Nonlinear and stochastic properties of rail track

Piotr Koziol

Literature and experimental investigations show that consideration of nonlinear and random properties of structures is of importance in the study of rail track dynamics. However, inclusion of such assumptions in models leads to their growing computational complexity. Existing classical methods of solution, including numerical approaches, do not allow the effective parametrical analysis of systems describing realistic structures. Semi-analytical methods, very often heuristic ones, using hybrid approximations are the reliable alternative for popular tools. Overview of results obtained by using one of such methods, based on wavelet approximation with a use of filter coefficients type of “coiflet”, will be presented. In the face of the current development of transport, in particular an increasing vehicle speeds, the search for new methods of prediction of dynamic phenomena occurring in structures subjected to dynamic excitations becomes a necessity. The presented review of the existing results, based mainly on the author's publications from the last years, shows that the skilful application of mathematical tools can lead to a significant expansion of knowledge in the field of rail track dynamics study. Description of achievements related to the semi-analytical methods adapted to railway engineering applications will be presented. The problems investigated in these papers are very current. Their present importance becomes even more visible in view of recent projects announced in Poland and Europe. Preliminary studies show that the developed semi-analytical methods can be applied to solution of systems with periodically changing stiffness of foundation layers which are directly related to models considering inclusion of geosynthetics in rail track structure. The contents of the seminar will include the following topics:

1. Semi-analytical methods for analysis of rail tracks dynamics - approximation using wavelet-based method [1, 2, 3]
2. Multi-layered track bed (inhomogeneity of foundation in vertical direction) [4, 5]
3. Solutions for nonlinear models (nonlinear properties of foundation, fastening systems and under sleeper pads) [6-8]
4. Stochastic properties of foundation and track components [9, 10]
5. Random properties of loads generated by trains [11, 12]

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