Complex Engineered Networks and Infrastructure Systems

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Complex engineered networks are a pervasive feature of modern society. Examples include transportation systems (road, rail, and airlines), electric power grids, networks of natural gas pipelines, cellular grids, and the internet. These distributed infrastructure systems with many interconnected components provide critical services for everyday life, such as water, food, energy, transport, communication, banking, and finance. Moreover, most of these critical infrastructures are interconnected and interact with and depend on social networks. As a result of technological progress and worldwide urbanization, the dependence of our society on these complex systems spanning cities, countries, and even continents, constantly grows. Given the critical role that engineered networks play in the functioning of our societies, there is an increasing demand for these systems to be highly reliable. A deep understanding of their actual capabilities to withstand natural hazard, such as earthquakes, tsunamis and hurricanes, and man-made threats, e.g. accidents and terrorism, is crucial. The related issues of resilient network design and operation are also closely related to sustainability problems which are of increasing importance today. In particular, the degree to which a technological network subjected to internal or external stresses (e.g. cascading failures or seismic hazards) is capable of keeping (or recovering) the service demanded needs to be quantitatively estimated. In this respect, cascading failures, where external perturbations trigger some initial local failures that lead to eventual global network failure, are especially hazardous. Quantitative assessment of network reliability and associated risks and uncertainties is therefore a key aspect of system design, optimization, and operation.

The main objective of this Special Session is to bring together experts working in the interdisciplinary area of engineered networks and infrastructure systems to present and discuss the latest developments in the field. Some relevant topics include reliability, risk, vulnerability and resilience analyses of critical infrastructures, multi-sector interdependencies of infrastructure networks, survival signature, common cause failure, and cascading failures.