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Infrastructure systems are crucial for the development of communities because they provide essential services to the habitants. Here we focus on the transportation network, which is designed to provide a continuous service to the community. Due to its decisive role in the economy, governments and policy makers have been investing in developing strategies to increase the resilience of this kind of infrastructure against disruptive events.

In the literature, several methods to evaluate networks' reliability and resilience can be found. The applicability of these methods is limited to small networks due to the computational complexities. In this paper, the case of city-scale road transportation networks is tackled. The case study considered in this work is the transportation network of a virtual, city called 'Ideal City'. First, the road map of the city is transformed into an undirected graph with 15012 nodes and 19614 edges. A non-random gradual removal of the edges has been applied until the network's failure point is reached. The edge removal process is related to the failure probabilities of the edges when the network is exposed to a certain hazard. In fact, the effect of hazards on the transportation network is not direct. The hazard exposes the building structures on the road sides to a failure risk. These structures if collapsed would cause the adjacent roads to be blocked and thus lose functionality due to the debris falling from the structures. For this purpose, a building infrastructure is modeled and the relationship between the level of damage of building and the amount of debris falling on the adjacent roads is developed. A Monte Carlo approach is used to generate failure permutations of edges considering their failure probabilities. The network reliability is then calculated using the Destruction Spectrum (D-spectrum) approach. In addition, the network's edges have been ranked from the most to the least important by applying the Birnbaum Importance Measure (BIM). Due to the large size of the network, a number of computational problems have arisen. Therefore, several coding algorithms have been developed to allow evaluating both the reliability and the BIM indexes while avoiding computational errors.

The results obtained in this study are used to identify the vulnerable components of the network. The vulnerable components are the ones that should be focused on to improve the overall resilience of the infrastructure. The analysis concept adopted in this study is applicable to all network-based infrastructure systems such as water, gas, transportation, etc. Future work will be oriented towards applying the methodology to other network-based infrastructure systems.