ABSTRACT

Author: Alinizzi, Majed, F. PhD
Institution: Purdue University
Degree Received: August 2017
Title: (Integrated Framework for Optimizing the Maintenance and Rehabilitation Schedules of Interdependent Infrastructure Systems).
Major Professor: Amr Kandil

In current practice, civil infrastructure systems are typically managed and operated without duly accounting for the interdependencies that exist among the different types of systems. Such separate management may result in practices that may be cost-effective locally (for the individual system only) but not globally (for two or more systems with shared locations or functionality). This dissertation develops an optimization framework for scheduling infrastructure repairs that considers such interdependencies. The framework determines the optimal performance thresholds for applying a treatment to a primary system that is subject to disruption induced by a neighboring (secondary) system. This disruption may be deterministic or probabilistic in terms of the severity and/or time of its occurrence. The optimization framework provides decision makers with optimal/near-optimal repair schedules of the primary system based on the incremental costs and benefits of the repair of that system treatment. A number of solution techniques including first-order derivative, multiobjective genetic algorithm (NSGI-II), and sampling average approximation are presented to solve the scheduling problem at hand. The developed framework is demonstrated using two case studies involving co-located pavement and underground utility assets. The results show that the proposed model can provide effective maintenance schedules for a primary system in the presence of disruptions of a secondary system.