Real-time Prediction Method of Fatigue Life of Bridge Structure under Digital Twin

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Abstract

Aiming at the structural safety problems caused by the coupling and randomness of factors such as the geometric characteristics, load status, service characteristics and failure mechanism of the in-service bridge structure in time and space, a real-time prediction method of fatigue life of bridge structure under digital twin is proposed. Based on the physical entity of the general bridge crane, the status information acquisition system is used to get the current service status information of the crane equipment, and the obtained current service status information is combined with inherent information and historical service information to construct a fuzzy information database, which is clearly quantified to form twin data; based on the characteristics of the equipment structure and the technology cycle process, the load, strength, defect and life analysis models are determined to form a multi-theoretical calculation model of the bridge structure through information transmission; using the informational data of the active service state, the multi-theoretical computational model is modified to obtain the main factors affecting the fatigue life, and fuzzy comprehensive evaluation theory is combined to determine the comprehensive influence factor; the Kriging proxy model is constructed through experimental design to obtain the response relationship between inherent and service information and the fatigue life of the bridge structure, and the whole life cycle process of the equipment is reflected by completing the real-time prediction of the fatigue life of the bridge structure in the virtual space. Taking the QD20/10t×43m×12m general bridge crane as an example, the feasibility and applicability of the proposed method are verified by comparison, which provides a strong theoretical basis for the safe service and timely scrapping of the crane.

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