Workshop on Railway track dynamics

Place: DEC/FCT/UNL (room 4.17)
Date: 5th of April, 2017
Duration: 13h-18h50

Railway track dynamics in relation to environmental vibration and track degradation

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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.

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.

Link to home page http://staff.tudelft.nl/en/M.J.M.M.Steenbergen/
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<tr>
<th>Time</th>
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<td>13:50-14:20</td>
<td>Prediction and mitigation of vibrations due to railway traffic. The role of numerical modelling</td>
<td>Pedro Alves Costa, Rui Calçada, FEUP</td>
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<td>14:20-14:40</td>
<td>Towards railways vehicle interiors design for occupant’s safety</td>
<td>Marta Carvalho, Ana Martins, DEM/FCT/UNL</td>
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<td>14:40-15:00</td>
<td>Statistical modelling of wear and damage trajectories of railway wheelsets</td>
<td>António Ramos Andrade, Julian Stow, DEM/IST/UL</td>
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<td>15:00-15:20</td>
<td>Development of co-simulation procedures for railway dynamics: vehicle/track and pantograph/catenary interaction</td>
<td>Pedro Antunes, DEM/IST/UL</td>
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<td>15:20-15:40</td>
<td>Dynamic train-track interaction due to short-pitch irregularities at rail welded joints</td>
<td>José Varandas, Diogo Pereira, DEC/FCT/UNL</td>
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<td>15:40-16:00</td>
<td>Coffee break</td>
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### 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.

### 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. The proposed method, in association with other tools can provide crucial information for railway infrastructure managers.

### 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.

### Beams on nonlinear elastic foundations under moving forces and oscillators

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

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

### Some aspects related to analytical and semi-analytical solutions of moving loads problems

**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.

### Viability and applicability of simplified models for the dynamic analysis of ballasted railway tracks

**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 mechanic expressions.

### Round Table: Perspectives for Collaboration