

Workshop on Railway track dynamics

Place: DEC/FCT/UNL (room 4.17)

Date: 5th of April, 2017

Duration: 13h-19h00

13:00-13:40

Railway track dynamics in relation to environmental vibration and track degradation



Michaël Steenbergen

Delft University of Technology, the Netherlands

Michaël Steenbergen (1979) is assistant professor in the Railway Engineering Department of Delft University of Technology. He has a background in Structural Dynamics and Material Engineering. He leads a small research group with a specific focus on the long-term performance of mechanical/infrastructural assets subject to contact loading processes of a dynamic nature. Applications are: dynamic train-track-soil interaction in relation to track degradation mechanisms and dynamic aspects of wheel-rail contact mechanics in relation to surface damage mechanisms. Both topics typically involve the study of mechanical and material behaviour on different spatial scales (macro and micro) and time scales (instantaneous versus long-term) as well as their interaction.

Michaël Steenbergen holds an MSc and PhD degree, both cum laude, from Delft University of Technology.

Link to home page <http://staff.tudelft.nl/en/M.J.M.M.Steenbergen/>

In his presentation, he will give an overview of past and ongoing work, with a special focus on track dynamics in relation to two physical aspects that determine the way in which the railways are often perceived from a non-technical public: environmental vibration hindrance from train operation and track degradation involving the need of costly maintenance and renewal. Basic physical mechanisms that govern the dynamic track response will be discussed in relation to track design as well as consequences for the long-term behaviour. This yields a number of control parameters with respect to the long-term performance, allowing for both improved track design and lifetime exploitation. Finally, ongoing and planned research in this area in the Netherlands for the next 4 years will be discussed.

13:40-14:00

Experimental and numerical evaluation of the vibration isolation efficiency of a stiff wave barrier in the soil



Geert Degrande

University of Leuven, Belgium

Link to home page <https://bwk.kuleuven.be/bwm/people/members/00005656>

This talk reports on the design, the installation, and the experimental and numerical evaluation of the efficiency of a stiff wave barrier in the soil as a mitigation measure for railway induced vibrations. A full scale in situ experiment was conducted within the frame of the EU FP7 project RIVAS at a site in El Realengo (Spain), where a barrier consisting of overlapping jet grout columns was installed along a railway track. The presentation reports on the design of the barrier, the experimental work (geophysical prospection and measurement of track receptance, transfer functions, and free vibrations during train passages) as well as numerical prediction by means of coupled finite element – boundary element formulations.



14:00-14:30

Prediction and mitigation of vibrations due to railway traffic. The role of numerical modelling

Pedro Alves Costa, Rui Calçada, FEUP

The cases presented concern the analysis of railway coach interiors during crash focusing the protection of occupants. A railway accident is described by the primary collision, in which the vehicle is subjected to an abrupt deceleration causing the unrestrained occupants to continue the original motion, being projected through the coach. The simulations results are used to identify the most relevant injury indices and the design modifications are discussed to improve occupant's safety.

14:30-14:50

Towards railways vehicle interiors design for occupant's safety

Marta Carvalho, Ana Martins, DEMI/FCT/UNL

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14:50-15:10

Statistical modelling of wear and damage trajectories of railway wheelsets

António Ramos Andrade, Julian Stow, DEM/IST/UL

In this study the state of the art of statistical modelling of wear and damage trajectories of railway wheelsets will be presented. Life-cycle cost analysis will be used to assess the potential savings of introducing Economic Tyre turning as a maintenance option in the British standard that is currently allowed in other European standards. The role of maintenance technicians in the loss of diameter will also be highlighted, showing that human factors may influence significantly the life-cycle of wheelsets.

15:10-15:30

Development of co-simulation procedures for railway dynamics: vehicle/track and pantograph/catenary interaction

Pedro Antunes, DEM/IST/UL

The numerical dynamic analysis of both vehicle-track and pantograph-catenary interaction, represents a coupled problem where the dynamic behaviour of the two systems involved is affected by each other. Instead of a classical approach where a unique formulation is used to accommodate both subsystems, a co-simulation procedure is here proposed where each subsystem can have its specific formulation suiting their modelling requirements without compromises.

15:30-15:50

Dynamic train-track interaction due to short-pitch irregularities at rail welded joints

José Varandas, Diogo Pereira, DEC/FCT/UNL

This study analyzes the impact of short-pitch irregularities due to rail welded joints in the train-track system response. The study uses a three-dimensional dynamic finite element program that is suitable to represent the referred situation. The vibration and dynamic forces that result from these short pitch irregularities are studied in detail through parametric analysis.

15:50-16:10

Coffee break

16:10-16:30

Development of advanced multidisciplinary methods for railway dynamics applications

Hugo Magalhães, DEM/IST/UL

Operations of railway systems with increasing velocities and safety require the development and application of design and analysis tools in a concurrent virtual environment. Realistic numerical simulations of railway vehicles negotiating real railway tracks play a key role to investigate safety, comfort and maintenance issues.

16:30-16:50

Towards an integrated analysis of railway track performance at transition zones and other discontinuities

André Paixão, LNEC

A contribution to identify the early development of critical locations in railway tracks, such as transition zones and other singularities, is presented. Information on track geometry records is integrated with information from a numerical study on the effect of track irregularities on the train-track system and with characteristics of the track superstructure and substructure. This can provide crucial information for railway infrastructure managers.

16:50-17:10

Railway monitoring using Non Destructive Tests (NDT)

Simona Fontul, LNEC

The monitoring of the railway track is an important tool for proper maintenance planning. The NDT methods allow for a sound evaluation of the track condition and its evolution in time. A presentation of some tests performed with Ground Penetrating Radar together with track geometry analysis, aiming to identify the causes of track settlements in ballasted track is made. Considerations regarding the data interpretation are referred.

17:10-17:30

RailScan – Desenvolvimento de software para a detecção e caracterização de desgaste ondulatório em ferrovias

Rui Gomes, Arnaldo Batista, Manuel Ortigueira, DEE/FCT/UNL

Information can be found at: <http://sites.fct.unl.pt/aspi/pages/railscan>

17:30-17:50

Beams on nonlinear elastic foundations under moving forces and oscillators

Fernando Simões, António Pinto da Costa, DECivil/IST/UL

The dynamic response of beams on elastic foundations, subjected to uniformly moving loads or oscillators is addressed. Using FE, the response of the system is studied for three different types of mechanical behaviour of the foundation: (a) linear elastic (Winkler model), (b) nonlinear elastic (in which the foundation reaction depends cubically on the beam displacement) and (c) bilinear elastic (with different compressive and tensile stiffnesses).

17:50-18:05

Some aspects related to semi-analytical solutions

Zuzana Dimitrovová, DEC/FCT/UNL

Some new aspects related to analytical resolution of moving load problems are presented. The existence of several critical velocities resulting from dynamic interaction between the beam structure (subjected to moving loads) and the foundation is proven, based on exact analytical methods. New semi-analytical solution covering severe vibrations originated by sudden moving mass action governed by mass-induced frequencies will be discussed.

18:05-18:20

Viability and applicability of simplified models

André Rodrigues, Zuzana Dimitrovová, DEC/FCT/UNL

This study analyses simplistic models of railway tracks to establish their applicability and limitations, and provide estimates for their parameters that lead to a dynamic behaviour that is similar to more sophisticated models. A good approximation can be obtained for the Pasternak and discrete supports models, but only the properties of the latter can be given by considered mechanistic expressions.

18:20-19:00

Round Table: Perspectives for Collaboration