Risk management of extreme flood events

DIKE MONITORING

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

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Duration: 2005- 2008

Funding

Project Management

Coordination

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Motivation to start this research project

Problem

In case of an extreme flood dikes may lose their integrity

Goal: safer dikes

- Reinforcing
- monitoring

Solution

Integration of sensor systems into the textile structure

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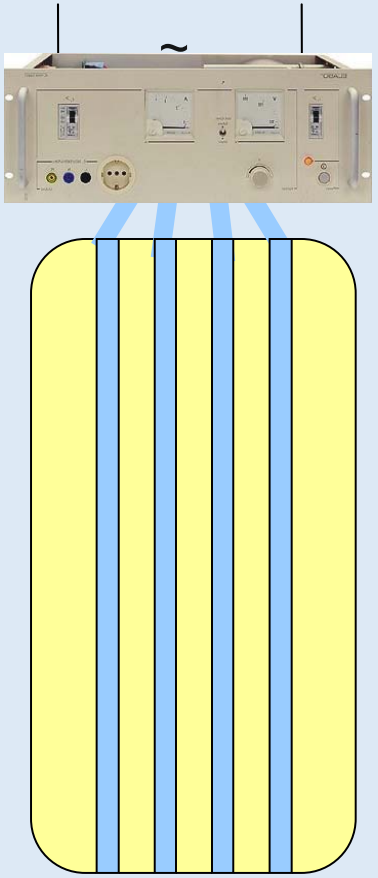
Components of a textile- fiber optical sensor system

- Measuring instruments
- Connecting system (forerunner fibers, end-runner fibers, plugs, ..
- Fiber optical sensors (glass materials, plastic materials)
- Textile structure to position fiber optical sensors (at *stfi*: by means of knitting)



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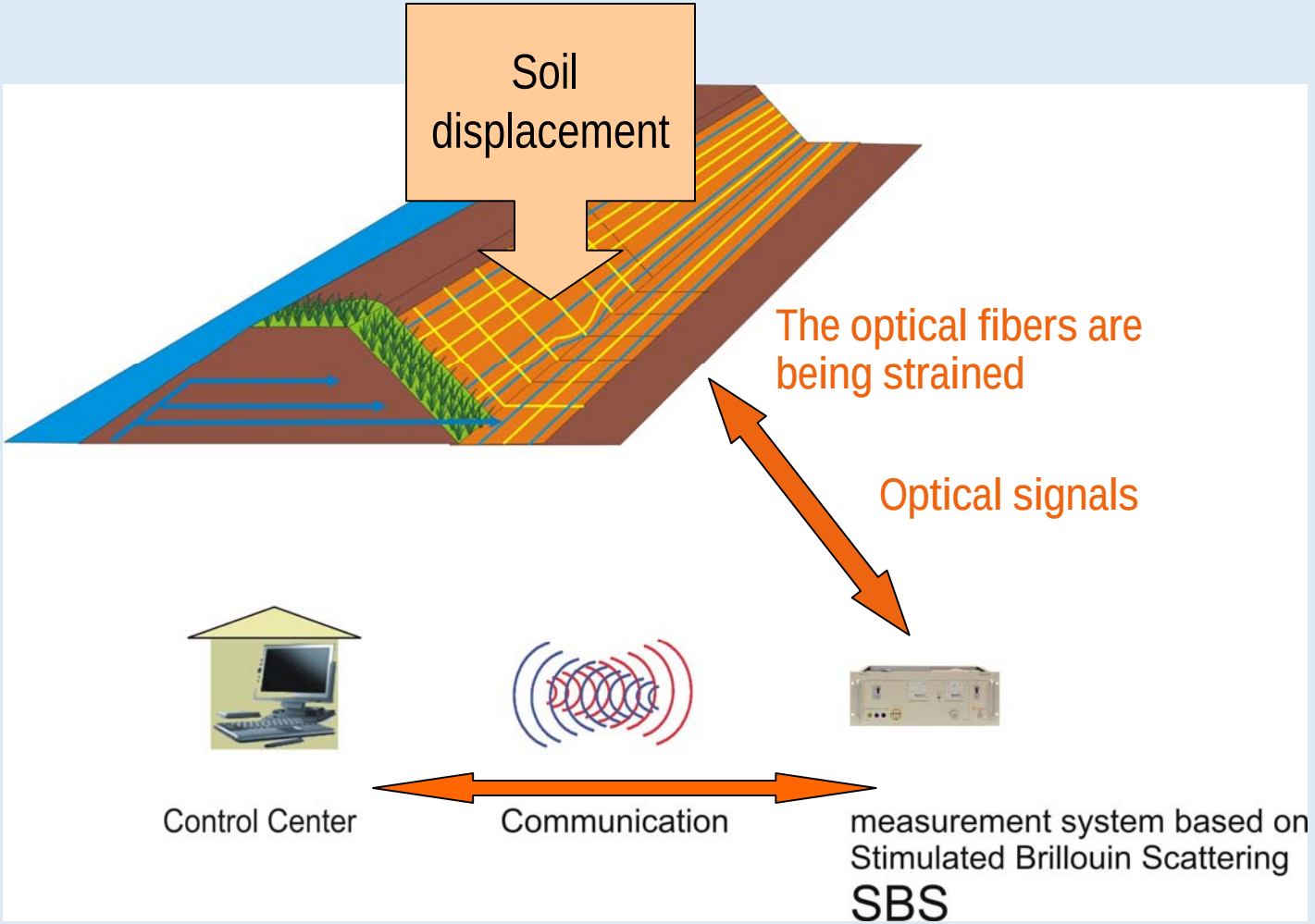

