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A Real-time Traffic Routing Framework for Flood Risk Management Using Live Urban Observation Data

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Reliable transportation infrastructure is crucial to ensure the mobility, safety and economy of urban areas. Flooding in urban environments can disrupt the flow of people, goods, services and emergency responders as a result of disruption or damage to transport systems. Pervasive sensors for urban monitoring and traffic surveillance, coupled with big data analytics, provide new opportunities for managing the impacts of urban flooding through intelligent traffic management systems in real-time.

A framework has been developed to assess the effect of urban surface water on road network traffic movements, accounting for real-time traffic conditions and changes in road capacity under flood conditions. Through this framework, inferred future traffic disruptions and short-term congestions, along with their spatiotemporal prorogation can be provided to assist flood risk warning and safety guidance. Within this framework, both flood modelling results from the HiPIMS 2D hydrodynamic model, and traffic prediction from machine leaning, are integrated to enable improved traffic forecasting that accounts for surface water conditions. Information from 130 traffic counters and 46 CCTV cameras distributed over Newcastle upon Tyne (UK) are employed which include information on location, historical traffic flow, and imagery.

Figure 1 shows a flowchart of the traffic routing system. Congestion is evaluated on the basis of the level of service (LOS) value which is a function of both free flow speed and actual traffic density providing a quantitative measure for the quality of vehicle traffic service. Surface water results in decreased driving speeds which can in turn cause in a sudden increase of traffic density near the flooded road, and queuing in connected roads. A relationship among flood depth, free flow speed, flow rate and density has been constructed to examine the density curve variation in the whole process along with the surface flood dynamic. Based on the new speed-flow model and congestion degree an updated road network can be acquired using geometric calculation and network analysis. Finally, flooded traffic flows are rerouted by shortest path calculation associated with the origin-destination and changes in road capacity and vehicle speeds. A case study under a flood event similar to the one on June 28th 2012, which is a return period of 1 in 100 years, is demonstrated for Newcastle upon Tyne (UK).

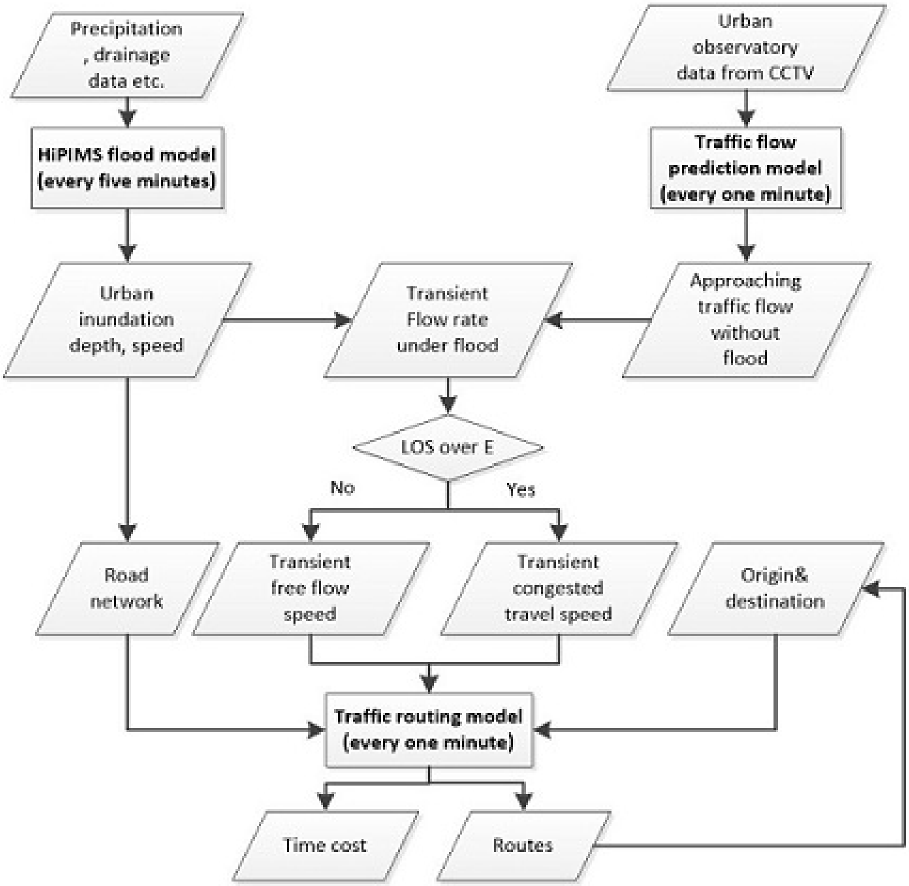

Figure 1. Flowchart of the integrated traffic routing model that accounts for surface water flooding.