SoIL Vibration and AuRalisation Software Tools for Application in Railways

Rendicontazione

Informazioni relative al progetto

SILVARSTAR

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[Sito web del progetto ↗]

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[Progetto chiuso]

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Periodic Reporting for period 2 - SILVARSTAR (SoIL Vibration and AuRalisation Software Tools for Application in Railways)

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Sintesi del contesto e degli obiettivi generali del progetto ⌄

Although rail is a sustainable and climate-friendly mode of transport, noise and vibration remain particular environmental concerns. People living near railways are becoming increasingly sensitive to high levels of noise and vibration, while the operation of sensitive equipment is hampered by high vibration levels. SILVARSTAR is a two-year collaborative project under the Shift2Rail Joint Undertaking that aims to develop validated software tools and methodologies to assess the noise and vibration environmental impact of railway traffic.

The first objective is to provide the railway community with a commonly accepted, practical and validated methodology and a user-friendly vibration prediction tool. This tool will be used for environmental impact assessment of new or upgraded railways on a system level. It will provide access to ground vibration predictions to a wider range of suitably qualified engineers and will facilitate project planning and implementation by improved simulation processes.

The second objective is to develop a fully functional system for auralisation and visualisation based on physically correct synthesised railway noise, providing interfaces with Virtual Reality visualisation software. This system will facilitate communication with the public, decision makers and designers through virtual experience before delivery of projects.

Lavoro eseguito dall'inizio del progetto fino alla fine del periodo coperto dalla relazione e principali risultati finora ottenuti

Ground Vibration, main achievements:

The concept and framework of the ground vibration prediction tool has been defined, based on the general framework recommended in ISO 14837-1:2005 and the empirical procedures recommended in the FRA/FTA guidelines. This expresses the vibration level in a building during a train passage as the product of source, propagation and receiver terms. In a first step, a prototype vibration prediction model was developed, including a simple Graphical User Interface. In a second step this ground vibration prediction tool was fully integrated within the existing noise mapping software IMMI developed by Wölfel. In particular, geographical data can be imported through an interface with a Geographic Information System. Well-documented numerical and experimental case histories were subsequently used for approval testing and validation.

The software also includes a database of vehicle, track, soil and building data coming either from experiments or from computations. A track independent vehicle indicator to identify ground borne noise friendly vehicle is also proposed.

The main achievements of the ground vibration work stream are the following:
• Calculation method developed according to methodologies recommended by international standards and guidelines.
• Software tool allowing fast computations which are needed for large scale vibration studies (e.g. urban scale).
• Coupling with noise impact study software (IMMI). Mapping of CNOSSOS-EU database (noise) on

SILVARSTAR database (vibration) for combined noise and vibration evaluation on the same model.
• Interface to GIS program (e.g. Open Street Map) for input data definition. 2D/3D views for visualisation of results.
• Validation against state-of-the-art software tools and well-documented case histories.
• Flexible approach: integrated database. Possibility to use calculated or measured data for each step of the computation. Possibility for the user to enrich the database.

Auralisation and visualisation of railway noise, main achievements:

The newly developed SILVARSTAR Auralisation Tool computes the auralisation of a train pass-by based on selectable input parameters (train and track types, speed, environment, noise mitigation measured). Auralisation model extensions were developed with an improved description of rolling noise sources and acoustic propagation (ground reflections and noise barriers). Different test cases using a regional train were computed for demonstrations and for comparison to pass-by measurements.The auralisation model was implemented as software with a graphical user interface. A functional VR application was developed by Empa. All required features and scenario options were included in the VR application. The software tools were successfully tested in demonstrations and at international exhibitions.

The main achievement of the auralisation and visualisation work stream are the following:
• Available free software tools for auralisation and Virtual Reality, which can be downloaded on Empa's website (www.empa.ch/web/silvarstar).
• Physics based sound synthesis.
• Demonstration of scenarios with combined noise mitigation measures.

Progressi oltre lo stato dell'arte e potenziale impatto previsto (incluso l'impatto socioeconomico e le implicazioni sociali più ampie del progetto fino ad ora) ⌄

The novel modular hybrid vibration prediction tool is equipped with a user-friendly GUI and an interface with GIS software. This prototype, at TRL 5, is now fully integrated in the existing noise mapping software IMMI. This results in a unique software platform that will allow engineers to perform noise and vibration environmental impact studies on a large scale, within the same integrated software environment.

The auralisation and visualisation software is deployed as standalone applications and released as freeware to provide easy access to a wide range of users. The physics-based structure of the auralisation models, that separately describe sources and propagation, makes it possible to test different noise mitigation measures, for example the introduction of noise barriers or rail dampers. Since auralisation and visualisation allow users to experience personally, i.e. hear and see, realistic 3D scenes in a virtual environment, they are an effective means to intuitively communicate acoustical

situations. With this type of communication, different design alternatives, noise mitigation measures or future scenarios can be demonstrated to non-experts.
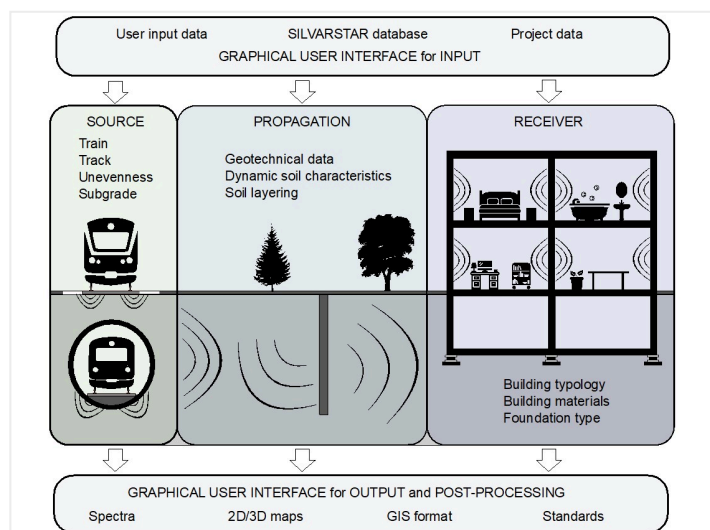
Ground vibration prediction process
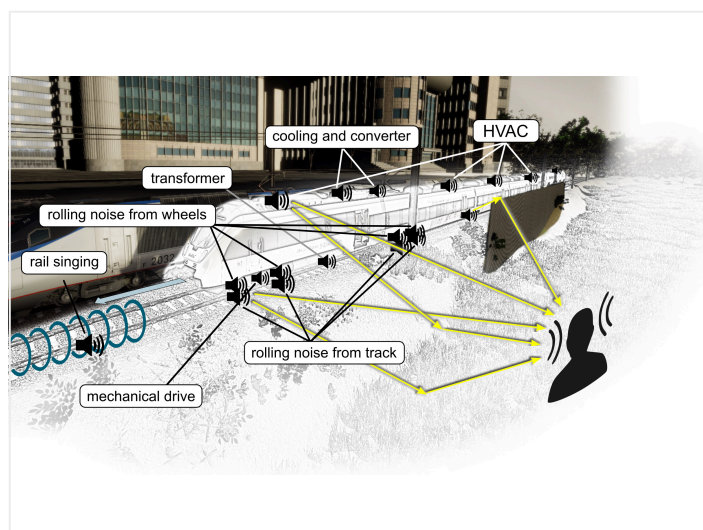
Auralisation of railway noise

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