Railway rolling noise minimization by topology optimization techniques using the mixed FE formulation

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ABSTRACT

Rolling noise is generated by the wheel-rail interaction, caused mainly by the combined macro-roughness from these two elements, and limits the use of higher speed trains near cities. This induces a vibration field in the wheel and track which results in a potentially-important acoustic field radiated by the wheel. Several strategies can be adopted in order to mitigate this problem, such as the modification of the wheel web geometry, or the introduction of perforations. In this work, the design of a boogie fairing by Topology Optimization (TO) [1] techniques is proposed. The mixed Finite Element (FE) formulation (displacement/pressure) [2] is implemented to solve the fluid-structure interaction optimization problem, since it does not require the explicit definition of the vibrating geometry along the optimization process, and is then applied to the TO of a lower train fairing, in order to minimize the acoustic pressure amplitude within a domain located at a certain distance of the train.

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Keywords: Topology optimization, Vibro-acoustics, Fluid-structure interaction, Wave equation

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