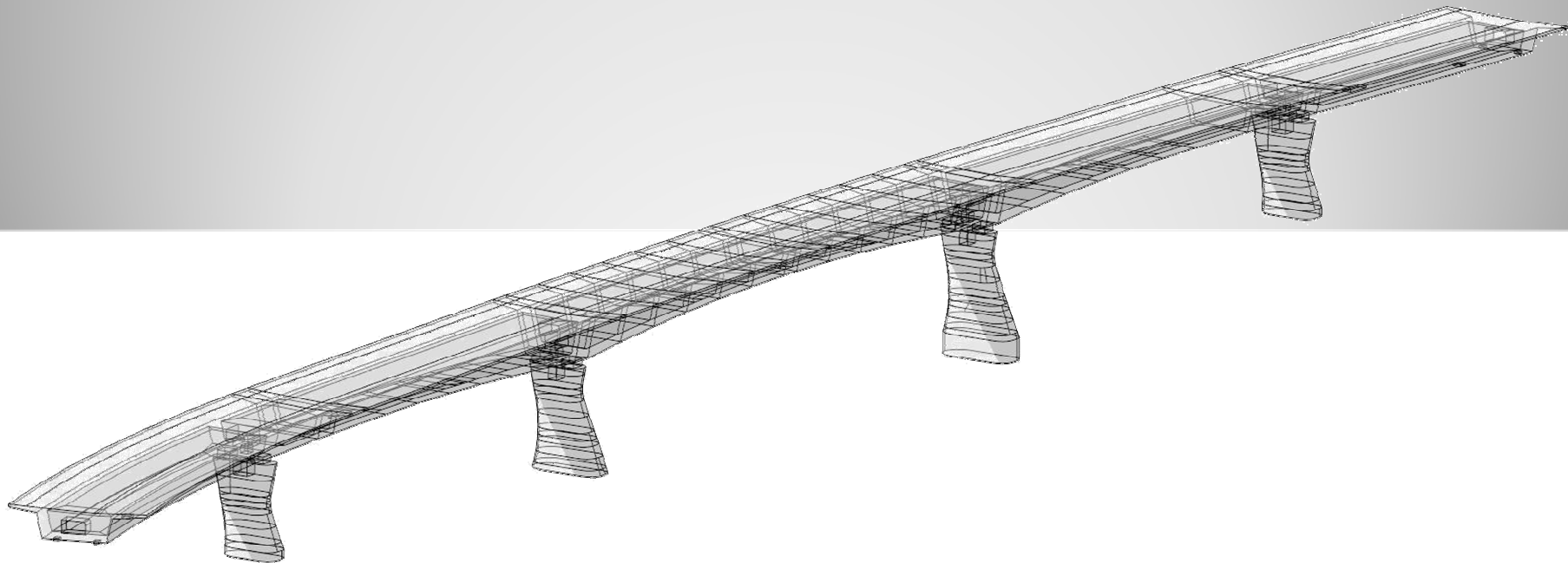


Energy Harvesting Aided Brigade Monitoring

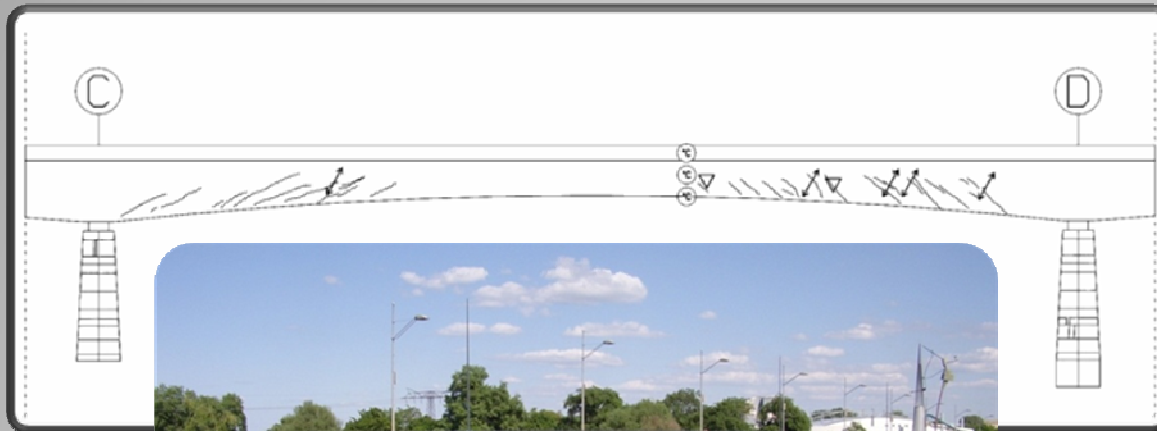


Overview

- **Presentation of project „Friedensbrücke Nord“, as subproject of research project „VibrEnergy“**
- **Concept: Long-time monitoring**
- **Project: „VibrEnergy“**
- **Energy Harvesting – Concept and application**



Project Presentation



Friedensbrücke Nord

Prestressed concrete construction

Construction year: 1994 – 1996

Costs: 8,6 Mio. DM

Length: 230 m

Width: 14 m

Height: 11 m

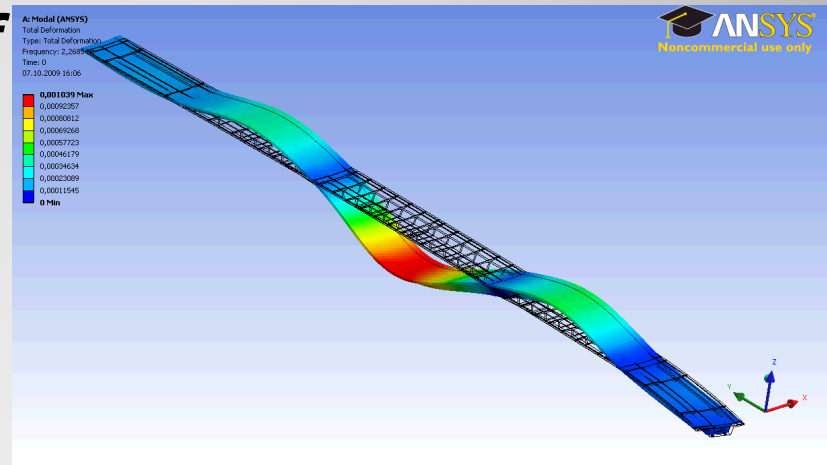
Spans: 34m, 49m, 64m, 49m, 39m

- **Main test 2008:** **note 3 = critical!**
