

# Paris Session 2022



## Surface inspection and control algorithms

SC B1 Insulated Cables – PS1 – Q1

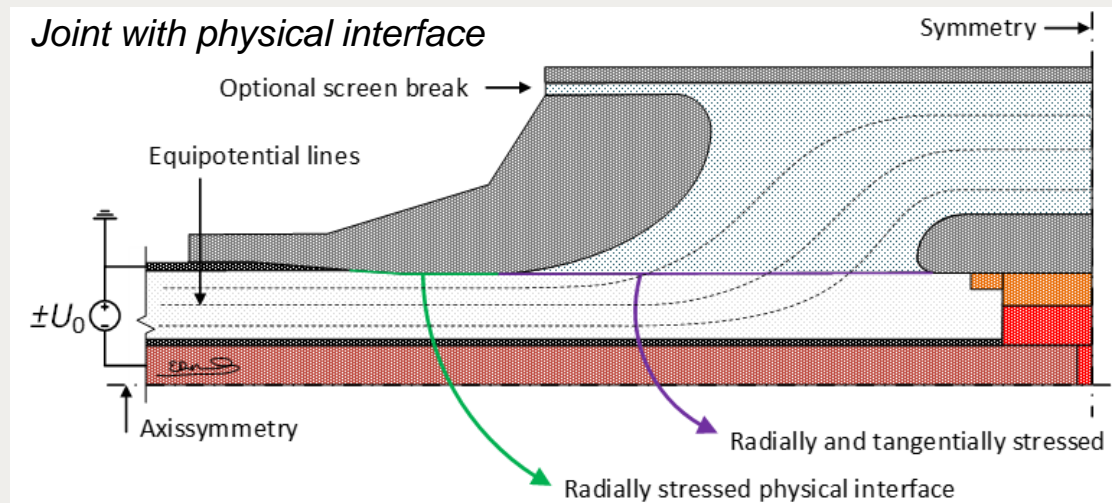
Dr. Espen Doedens, Norway



# Surface inspection and control algorithms

- *Quality control (QC) by means of post-installation AC PD measurements of joints:*
  - ONLY the interface is “new / untested”
  - Infeasible for long HVDC lengths (i.e., submarine joint)
  - **Dielectric oil/grease in interface suppresses PD**
  - Challenging noise suppression
- *Alternative QC is needed and developed; laser scanning accessory geometries and cable ends*
- Industry 4.0 enabler
- On-site direct quality feedback

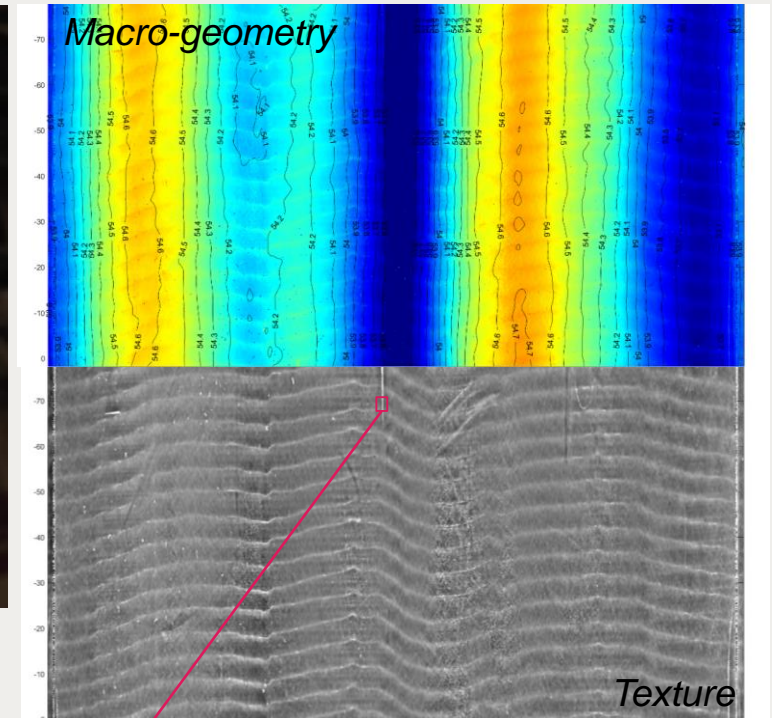
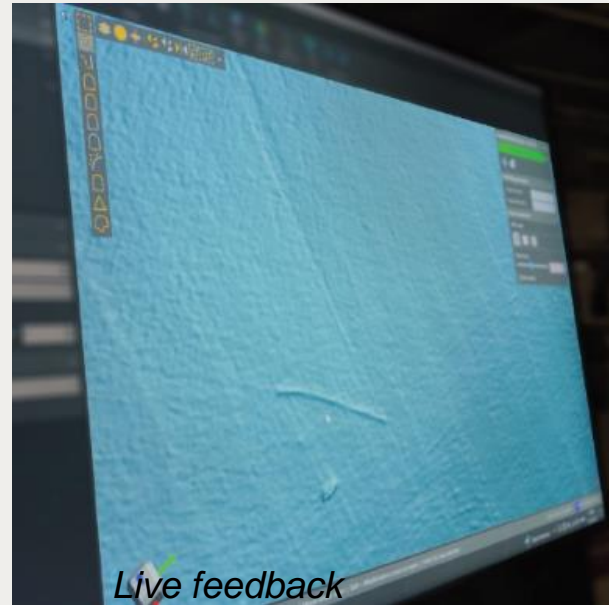
Group Discussion Meeting



