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Assembly procedure for elementary matrices of train-track-bridge railway system

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Abstract. The study of railway dynamics remains an active and fertile field of research, given the technological evolution of this transport system. Several modeling methods have been developed to explore the dynamic interactions of a train-rail-bridge system, and these numerical models enable optimization of bridge design, especially for high-speed lines. In this perspective, this work joins this huge modeling project by proposing a procedure for assembling the elementary matrices of a dynamic system composed of a train, a rail and a bridge, in order to obtain the global differential equations of the system. The model studied consists of a moving part, the vehicle, modeled by a mass-spring-damper system, and a fixed part, the rail and bridge deck, modeled by two Bernoulli beams. The elements to be assembled are not identical, which increases the complexity of their assembly, as the position of the vehicle wheel changes as a function of time and passes from one element to another, creating loaded and unloaded elements.

The dynamic equations were solved using the Newmark Beta numerical method. The model developed was subjected to a validation process based on a comparison of the dynamic responses of the bridge and vehicle obtained by the present study and those presented by previous studies.

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