A Routing Problem for Restoring Interdependent Infrastructure Systems

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Abstract

Fast restoration of infrastructure (power, water, gas, telecommunication, transportation) systems is crucial in the aftermath of a disaster. Restoration requires sending repair teams to major inoperative components of each system. In practice, restoration operations are carried out independently, i.e., a repair team for a power system visits a set of power network components uninformed about the routing plans for the gas system. However, functionality of these systems are dependent, i.e., a compressor in a gas network cannot function if power from a connected electricity network component is down. So, even after a component is *repaired*, it may not be *operational* until a component in the other system is repaired.
Such operational interdependencies complicate the repair process in terms of finding a prioritization in visiting system components under limited resources. In a decentralized decision making process where each system uses a separate team to visit its network components, such interdependencies would be overlooked. This would lead to inefficient routes, causing a delay in the operational time of the overall system.
In this ongoing study, we model these systems as a network of networks and consider a central decision making process when selecting routes for a set of repair teams. In this approach, interdependencies are modeled implicitly in an integer program as operational synchronization of network components.

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