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- Only light is transported, no electric current
- No puncture in case of a lightning strike
- System works under extreme conditions (moisture, wetness, vibration, radioactivity)
- The same fibers as used in telecommunication = low priced

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- Silica optical fibers are sensitive to bending and mechanical stress
- Minimum bending radius without increase of optical attenuation is 32 mm
- Fibers would break if they were not protected by coating and cabling materials

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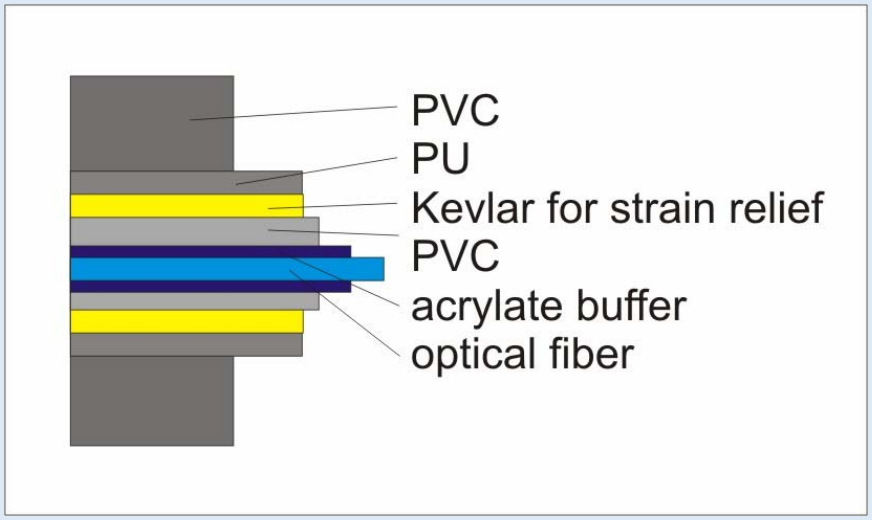
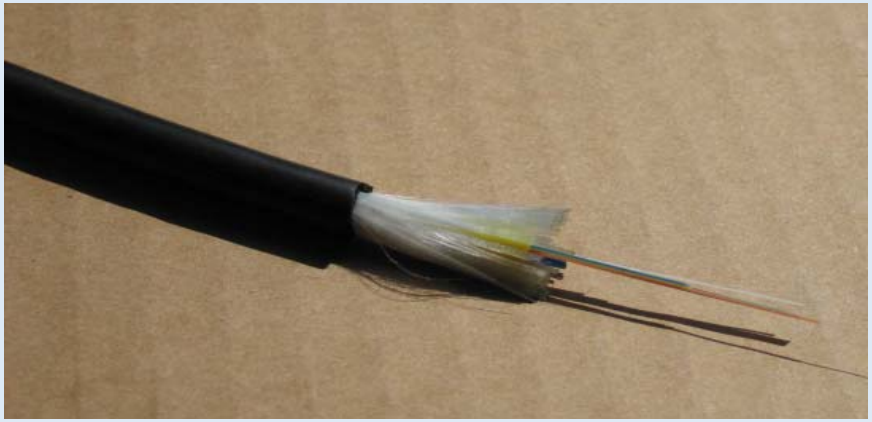
MATERIAL