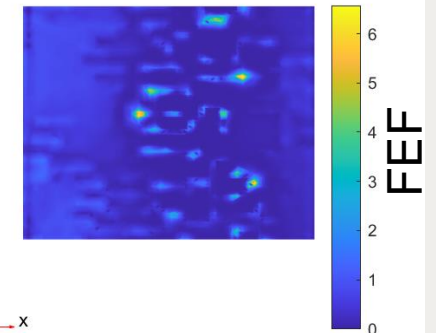
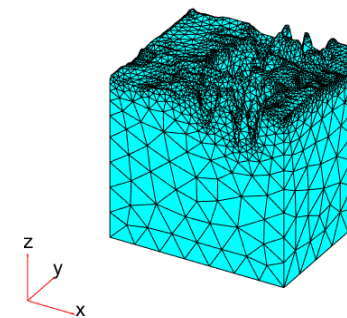
# Surface inspection and control algorithms

- *The laser scanning process enables*
  - Live feedback during scanning
  - 25  $\mu\text{m}$  geometric accuracy
  - Beyond 100  $\mu\text{m}$  resolution
  - Acquiring beyond 1 million points/s
  - Handling of any complex shapes
  - Fast set-up and direct measurement
  - Performed prior to joint finalization
  - Data storage as a surface mesh
- *Laser scanning mathematical algorithm*
  - Processes the surface mesh
  - On-site generated GO/NO-GO criterion with 10+ geometric acceptance criteria for direct operator feedback
  - Utilizes mathematical computation or AI to detect “geometrically worst regions”, performs local FEM analyses on selected regions
  - GO/NO-GO also based on FEM results (PDIV and FEF)
  - Visualizes processed scan data and auto-generates QC reports
  - Full traceability of geometries during the system’s life-time
  - Shareable results with end users

Group Discussion Meeting

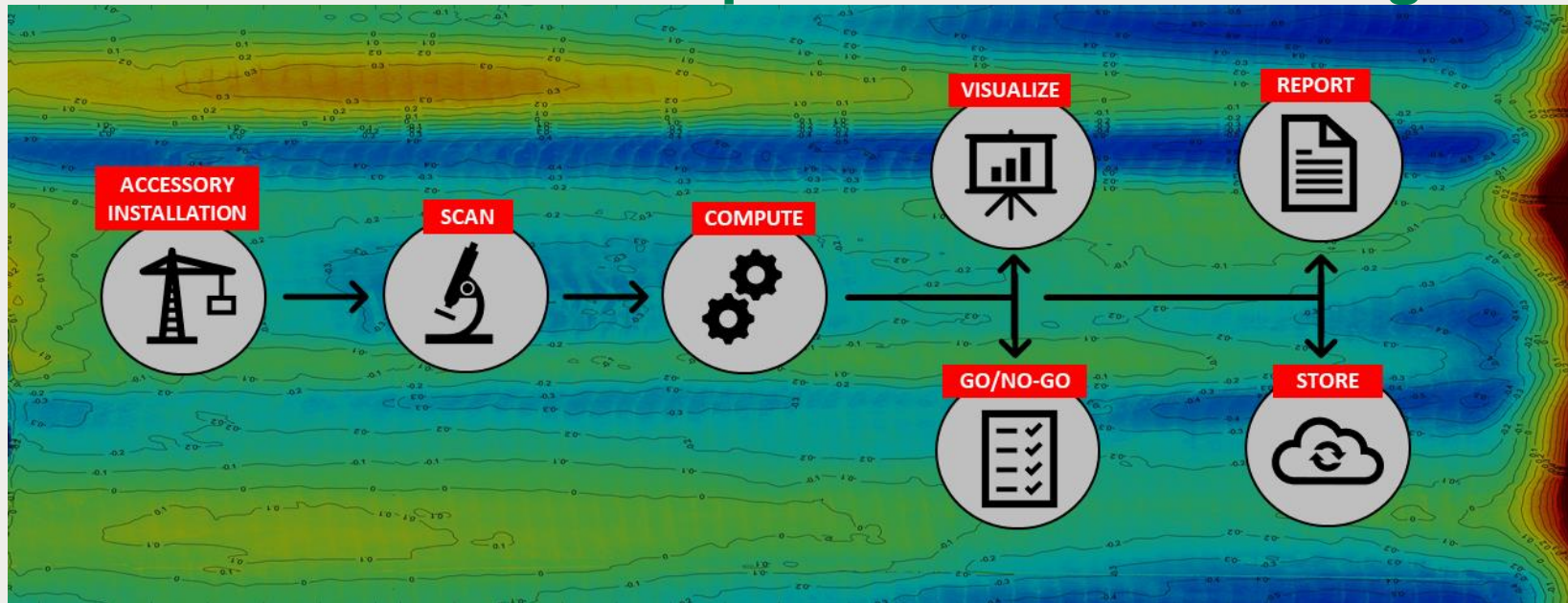


FEM domain



Field enhancement (FEF) result

# Conclusion on surface inspection and control algorithms



- *Laser scanning QC enables a reliable, digital analysis for on-site accessory installations.*
- *Contrarily to post-installation PD measurement:*
  - it can compute PDIV regardless of oil presence, and also estimate local field enhancements.
  - Long length energizations and electric noise control are no issues.
- *Laser scanning QC enables sharing data with end-users of the cable system. It is superior to today's QC methods and enables HV industry 4.0.*

Group Discussion Meeting