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Improving Societal Resilience Through Enhanced Reconnection Speed of Damaged Networks

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Road networks rank among the foundations of civilization. They enable people, services and goods to be transported to arbitrary places at any time. Its functioning can be impacted by various events, not only by natural hazards and their combinations. This can lead to the concurrent interruption of a number of roads and even cut-off parts of the network from vital services. The impact of these events can be reduced by various measures, but cannot be fully eliminated.
We are aware of the fact that extreme events which result in road network break up will occur regardless of the ongoing process of hazard reduction using, for example, the improvement of the structural robustness of roads. The next problem is that many of the events are unpredictable and thus the needed costs of the improvement can easily spiral out of control. We therefore focus on the speed of the recovery process which can be optimized. This means that the time during which the damaged network is reconnected again will be as short as possible. The result of the optimization procedure is a sequence of road links which represent the routes of the repair units.
The optimization process is, however, highly nontrivial because of the large number of possible routes for repair units. This prevents anyone from finding an optimal solution. We consequently introduce an approach based on the Ant Colony Optimization algorithm which is able to suggest an almost optimal solution under various constraints which can be established by the administrator of the network. We will also demonstrate its results and variability with several case examples.