- **Treatment needs !!!**

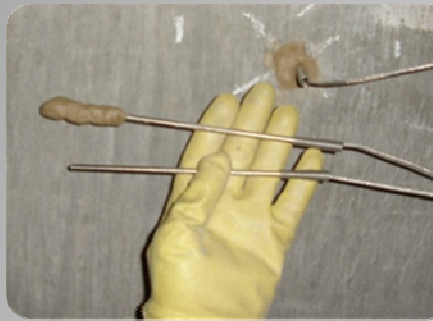


Monitoring Concept

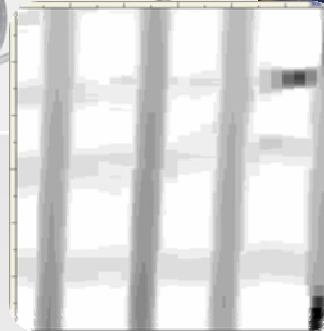
- **Assessment of the current status and development of the bridge condition**
- **Pre-modeling of the bridge**
- **Determination of sensor types and sensor locations via initial measurements and FE - model**
- **Data evaluation with help of Operational Modal Analysis (OMA)**



Sensors and Testing Methods

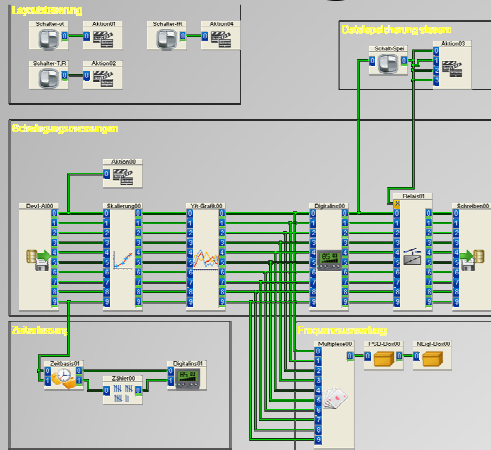


- **Temperature**
- **Humidity**
- **Crack width**
- **Speed/Acceleration sensors**
- **Reinforcement scanner**
- **Settlement meter**
- **Laser vibrometer**

