Media release

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sonRAIL – computer model to calculate noise levels along the Swiss rail network

Computational power against noise

Working together with an international project team, Empa's acoustic specialists have developed a computer model which allows them to calculate noise levels along the entire Swiss rail network. The program describes how much sound is radiated and how it is attenuated. The results will one day show in high precision where residents are particularly exposed to noise and what abatement measures will be most effective in protecting them.

Goods trains move at night because during daytime the Swiss rail system is used to full capacity by passenger traffic. Unfortunately, it is goods trains which make the most noise – and they operate at exactly the time when most people want to sleep. If the policy of shifting goods transport from the roads to the rail network is to succeed, then goods trains must be made significantly quieter.

The Swiss Federal Office for the Environment (FOEN) therefore tasked a team of scientists, headed by Kurt Eggenschwiler of Empa's Acoustics and Noise Control Laboratory, with the development of a computer model to simulate noise levels along the Swiss rail network. sonRAIL, the name given to the model, was intended to provide not just noise maps but to calculate the sound exposure of individual buildings. The model thus identifies what remedial measures would be most effective. Federal and local authorities can therefore use sonRAIL to calculate sound levels around existing and planned railway lines and to evaluate the effectiveness of their countermeasures. A noise barrier reduces the rolling noise of the wheels, it is true, but does not protect against the drone of the ventilation system on the roof of a wagon. It is important, therefore, that the researchers do not just focus on wheel-rail noise, but view the problem as a whole, regarding the train as a complete system.

Measuring the noise from 15,000 trains

With this in mind, Eggenschwiler's colleague, the acoustic expert Jean Marc Wunderli, together with an international team of scientists involved with the development of sonRAIL, have collected an enormous quantity of data. Between 2007 and 2009 they made measurements of some 15,000 train passings at eighteen locations. In doing so they identified sound sources at various heights along the train, allowing

them, together with project partners from the Technical University of Berlin, to describe in detail the noise emission of individual train compositions.

The Empa researchers need this data to calculate how noise propagates in the direction of nearby residents. The intensity of train noise depends on many factors such as the kind of train passing, its speed, whether cliffs or buildings reflect the noise, the construction of the track bed, the local topography, and – not least – the weather. Only if all these parameters are taken into account in the computer simulation it is possible to quantify the noise pollution levels accurately.

To apply a model like sonRAIL for the calculation of acoustic emission levels along hundreds of kilometers of railway tracks and for the evaluation of noise propagation patterns at several tens of thousands of locations, a powerful computational system is required. At Empa the computer cluster «Ipazia» is available for this purpose, a system which not only provides high computational performance but more importantly, thanks to the cluster concept, allows parallel calculations on several processors.

40 processors working day and night

In the first practical «test» of the system, performed early 2010, the Empa acoustic specialists modeled noise levels along a section of the north-south rail corridor through Switzerland, an area of some 340 square kilometers in Canton Tessin. This area contained 50 kilometers of rail track, some 30,000 buildings, 17 noise barriers and involved some 17,200 individual receiver locations. 40 processors of the Empa computer cluster were approximately during a month in operation day and night, completing over 17 million individual point-point-calculations. Each calculation results in 14 frequency spectra, consisting of 20 one–third-octave bands, giving a total of over 1.4 billion individual values for the entire calculation area.
In the summer of the same year a comprehensive measurement campaign to validate the model took place on the northern side of the Gotthard tunnel. During a 24 hour period the Empa scientists, in cooperation with the company Prose AG, made measurements of rail traffic noise at the Federal Office of Transport's (FOT) monitoring station in Steinen. Noise levels were evaluated at 7.5, 200, 500 and 900 meters from the source. The results showed that sonRAIL is capable to reproduce the measured values with high accuracy.

The researchers are now championing the case for their noise simulation model to become the standard to be used in Switzerland, and also that it be considered in the rest of Europe too. In addition they are planning to use the simulation for applications involving other kinds of noise, such as road traffic and shooting noise.

Further information

http://www.empa.ch/sonrail

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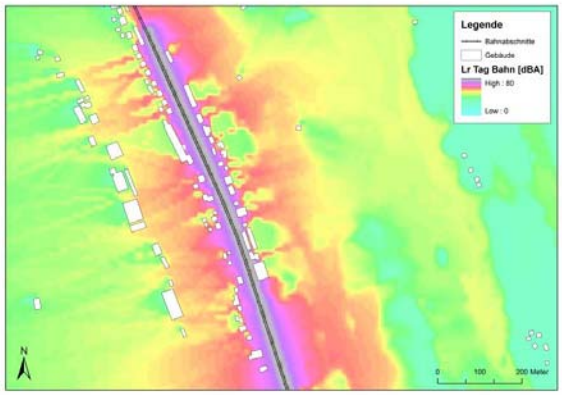
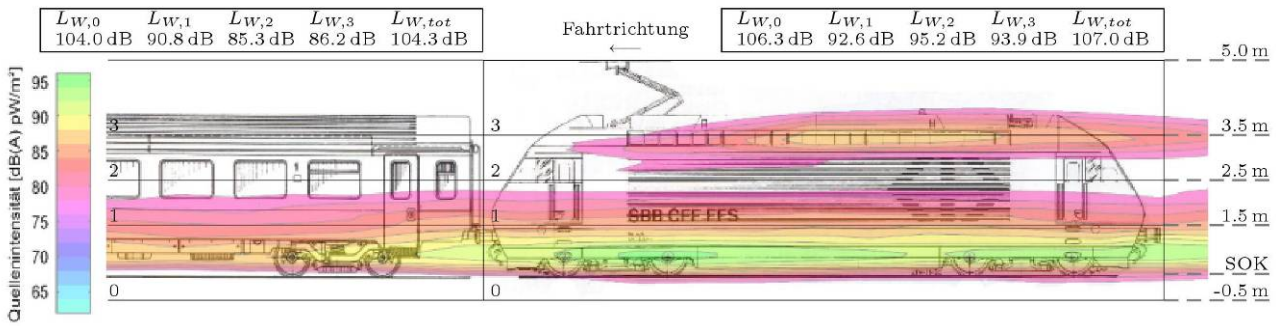


Noise levels along the track due to rail traffic can be predicted accurately using the computer model. (Source: LCC Consulting)



Noise is generated at several different locations along a train composition: primarily at the wheels, but also higher up at the exhausts of the engine cooling system on the roof. (Source: Sulzer Innotec)

Noise emission measurements on a passing train. The measuring equipment is in the foreground to the right.

In summer, as part of the validation process, noise measurements were made at greater distances from the rail track.

The images and text in electronic form are available from redaktion@empa.ch