

Structural Deterioration Knowledge Ontology for Supporting Adaptive Intelligence-Based Bridge Deterioration Prediction

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ABSTRACT

Bridge deterioration prediction plays a critical role in supporting bridge maintenance planning and prioritization. However, existing bridge deterioration prediction approaches are either model-driven or data-driven – missing the opportunity of integratively learning from both domain knowledge and data for enhanced deterioration prediction. To capitalize on this opportunity, this paper proposes a novel adaptive intelligence-based bridge deterioration prediction framework. It integrates model-driven and data-driven prediction approaches by (1) formalizing the domain knowledge captured by mechanistic structural deterioration models as constraints and (2) using the constraints to regulate and enhance data-driven learning of bridge deterioration patterns. Nevertheless, formalizing domain knowledge is challenging. One specific challenge is to explicitly represent the complex mathematical relationships between the concepts defined in mechanistic structural deterioration models in a machine-interpretable way. To address this challenge, this paper proposes a structural deterioration knowledge ontology (SDK-Onto), which leverages the arithmetic-logical expression to capture and represent the complex mathematical relationships. This paper provides an overview of the proposed framework and focuses on presenting the proposed ontology. The presented research contributes to the body of knowledge by offering a means to formally and explicitly represent domain knowledge captured by mechanistic structural deterioration models in a machine-interpretable way for supporting adaptive intelligence-based bridge deterioration prediction.