Optical interrogator for Fiber-Optic Sensors in Sustainable Agriculture

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Challenges: Our mother earth

Crop yield, irrigation, water saving

Earthquake analysis, risk and mitigation

Landslide, damages and prevention

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Fiber optics / FBG based sensors involves ‘interrogation’
The current interrogators on the market are high cost
E.g. used by petroleum multinationals
Interrogator for Sustainable agriculture: static
Already validated

Challenge I: Overcome climate change and water deficits on food shortages

- Maximize crop yields: Avoid loss of crop due to soil wilting point
- Avoid over irrigating: water loss, energy cost
  - Smart irrigation: Control of soil water content
    - Irrigate as much as ‘needed’!

All efforts, technologies, are needed:

- Capacitive: Electronics and power supply on all measurement points LoRa/IoT for data transmission
- Time/Frequency Domain Reflectometers (TDR/FDR): Data logging, ...
- FOSS4I.0: CERN technology used for the development of Fiber optics (FBG based)
  - Centralized electronics and power supply

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Extension A: Earthquake, dynamical

We cannot predict earthquakes, but we can minimize its effect!

All efforts, technologies, are needed:

- Earthquake Alert system (ShakeAlert): (Hold on, Cover, Drop)
- A wider network of sensor.
- Low frequency (VLFE, LFE) affecting mostly large building
- High frequency, affecting mostly small buildings
Extension B: Landslide Early Warning, Dynamical

- Local landslide early warning systems (LEWSs) monitor a specific slope that has been pre-identified as being at risk of failure.

- Changes in slope conditions are monitored using instruments to measure the movement of slope materials and/or a proxy for pore water pressure. Often a range of monitoring sensors are used.
DFB based interrogator: static

Solution based on:
- Hardware: common / basic components: DFB Laser, PID controllers, FPGA
- Software: advanced ‘learning’ algorithms

Affordable solution for most applications
- Irrigation- validated
- Seismic- to be developed
- Landslide- to be developed

Robust against vibration, autonomy:
- No mechanical parts
- Sensor without on site powering

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Who can profit?

- Agriculture worldwide
- Seismic analysis systems (within and outside of CERN)
- Geophysical society

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Partners, potential partners

- CERN: Safety and electronic departments, JPARC, ....
- Research: Potential partner
  - Remote sensing center
- Commercial: TBD
- Industrial: TBD

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Roadmap and timeline: 24 months

Interrogator Dynamical behavior: Assessing current solutions + commercial dynamic interrogator
• Month 1—Month 12

Inertial sensors:
• Fully integrated solution
• Month 12 – Month 24

Packaging of ‘our’ interrogator:
• Month 6—Month 18
Resources

Equipment:
- Current solutions inertial sensors
- Dynamic interrogator (existing solution)
- Vibration table and reference sensors

HR:
- Electronics technician
- Mechanical technician

Support from electronics department CERN, CERN HSE

Electronics and mechanical materials

Mobility support (CERN and Expos)

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