Components of the novel multifunctional textile system

Optical fibers





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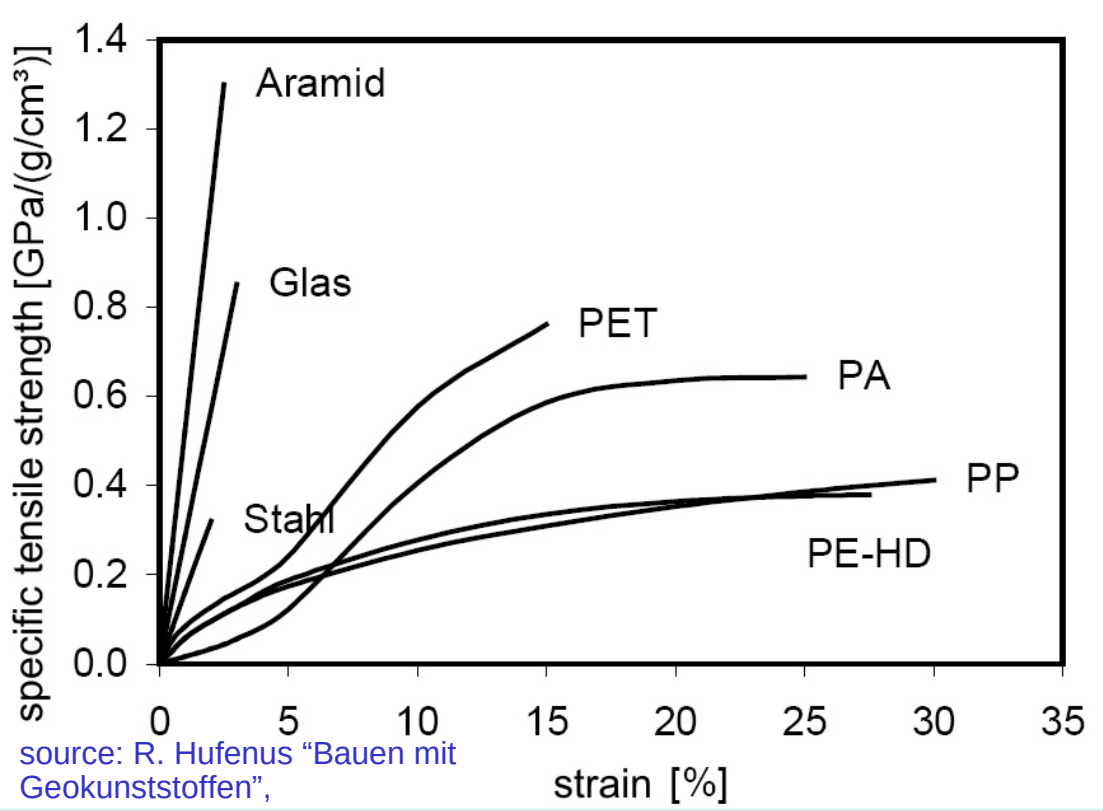
Components of the novel multifunctional textile system