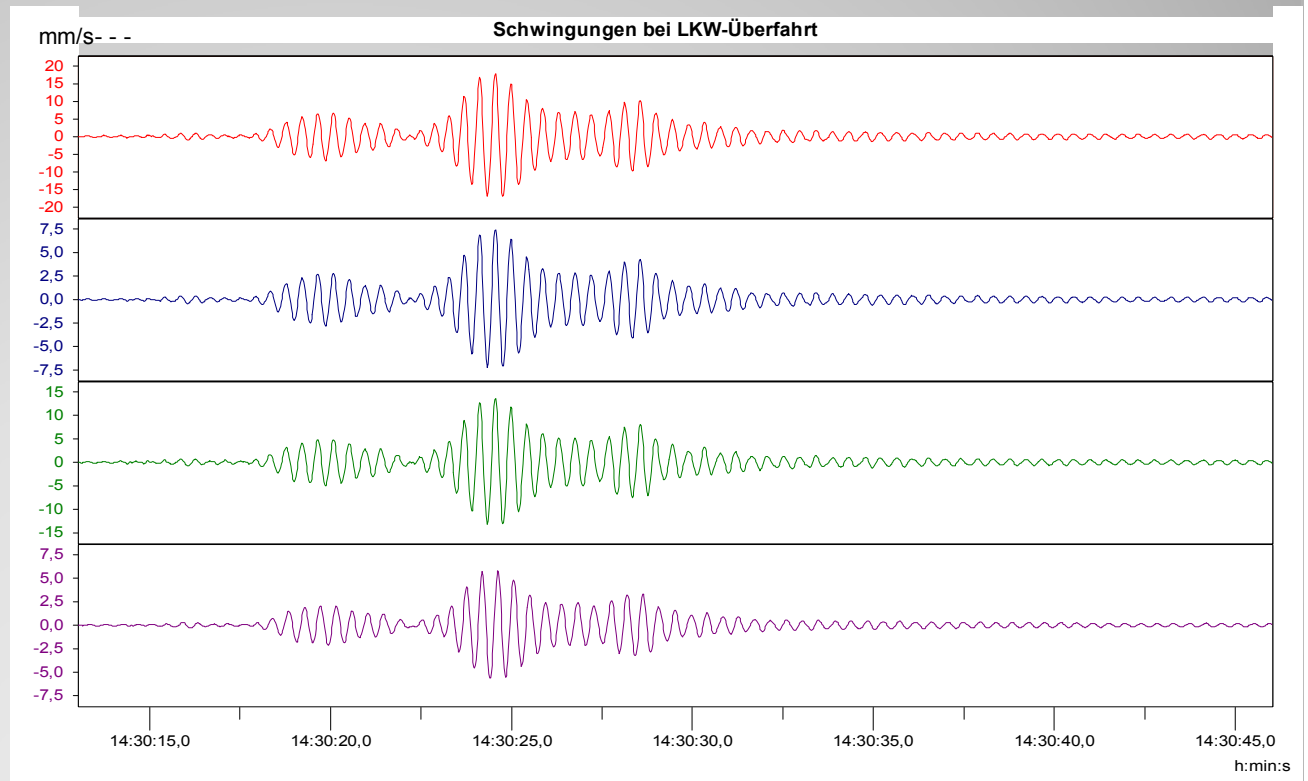


Monitoring System

DasyLab circuit diagram



Bridge vibrations



Measurement setup



Monitoring Goals

Ensuring stability, durability and safety

- ***Supplement to visual examination***
- ***Bridge remaining service life estimation***
- ***Quality assurance***
- ***Better understanding of structures with the goal of improved building design and models***
- ***Cost reduction of maintenance and repair***



Project „VibrEnergy“

***„Development of a new methodology
for bridge monitoring based on
vibration analysis and vibration
energy evaluation“***

Partners:



Energy Harvesting [Motivation]

- ***Lack of power supply in buildings***
- ***Utilisation of existing energy potential from bridge vibration***
- ***Continuous development of measurement technology results in highly energy efficient solutions***



