Railway noise and vibration monitoring - the Austrian example

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psiA-Consult Umweltforschung und Engineering GmbH

- **Founded in 2000 by Manfred Kalivoda & Monika Bukovnik**
  - (former company name was "psiA-Kalivoda Consult" which had been founded in 1995)
- located in ***Vienna, Austria***
- business focus ***Environmental Research and Consulting***
- **8 Employees** (full/part-time)
  - 2/2 Engineers
  - 2/1 Technicians
  - 1 Secretary
- **Our business principles**
  - Environmental engineering must be dealt with in a holistic way including all other relevant like economy, technology and sociology
  - integrative solutions for environmental protection on scientific level

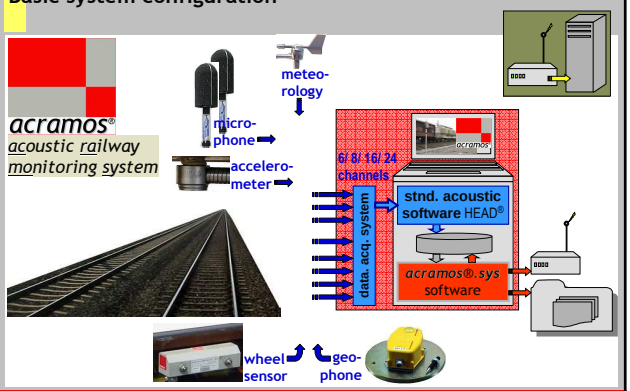
Fields of activity

Measurements	***Studies***	***Consulting*** for
• single-/multichannel • noise/vibration • TSI-Noise Type Tests	• R&D • Env.Impact Assessment • Engineering	• public sector • industry • privat persons

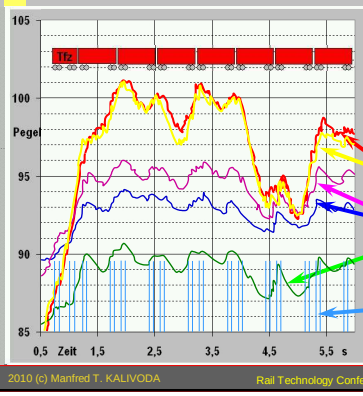
in the fields of

• noise & vibration control • buildings acoustics • exhaust emission calculations	• railway noise & vibration • rly noise/vibration monitoring • Psychoacoustics

Basic system configuration



acramos - data acquisition & processing



Finally axle signals are merged with noise and vibration levels → correlation of emission data and train/wheel positions

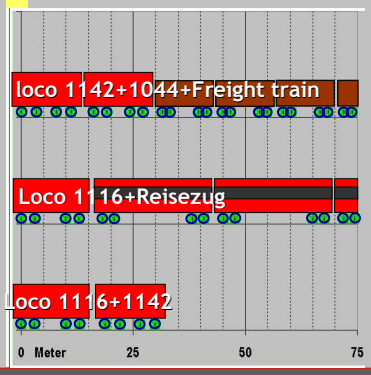
During train pass-by different signals are recorded in parallel:

Noise level

Rail & sleeper acceleration

impulses from the axles

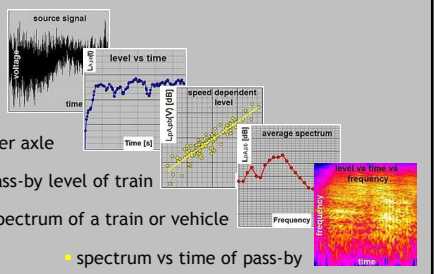
acramos - train categorisation



- axle patterns are compared with an internal database and the train category is assigned
- no RFID tags or train lists are needed for the categorisation

acramos - standard output

- Recording of time signals during train pass-by (optionally)
- Level vs time, level per axle
- Speed dependent pass-by level of train
- average spectrum of a train or vehicle
- spectrum vs time of pass-by
- Direction of the train, average train speed, speed per axle
- Axle pattern of the train (=distance between the single axles)
- Automatic categorisation of trains based on the axle pattern