MATERIAL

Textile material



source: R. Hufenus “Bauen mit Geokunststoffen”,

Polypropylene (PP)
Polyethylene (PE)
Polyester (PET)
Glass
Aramid

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Vliesraschelmaschine RS 3 MSUS-V with weft insertion

MACHINE

Specification

special warp knitting machine

parameters

- gauge 6 E
- 3 bars (1 ground bar, 2 guide bars to take up the sensors and the strengthening fibres)
- working width 165 inches

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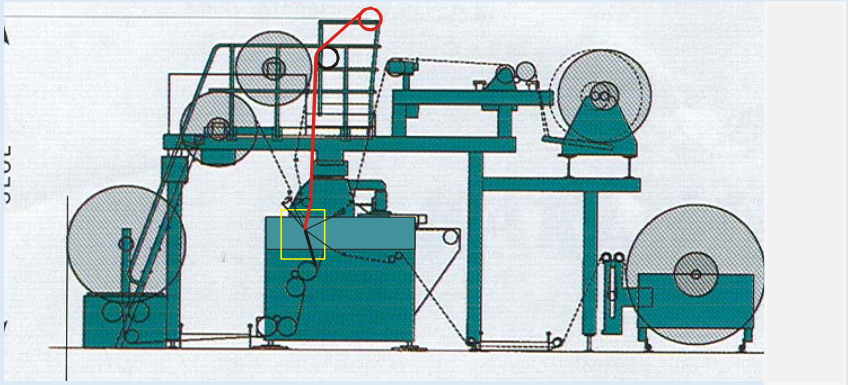
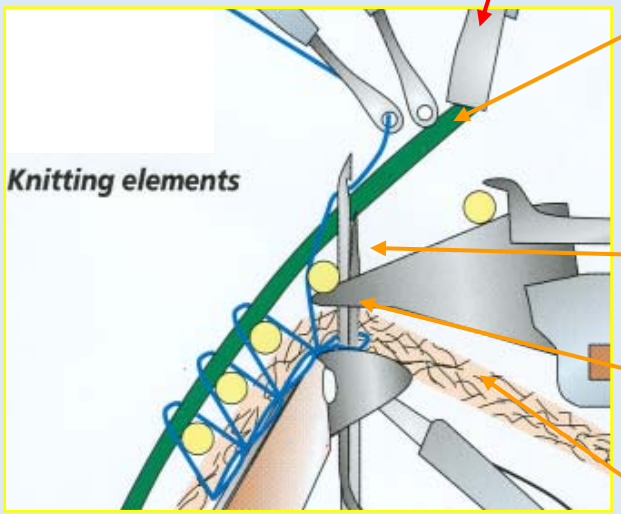
Critical mechanical impacts on fiber optical sensors



MACHINE



tube

Sensor fibers or reinforcing fibers

Weft insertion

Ground yarn

Nonwoven

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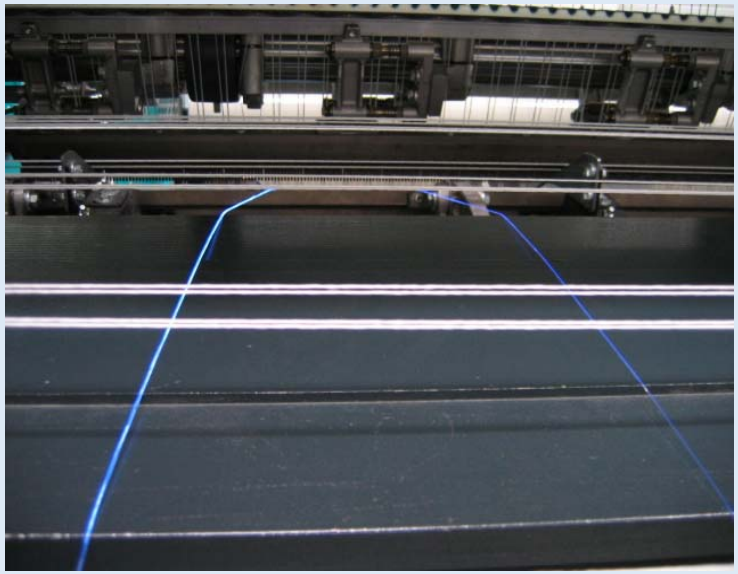
Analysing methods of critical mechanical impacts on fiber optical sensors

