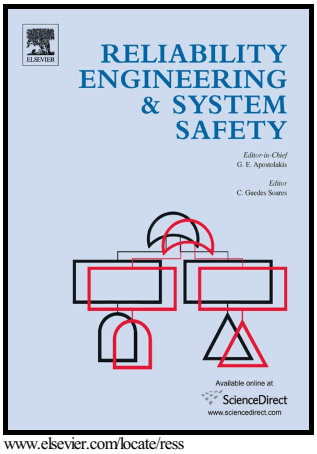

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Abstract

The complex and interdependent nature of modern critical national infrastructures provides the conditions for which localized failures can propagate within and between network systems, resulting in disruptions that are widespread and often unforeseen. Within this study we characterize critical national infrastructures as a system-of-systems and develop methodology to perform a multi-scale disruption analysis. To achieve this we map functional pathways between network source and sink assets across a range of operational scales. Customer demands are attributed to these pathways and are used to build a weighted network. The resultant functional path set and weighted network are used to perform a disruption analysis that encodes information on the long-range functionality within and between infrastructures, providing insights into failure propagation and the functional dependencies that exist between assets from multiple sectors. We supplement the methodological development with a detailed national scale demonstration for England and Wales using a unique representation of the integrated electricity network and the domestic flight network. The results highlight the potentially large disruptions that can result from the failure of individual electricity assets from a range of different sub-systems.

Keywords:
Infrastructure, network, interdependence, system-of-system, multi-scale, disruption analysis