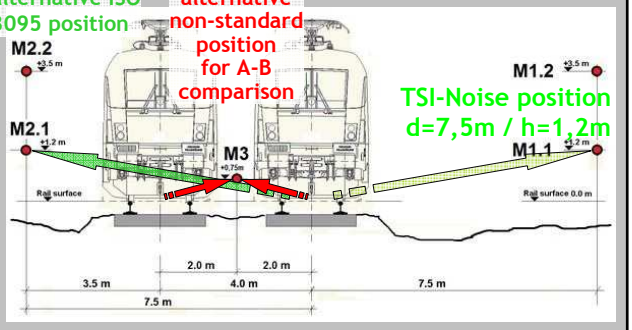


Microphone positions

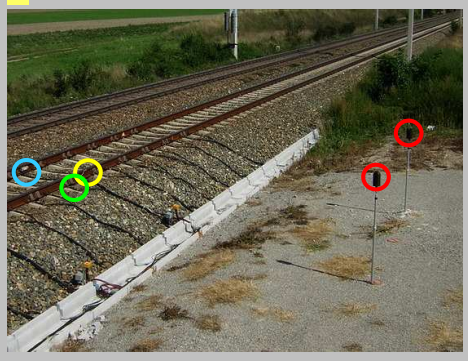
alternative ISO 3095 position

alternative non-standard position for A-B comparison

TSI-Noise position d=7,5m / h=1,2m

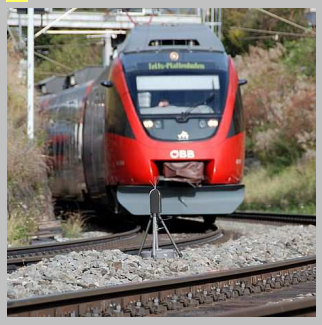


Application: *acramos* site of ÖBB north of Vienna



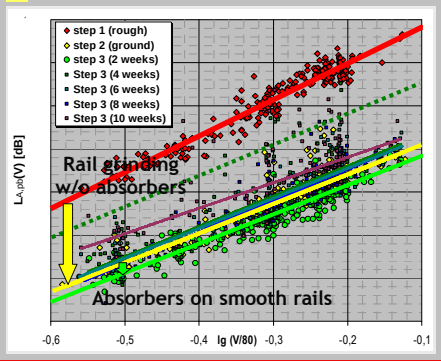
- Research site
- installed in 2006, track 2 → R&D project *SIN*: Safety-Instability -Noise
- Track 2 TSI-Noise compliant
- test of a low barrier in 2008 with additional micro in h=3,5m
- Integration of track 1 and test of a rail damper

Application: rail damper test in a narrow curve - situation



- critical intra-urban situation
- 7,5m position not feasible →
- a microphone in between the tracks (d= 2m, h= 0,75m) collecting data from both tracks

Application: rail damper test in a narrow curve - results



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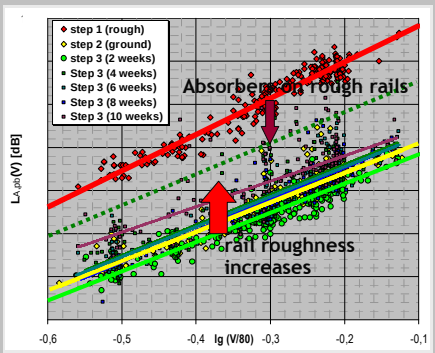
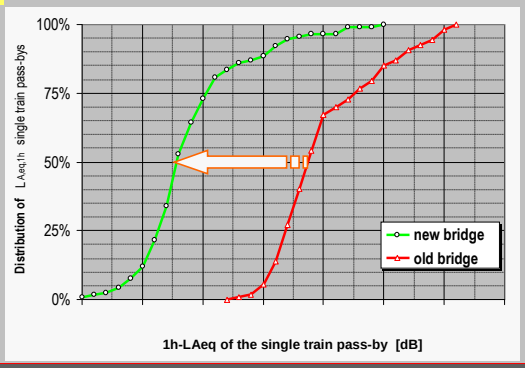


- Only monitoring over several weeks was able to distinguish between acoustic effects from
  - rising rail roughness and
  - Rail dampers

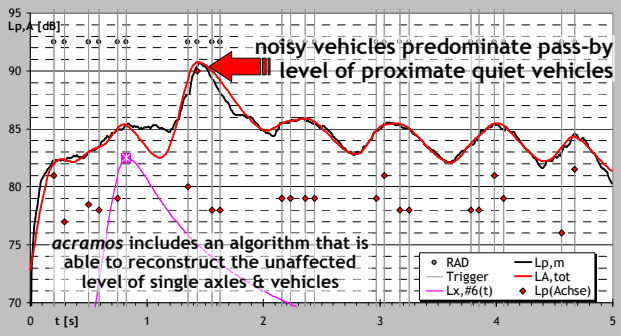
Application: Comparison old/new steel bridge - situation

