ASSESSMENT ON SEISMIC FRAGILITY OF BRIDGE STRUCTURAL SYSTEMS BY OPTIMIZED VINE COPULAS

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Abstract

To better consider the correlation between different components in the bridge system fragility, a new method for seismic fragility assessment of bridge structural system with optimized vine Copula function is proposed in this work. Different from the existing fragility analysis methods considering the correlations of component types, the fragility of each component contained in the bridge system is taken as a variable of the vine Copula function in the proposed method. Based on the rank correlation coefficients of seismic demand samples of different components, the vine Copula function is optimized by the shortest Hamiltonian path approach, so that the a lot of estimations on joint probability density functions (PDF) and trial calculation of information decision criteria may be obviated. Moreover, the proposed optimized vine Copula function is a joint probability density function constructed from the complement functions of component fragility. Hence, the bridge system fragility can be analyzed by establishing only one joint PDF without the necessity of many joint PDFs under different combinations of structural components. A four-span concrete bridge structure model with abutment is selected and the residual capacity model is used to simulate structural damage. Based on the proposed method, the fragility of the bridge system with correlations of ten individual components of pier, abutment and bearing in the bridge system is analyzed, and then the analysis results are compared with those obtained by MC method and the traditional fragility method considering the correlation of component types.

Keywords*: Seismic fragility; Bridges; Vine copulas; System level fragility*