**: Network graph is a very important mathematical structure used in many applications, one of which is transportation science. In transportation networks, one deals not only with the network structure, but also with information related to the utilization of the elements of the network, which can be shown using flow and origin-destination matrices. Applying this concept network structure and network utilization on pedestrian agents, we show the data collection of trajectory data and the analysis of trajectories into shopper's behaviors, flow pattern and alley attractiveness index as well as the quantification of pedestrian behavior compared to the ideal shortest path. We also show the mathematical relationship between network utilization (flow, generalized origin destination (OD) and alternative route flow from trajectories) and network structure (adjacency and path matrix). In contrast to traffic assignment methods that employ OD matrix to produce flow matrix, trajectory analysis on a network graph as input and produce both the generalized OD matrix and the flow matrix as outputs. A new tool based on random walk multi agent on network to prioritize the importance of edges in a network graph based on an ideal relative flow distribution is also proposed. An ideal flow, which is uniform distributed flow over space and time, is based on the maximum entropy for the utilization of a network. Higher ideal flow may indicate possible relative higher flow level or congestion. This edge relative importance is based on the network structure rather than the utilization of the network. Adding edge on the network may increase or decrease congestion level due to the increase of importance level of the edge. Ideal flow is a good tool to evaluate network dynamic that can give us the ability to see the effect of a change in a network structure, even for far away from the place of the change.*