- 2 microphone positions in the "ISO distance" of 7,5m distance
- 3 cases :old bridge - new+w/o barrier - new+with barrier

Comparison old/new steel bridge - results



New features - reconstruction of unaffected vehicle level



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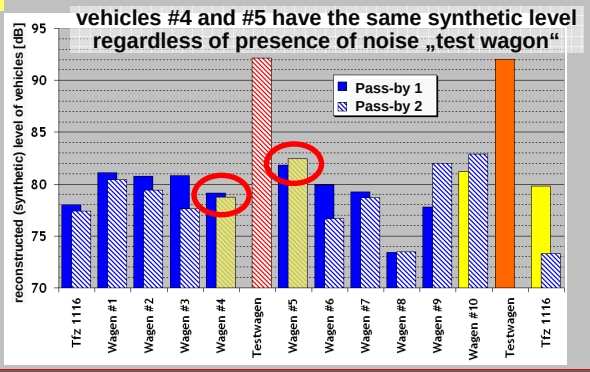
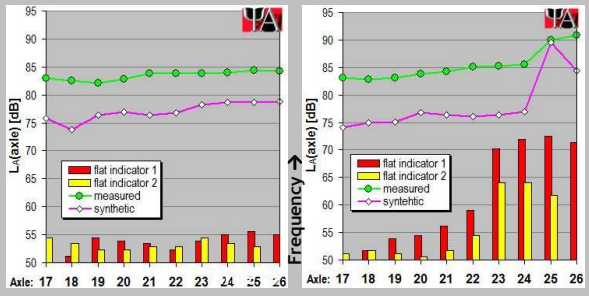
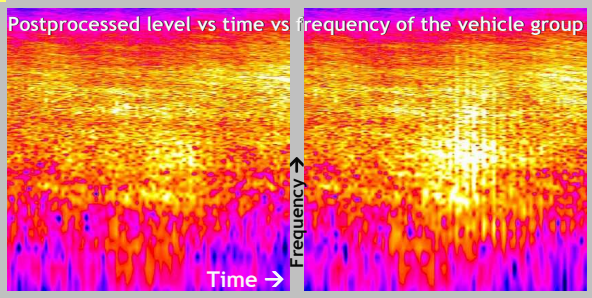


New features - automatic wheel flat detection



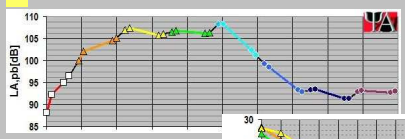
2 pass-bys of one and the same vehicle that (accidentally) caught a wheel flat on axle 26 during the tests

New features - automatic wheel flat detection

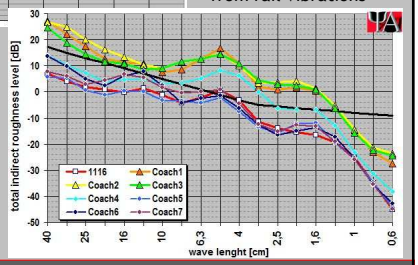


2 pass-bys of one and the same vehicle that (accidentally) caught a wheel flat on axle 26 during the tests

New features - indirect total roughness



- TNO offers the PBA-tool which is able to calculates total indirect roughness from rail vibrations
- Data of mixed (disc/ci) passenger trains have been analysed so far
- Results show a good correlation between height of pass-by level and total indirect roughness per vehicle
- PBA implementation in ***acramos*** considered



Conclusions

acramos is a very flexible tool for various purposes

- permanent environmental noise and vibration monitoring of railway operation for
  - identification of "irregularities" like wheel flats → safety issue
  - monitoring of individual vehicles if vehicle identification is available → test run in summer 2010 with RFID equipped wagons
  - data collection for a future (actual) noise related track access charge →reconstruction of unaffected level
- temporal noise and vibration monitoring for
  - assessment of vehicle or track related mitigation measure
  - data collection for noise calculation schemes

Thank you for your attention

For further information, please, contact
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