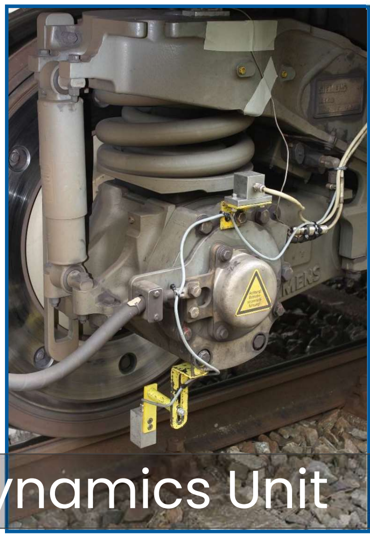
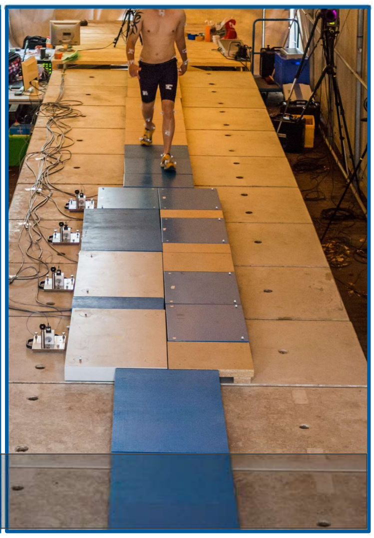
TECHNISCHE UNIVERSITÄT DARMSTADT

ISM+D
Institute of Structural Mechanics and Design
Institut für Statik und Konstruktion

Structural Dynamics Unit



Structural Dynamics Unit

The Structural Dynamics Unit of the Institute of Structural Mechanics and Design deals with a series of projects that investigate vibrations on bridges and their effect on the structure's service life prediction. Moreover, the respective impact of vibrations on objects that cross bridges, such as trains, motor vehicles or pedestrians is also investigated and the results are used for the development of measurement methods and calculation models of the future.

ARTIFICIAL INTELLIGENCE FOR THE CONDITION ASSESSMENT OF RAILROAD BRIDGES - ZEKISS

Data from monitoring systems on structures (primarily bridges) has been typically used for the structural assessment and maintenance measures of such structures. In a similar way, sensor systems installed on vehicles are used to monitor vehicle components and the track system. Inherently, however, the respective sensor systems collect data that contain further information: An instrumented train passes over a large number of bridges on its journey and a large number of trains pass over an instrumented bridge. The objective of the project is to develop, implement and validate a digital tool for the in-situ monitoring of railroad bridge structures in the context of a sensor data-based predictive maintenance concept using a BIM-integrated Digital Twin, based on Artificial Intelligence. More specifically, a template will be developed for a highly automated and improved assessment (resonance hazard, structural safety, remaining service life) of existing railroad bridges.

Website: www.zekiss.de

DATA-BASED INDENTIFICATION OF OPERATIONAL LOADS IN THE RAIL NETWORK - DEEB-INFRA

Bridge structures are assessed at certain intervals for their remaining service life. This depends largely on the stress cycles in the material, caused by traffic & associated accumulation of damage. Current approaches for determining the remaining service life of existing bridges are based on idealized historic load models or on assumptions about future traffic volumes. However, these assumptions are subjected to great uncertainties and, therefore, in reality they have very conservative character, which can lead to premature repairs of the structure. Data from axle load measuring points cannot currently be used to determine the remaining service life. The main objective of this project is the development of a concept for the integration of existing real dynamic vehicle loads into the remaining service life assessment of railway infrastructures. For this purpose, data from the axle load measuring points implemented in the European railway network as well as classic structural monitoring systems are used.

Website: www.deeb-infra.de

NEW LOAD MODELS FOR HIGH-SPEED TRAINS - EBA

Current high-speed rail bridge design and evaluation standards do not cover a number of newly developed trains with innovative axle arrangements, which are faster and heavier than the vehicles considered for the current load models. Therefore, a parametric high-speed load model needs to be developed to consider current and future changes in the rail vehicle industry. The implementation of the project involves the following steps: (a) Conceptualization of a load model upon analysis of previous approaches, where a general load model will be created to represent all central factors and enabling also possible adaptations in the future. (b) Simplification of the load model for a plausibility check, where an evaluation method is developed, adopting qualitative assessment and user-friendly simplifications for the load models. (c) Design and implementation of a validation process for the new dynamic load models, where detailed and simplified calculation models and their application models are considered.

HUMAN - STRUCTURE INTERACTION ON PEDESTRIAN BRIDGES - HUMVIB

Motivated by increasingly stringent architectural requirements, there is a current trend in civil engineering to design and build slimmer and lighter structures with larger spans. For structures exposed to human locomotion (e.g., pedestrian bridges), this often results in excessive pedestrian-induced structural vibrations. As a result, humans must adjust their gait to match the vibrations of the underlying structure in order to maintain balance. In turn, changes in gait affect the response of the structure, resulting in a continuous interaction between the human and the structure. However, current models used in design do not take into account the interaction between humans and structures, which can lead to unsafe structures or to oversized and unaesthetic structures.

The aim of the project is to develop and validate improved biomechanical and structural loading models to describe and investigate the act of humans walking on vibrating structures.

Website: https://www.tu-darmstadt.de/humvib

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