- Test with special Polymer optical fiber (POF)

MACHINE



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Analysing methods of critical mechanical impacts on fiber optical sensors

OTDR equipment used to check the quality of fiber optical sensors during the manufacturing process

MACHINE

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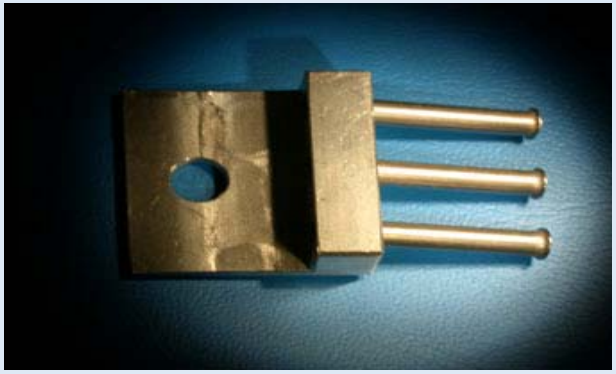
Textile machine adaptation

Analysing methods of critical mechanical impacts on fiber optical sensors are the basis for the textile machine adaptation

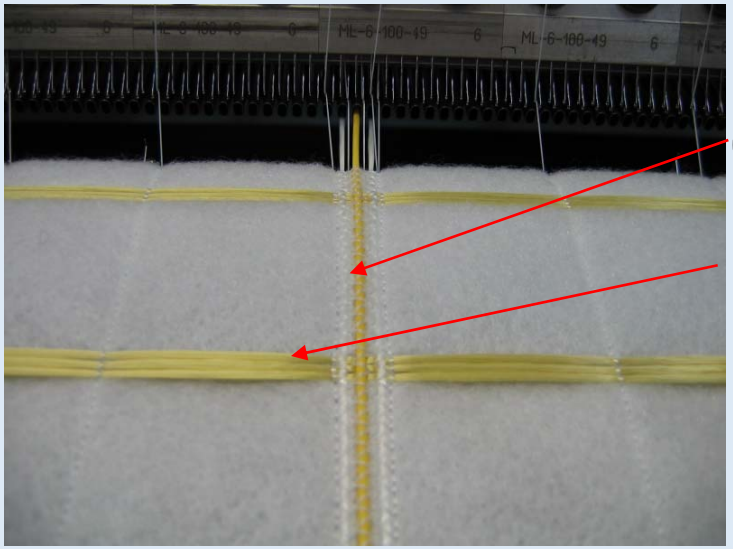


MACHINE

Single needle bar raschel knitting machine RS 3 MSUS-V

Advantages:
- very dense,
- semi-open or
- open structures can be produced

STRUCTURE



Reinforcing fibers in 0° and 90° direction
sensors in 0° direction

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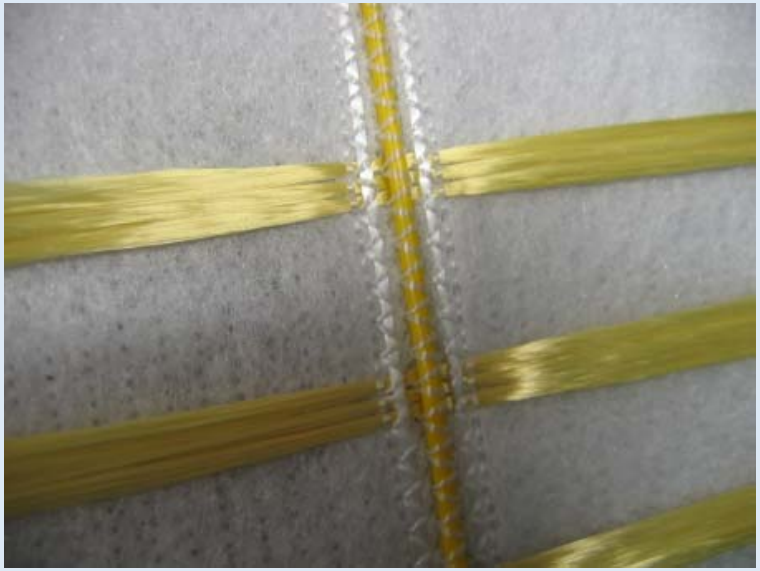
STRUCTURE



