

EUROMECH Colloquium 574

“Recent trends in modelling of moving loads on elastic structures”

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Background

Analysis of moving loads on elastic structures, including bridges, tunnels, half-spaces and rings, is an important area of modern interdisciplinary research. The significance of modelling of high-speed train operations, near-surface dynamics of underground structures such as tunnels, vibration responses of bridges subject to moving loads, as well as harvesting of energy through the use of moving masses, particularly in the mining industry, motivates theoretical and experimental analysis of the related problems. Recent advances in the development of analytical, numerical procedures and experimental techniques enable treatment of 3D real world problems instead of 2D studies prevailing some time ago. The main aim of EUROMECH Colloquium 574 was to bring together researchers from diverse areas to exchange and share the latest achievements in the fields of their own expertise. The main topics of the Colloquium are indicated below.

Colloquium Topics

- **Experimental investigation of train-induced environmental vibration** Moving loads on the surface of the earth or in underground tunnels induce soil vibrations, which can strongly affect the environment. Sensitive machines can also be disturbed by these vibrations. Therefore, both experimental investigation of the vibrations due to high-speed trains, including the movement along underground tunnels, and accurate modelling of the surrounding media are of interest. Experimental data on high-speed train operations for existing networks were compared with the results of computer modelling [Bratov, Çelebi, Göktepe].
- **Computer modelling (numerical simulations) of realistic railway configurations** The effect of moving load speeds on ground vibrations was analysed numerically. The surface loads arising from high-speed trains and the interior loads moving along underground tunnels were considered. The advancement of computational technology nowadays gives a chance to approach sophisticated 3D problems modelling realistic setups. The results of numerical analysis of some of these problems were presented at the Colloquium [Bratov, Cao, Hackenberg].
- **Analytical Methods** Near resonant behaviour of elastic structures, including half-spaces and plates resting on a foundation, was a prominent theme. Although numerical methods are widely employed, analytical approaches are still important in deriving physical insights into the nature of novel moving load problems. For example, an asymptotic approach has been developed for simplifying analysis of the near-surface dynamic response [Ege, Erbaş, Kaplunov, Prikazchikov, Sahin]. The results demonstrated that such an approach is robust for tackling the difficult 3D problems associated with the case of a layered half-space. Another procedure allows derivation of the associated Green's functions in accessible form and facilitates analysis for circular and cylindrical geometries [Alexeyeva, Zakiryanova]. Kiselev described a possible anomaly of the wave field induced by a source having rather general time dependence. Some nonlinear effects associated with surface wave propagation were described by Rushchitsky. Certain aspects of the relation between moving load problems and surface waves, including the peculiarities of exciting surface waves and the drift of wave speed, were mentioned.
- **Harvesting of energy** A very interesting and novel direction was introduced by Rylnikova. In her talk, she presented the possibility of harvesting energy from the moving masses, encountered particularly in the mining industry. There are important potential applications to renewable energy sources.
- **High-tech areas including micro-mechanical engineering** The modern applications of moving load problems are not restricted to the traditional fields like railway transport but also arise in high-tech

domains including micromechanical engineering. Fundamental talks by Borodich and Petrov studied important problems that arise in fracture mechanics and tribology.

Concluding Remarks

The concluding open session was chaired by Prof. Kaplunov, one of the organisers of Colloquium 574. The interdisciplinary nature of the subject theme of the conference was emphasised. Recently developed advanced methodologies and possibilities for collaborative research were discussed. Colloquium 574 included valuable contributions from Munich Technical University, Delft University of Technology, Timoshenko Institute of Ukraine, Steklov Institute of St. Petersburg and Beijing University. The social programme included a banquet and a social tour of Eskişehir. These social events stimulated fruitful discussions and a friendly atmosphere among the participants, leading to very positive feedback. We would like to thank EUROMECH for supporting the Colloquium from early planning to a successful conclusion.