Dynamic influence diagrams for risk-based decision making for rebars

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Dynamic influence diagrams for risk-based decision making for rebars

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This paper presents recent contributions to the Marie Skłodowska-Curie Innovative Training Network titled INFRASTAR (Innovation and Networking for Fatigue and Reliability Analysis of Structures - Training for Assessment of Risk) to the field of reliability and risk-based approaches for decision-making in wind turbine and bridges (http://infrastar.eu/). In this paper, a risk-based framework based on a Bayesian approach is applied where a probabilistic damage evolution model is applied to assess the reliability and to plan mitigation actions, including inspection, repair, and change operation of bridge. Using dynamic influence diagrams by Bayesian networks (BNs), which relate variables to each other over adjacent time steps, decision making is carried out. Nowadays, one of the challenges in the industries is to minimize the cost of operation and maintenance (O&M) as well as inspection. [1] Two topics became popular to find the best solution in this regard: Risk-based inspection and risk-based O&M; they could be assumed as a subset of risk-based decision making. Extension of the lifetime of bridges is a significant issue for engineers as their collapse or failures could cause economic and environmental consequences. Hence, in decision-making, it is of key importance to take cost-efficient actions to avoid any failure in these structures. Decisions taken at the design stage can be updated when information becomes available on climate or traffic actions, possibly changing over time. Hence, it is an important subject for risk decision-makers to update their actions according to the real state of the structure. In other word, bridges are continuously exposing to loads which has a direct influence on their lifetime [2], results in an increased risk of failure. These environmental impacts can be due to fatigue of reinforcement steel components in a composite bridge [3,4]. In this paper, a composite bridge with steel box girder and concrete deck is assumed as a case study to investigate this issue. A risk-based framework based on a Bayesian approach is applied where a probabilistic damage evolution model is utilized to assess the reliability and to plan mitigation actions, including inspection, repair, and change operation of bridge. Using dynamic influence diagrams by Bayesian networks (BNs), which relate variables to each other over adjacent time steps, decision making is carried out. Therefore, different strategies are applied to prolong their life cycle performance using risk-based inspection and risk-based O&M. A comprehensive framework utilizing BNs is suggested for risk-based inspection and O&M planning. The decision tool is proposed to deal with structures exposed to deterioration damage over time; damage over time can be calculated using this information. The aim is to find the optimum decisions based on the cost of maintenance and inspection. Besides, this procedure can help to find the optimal time interval for maintenance and inspection. The procedure will prevent failures in the structures in order to reduce consequences caused by late inspections or maintenance as well as early ones to optimize the cost of repair and inspection. The application is presented for an illustrative example for the assumed bridge.

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