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FIELD TESTS

Dike of the river Mulde

1st test in Sollnitz near the town of Dessau

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FIELD TESTS

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FIELD TESTS

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2nd test in Solina, Poland downriver of a retaining wall

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gravity dam in Solina, Poland

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FIELD TESTS

gravity dam in Swinna Poremba, Poland

3rd test in Swinna Poremba, Poland downriver of a retaining wall

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LAB TEST

4th test in Lab dike at the Franzius Institute at the University of Hannover

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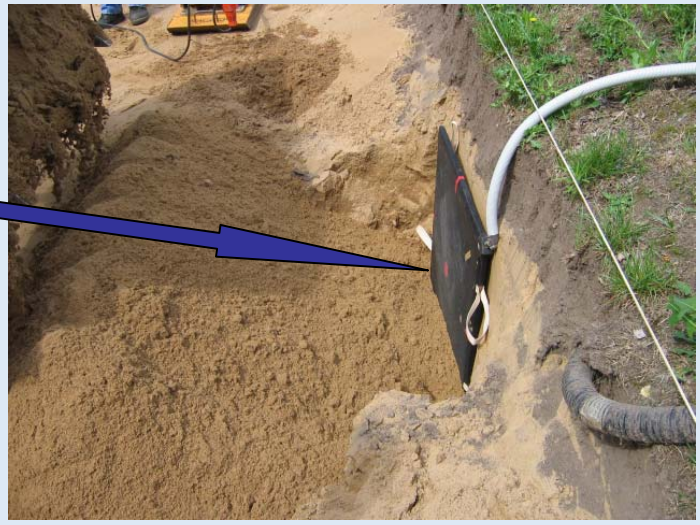

Integration of lifting bags to initiate failures

LAB TEST

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Integration of the geotextile into the lab dike

LAB TEST

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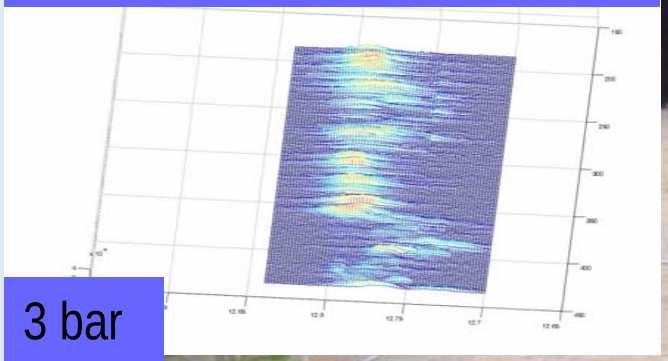
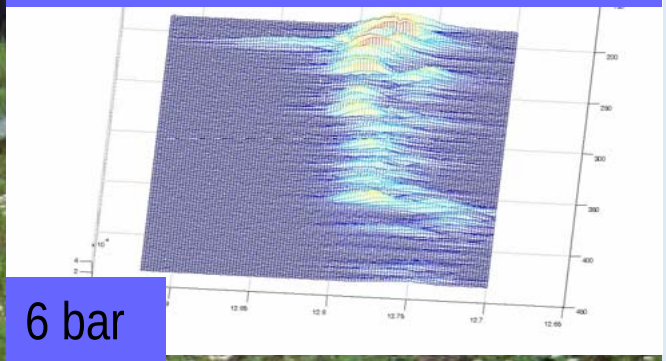
Brillouin effect in optical fibers



