

Predicting Structural Health and Inspection Frequencies of Civil Infrastructures using Correlation Network Model

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Abstract:

Many recent studies have shown that a large percentage of bridges in many parts of the world have low safety rating. Federal Highway Administration (FHWA) maintains National Bridge Inventory (NBI) database that contains the information of more than 600,000 bridges. Each bridge has 130 parameters including Average Daily Traffic, Structural Condition Rating, Deck Condition Rating, and overall Sufficiency Rating. Current safety inspections require bridge inspectors to manually inspect each bridge every few years. Manpower and budget constraints limit such approach from inspecting the bridges more frequently. Clearly, more efficient approaches need to be developed to improve the process of bridge inspection and increase the overall safety of bridges and civil infrastructures. In this study, we propose a Correlation Network Model to analyze and visualize the big-data associated with more than 600,000 bridges of NBI database. We use Correlation Networks based on various safety parameters, then apply Markov Clustering algorithms to analyze a population of 9,546 “Steel-stringer/multi-beam or girder bridges” across three states, California, Iowa, and Nebraska representing three different climatic regions. We use the produced clusters to propose a different maintenance schedule based on which bridges follow a pattern that leads to a higher chance of deficiencies. Results show that out of top five clusters, three need to be serviced more frequently. Hence, we recommend their Inspection Frequency to be reduced to 12 months instead of 24 months. Our analysis also shows that bridge conditions are sensitive to the Average Daily Traffic and that the traffic needs to be considered as a key parameter in maintenance schedule.