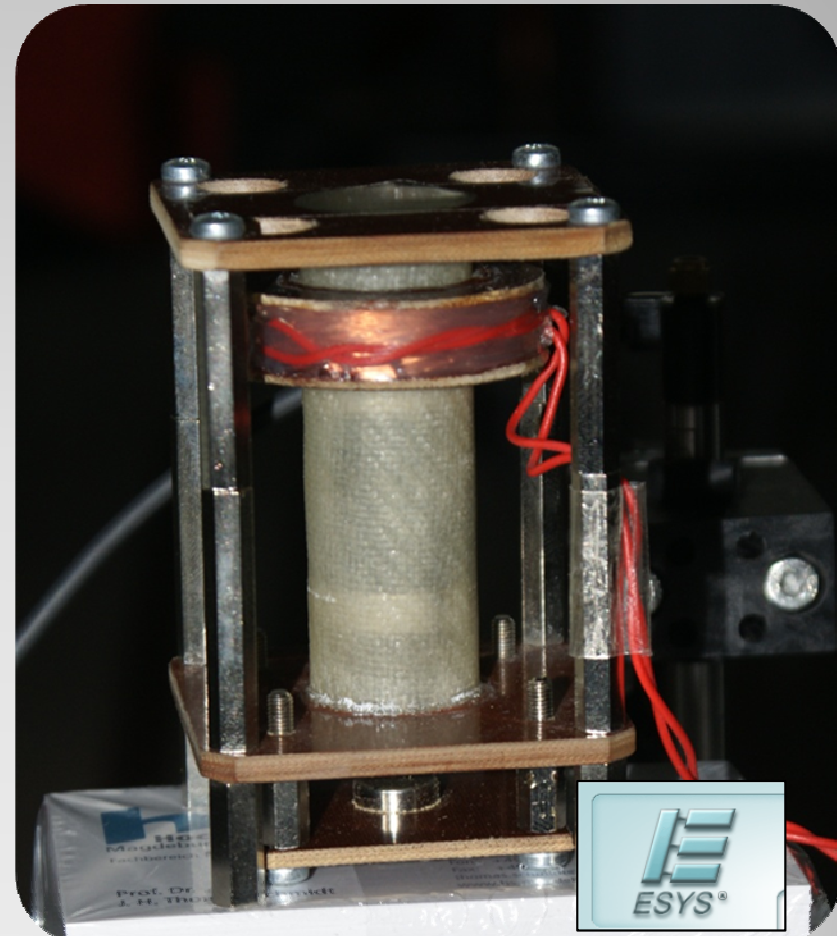
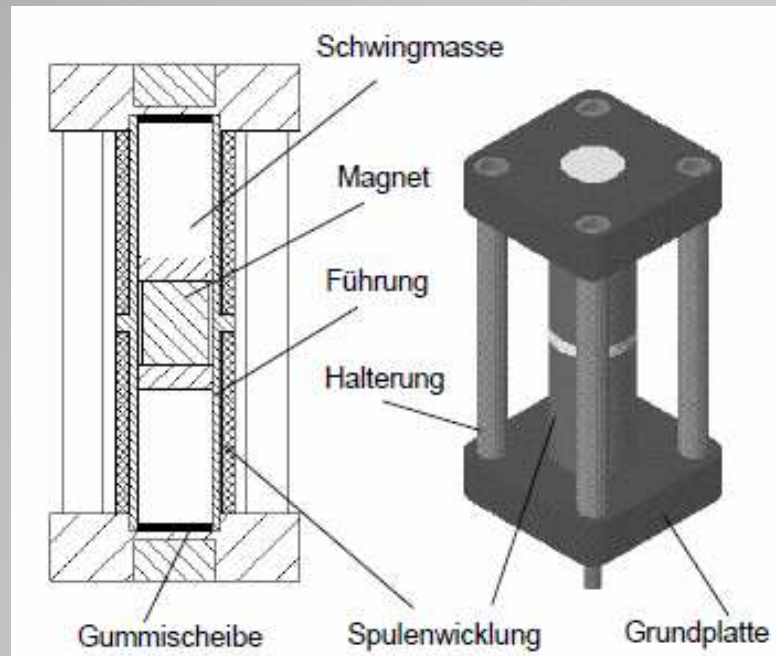
Energy Harvesting [Goals]