3 bar

Brillouin effect in optical fibers



6 bar

LAB TEST

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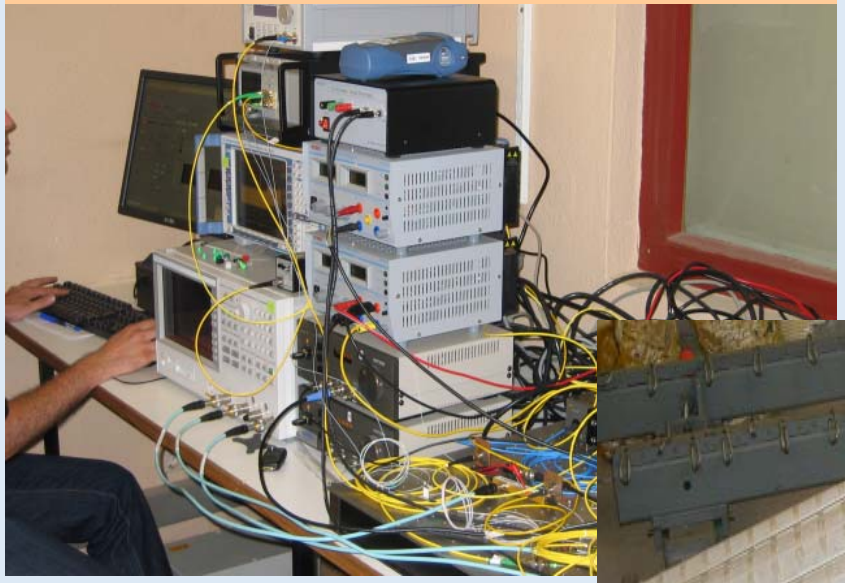
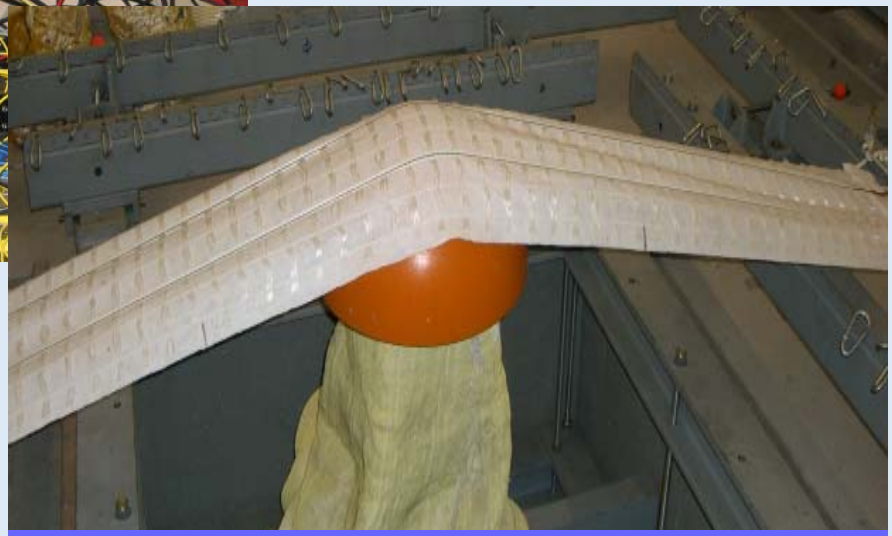
Optimization of the measurement system





Calibration of the geotextile- fiber optical sensor system

SCHEDULE

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Research has been carried out in the framework of the Risk Management of Extreme Flood Events (RIMAX) program of the Federal Ministry of Education and Research within the project "Sensorbasierte Geotextilien zur Deichertüchtigung (FKZ 02WH0573)".

We would like to thank our partners

Bauberatung Geokunststoffe GmbH & Co. KG,

Glötzl Gesellschaft für Baumesstechnik mbH,

Franzius-Institut für Wasserbau und Küsteningenieurwesen at the University of Hannover

KARL MAYER malimo Textilmaschinenfabrik GmbH and

fiberware Generalunternehmen für Nachrichtentechnik GmbH.

Thank you very much for your attention!!