RESEARCH INSTITUTE FOR SUSTAINABLE URBAN DEVELOPMENT (RISUD)

News Article for RISUD Emerging Frontier Area (EFA) Scheme

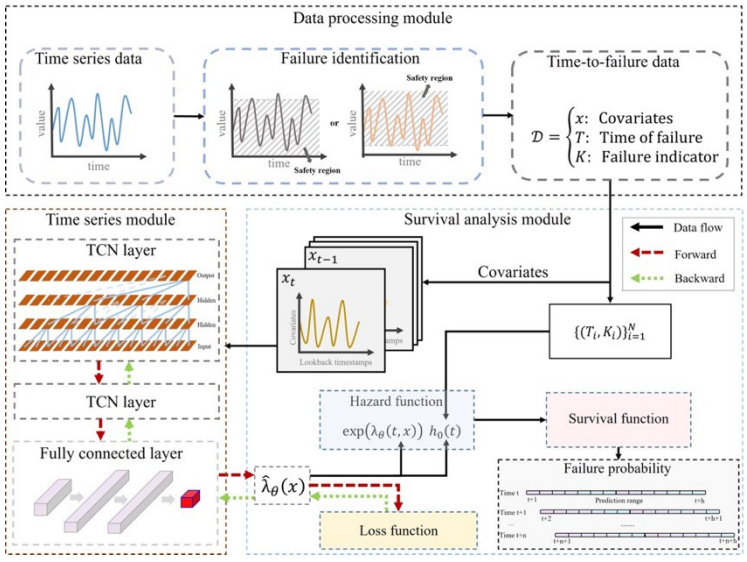
		Name	Department
1.	**Principal Investigator**:	Dr. Wei MA	CEE
2.	**Name of EFA:**	Disaster Emergency Response in Smart Cities	
3.	**Project Title:**	Towards a Smart System for Post-Windstorm Tree Debris Cleanup and Transportation Network Restoration in Hong Kong	

4. **Annual Progress/Achievement (***in layman's language, no more than two A4 pages, pls attach photos***)**

In the second stage of this EFA project, we focus on developing methodologies that make use of multi-source urban data, identify potential risks, and manage the system in the smart cities. We summarize the following main research outcomes for sharing.

1. A deep learning-based failure prediction framework

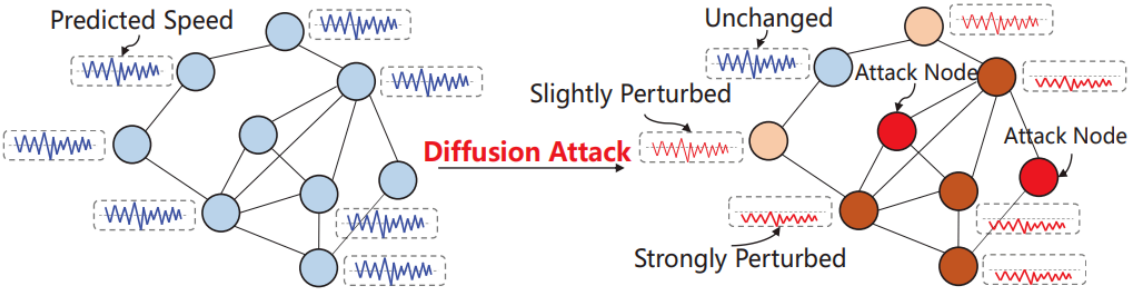
In civil infrastructure systems, identifying extreme operational conditions, which could cause system failures, is critically important. To this end, we propose a novel task of failure prediction, which aims to predict system failures before it happens. TCNSurv, a generalized model that integrates survival analysis and time series analysis, is developed. TCNSurv mainly contains three components: a data processing (DP) module, a time series (TS) module, and a survival analysis (SA) module.



2. A bi-level optimization-based vulnerability assessment framework

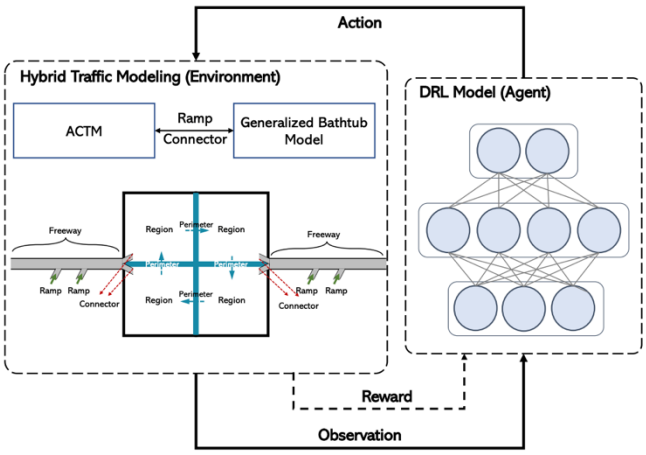
We proposed a new task -- diffusion attack, to study the robustness of Graph Convolutional Networks (GCN)-based traffic prediction models. The diffusion attack aims to select and simulate attacks on a small set of nodes to degrade the performance of the traffic prediction models, and it can be used to examine vulnerabilities of the traffic prediction models. We propose a novel attack algorithm, which consists of two major components: 1) approximating the gradient of the black-

box prediction model with Simultaneous Perturbation Stochastic Approximation (SPSA); 2) adapting the knapsack greedy algorithm to select the attack nodes.



3. A deep reinforcement learning-based traffic management and operation framework

In recurrent situations, we formulate coordinated ramp metering and perimeter control on large-scale road networks. To model the traffic flow dynamics on heterogeneous networks (freeways and urban roads), we refine a general hybrid traffic model using ACTM and the generalized bathtub model. To coordinately control freeways and urban roads in a large-scale network, we develop a demonstration-guided DRL method that is trained by incorporating "teacher" and "student" models.



4. A multi-agent Reinforcement learning approach for emergency vehicle dispatching

In non-recurrent situations, to dispatch emergency vehicles, we develop a multi-agent reinforcement learning approach to determine which vehicle to dispatch and how the route is designed. Specifically, one agent is responsible for sending each request to each region, and each region is operated by one agent, responsible for route planning.

5. Collaborations with HKTaxi Industry Innovation Committee

Based on the developed platform in this project, we are now collaborating with HKTaxi Industry Innovation Committee to evaluate the improvement of service availability for e-hailing in Hong Kong: a data-driven approach for spatio-temporal analysis.