- ***Using bridge energy for power supply***
- ***Waiver of batteries or accu´ s in data logging system***
- ***Full or partial power supply of the sensor and measuring technology by „energy harvesting“***
- ***Energy self-sufficient building monitoring***



Translatoric Harvester V 1.1

Principle

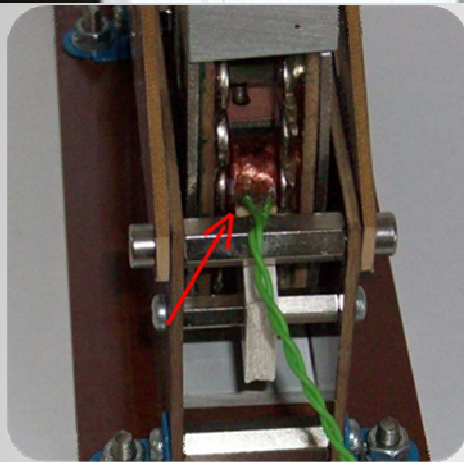
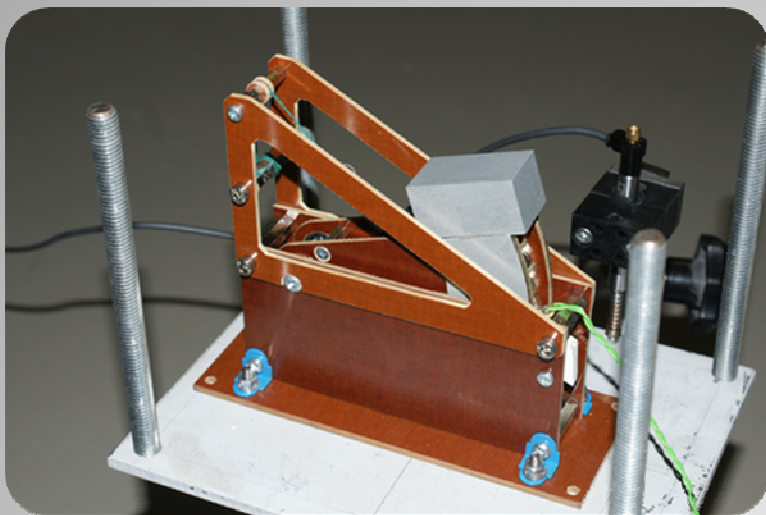


Source: Gunter Naumann, *Energiewandlersystem für den Betrieb von autarken Sensoren in Fahrzeugen*, Diss. Dresden, 2003

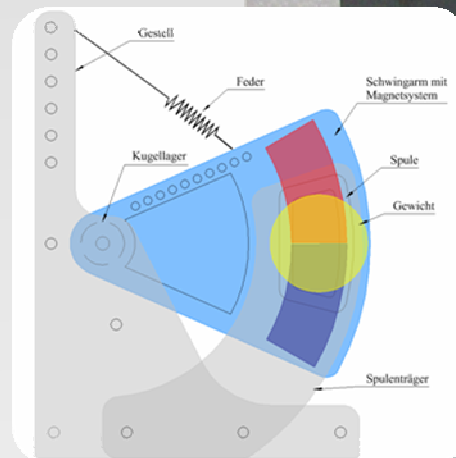
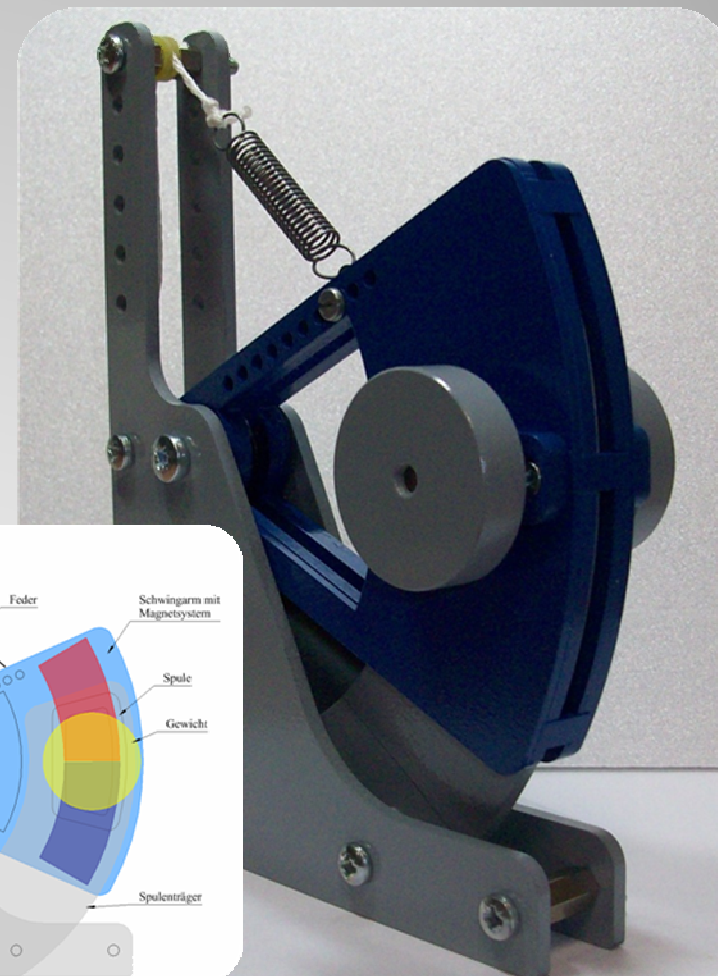


Rotatoric Harvester

Prototype V 1.2

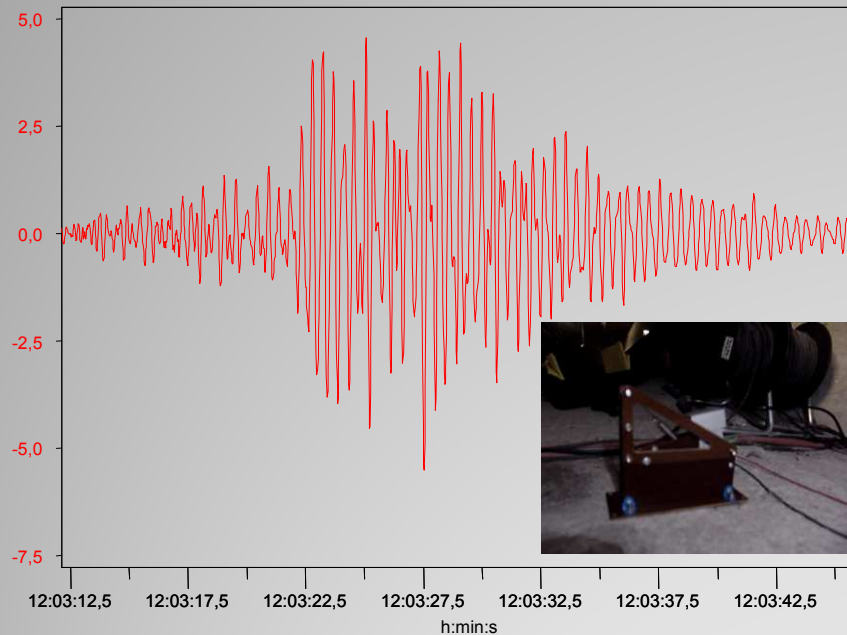


Prototype V 1.4



Current State

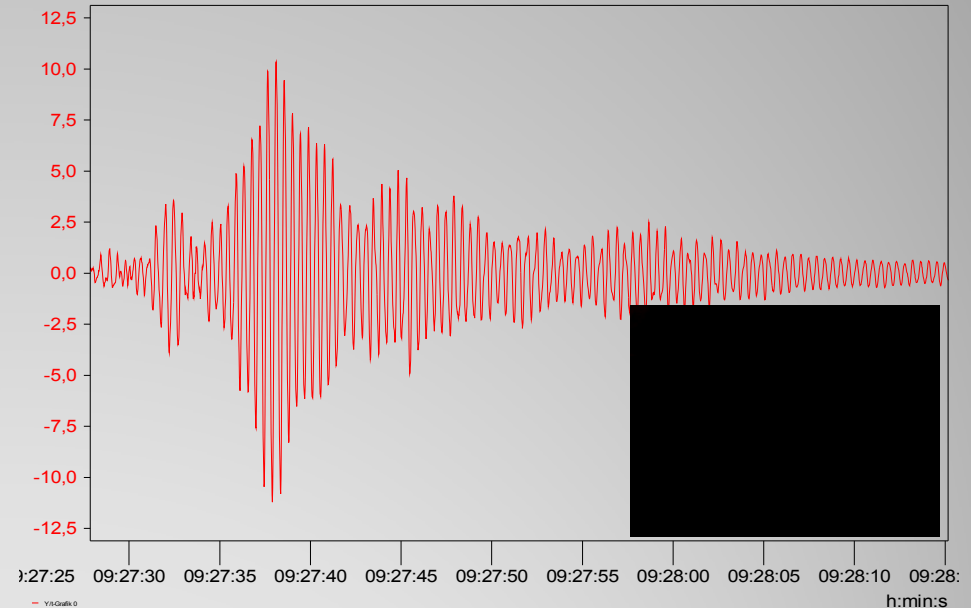
V *Test measurement of Harvester V1.2 on the bridge*



Performance improvement through:

- **Reduction of damping ratio**
- **Better resonance tuning**
- **Increased displacement amplitudes**
- **Improved coils [2700 Windings]**

V *Test measurement of Harvester V1.4 on the bridge*

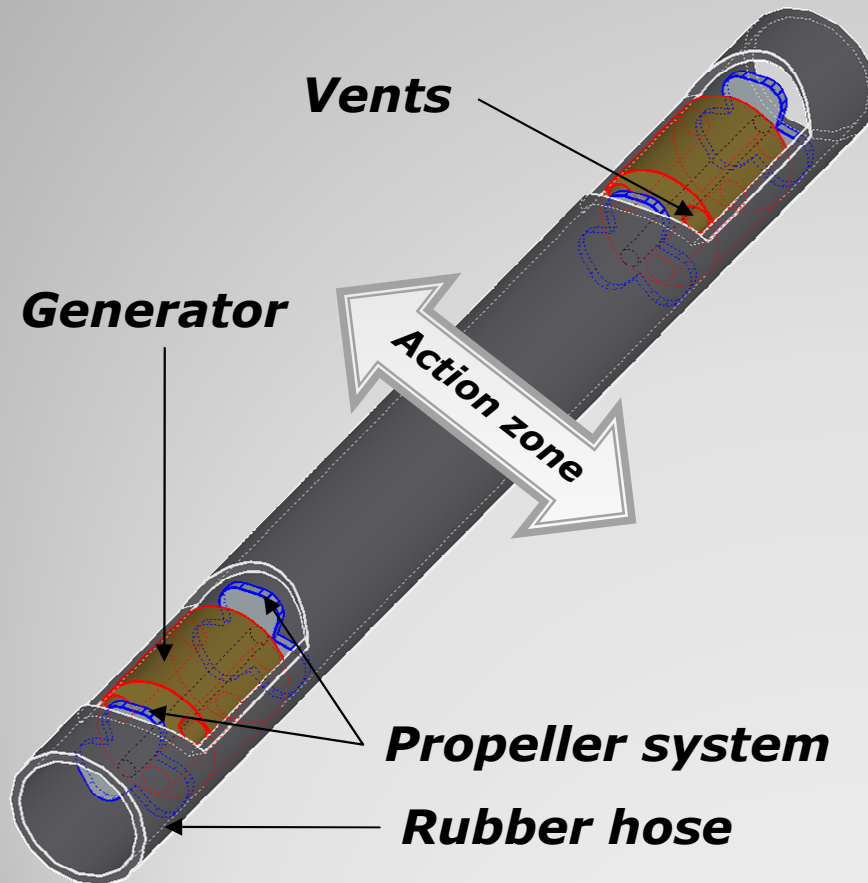


- **Further improvment of harvester prototypes mean energy with discontinuous excitation energy $\rightarrow 10-20 \mu W$**
- **Energy from laboratory tests $\rightarrow 1,4 mW$**
- **Data logger systems for temperature and humidity can be supplied with energy by current harvester prototypes**



Development of New Ideas

Energy Harvester integrated in bridge expansion joints



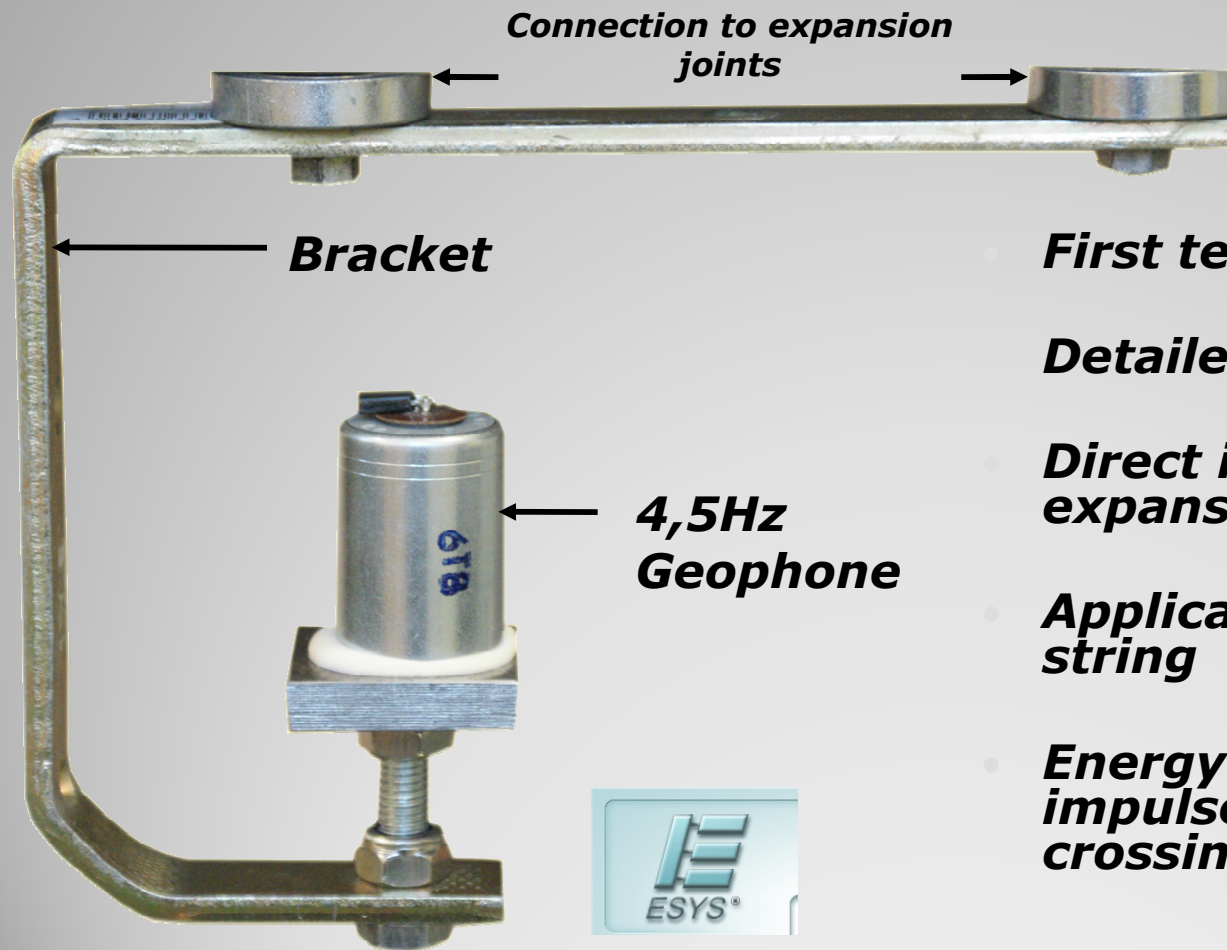
Detailed tests are in preparation

- **Integration in expansion joints**
- **Application of mini-generators**
- **Energy harvesting from vehicles crossings**



Development of New Ideas

Geophone as „Energy Harvester“



- **First tests are promising**
- **Detailed tests are in progress**
- **Direct integration in expansion joints**
- **Application of a geophone string**
- **Energy harvesting from impulse excitation by vehicle crossings**



Thank you!

***Question, Comments, Hints
are appreciated!***



Dipl.-Ing.(FH) A. Büttner

