Embedded Life-Cycle Management for Smart Multimaterials Structures: Application to Engine Components

MORPHO FINAL CONFERENCE

Structural Damage: Robust, Real-time, and Data-driven Modelling for Online Control (DREAM-ON project)

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European Research Council
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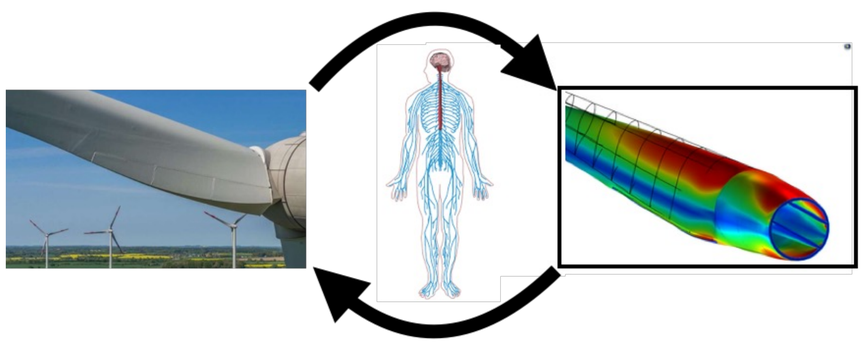
Objectives

- Design of **smart engineering structures** : self-aware, online monitoring of the integrity, anticipated action during service



- **Integrated simulation-based SHM**, for damage detection, accurate diagnosis & prognosis, and feedback control for decision on operating range

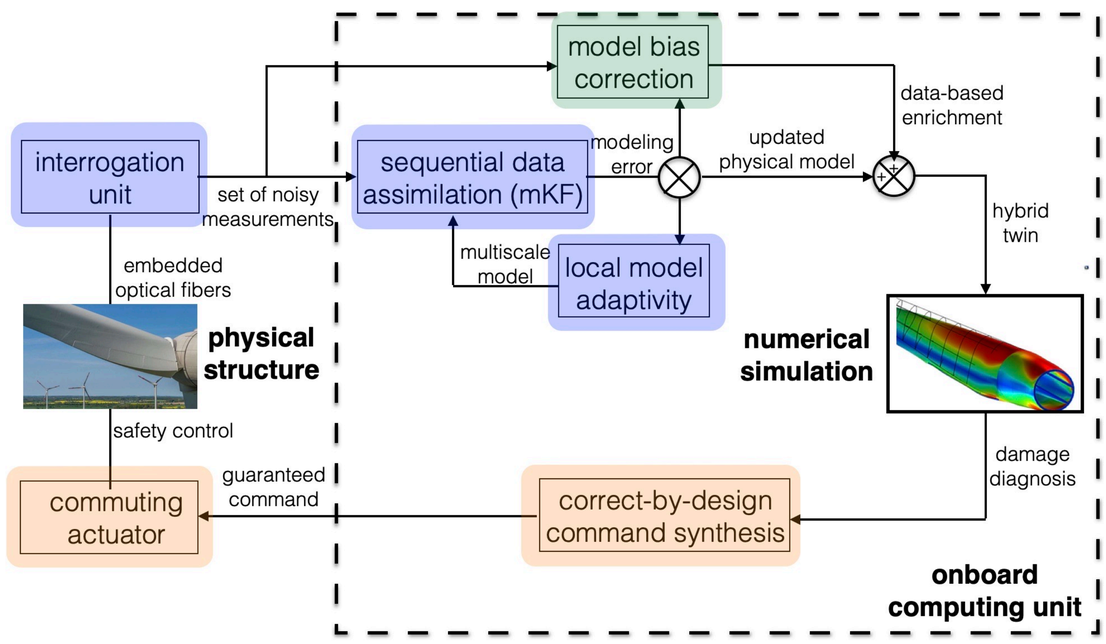
  ➡ Enhanced durability and performance

  ➡ Optimized maintenance

  ➡ Operation in degraded mode

- **Constraints**: real-time / reliability / portability (edge computing)

Strategy

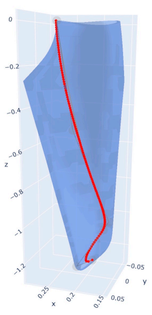


Combination of tools:

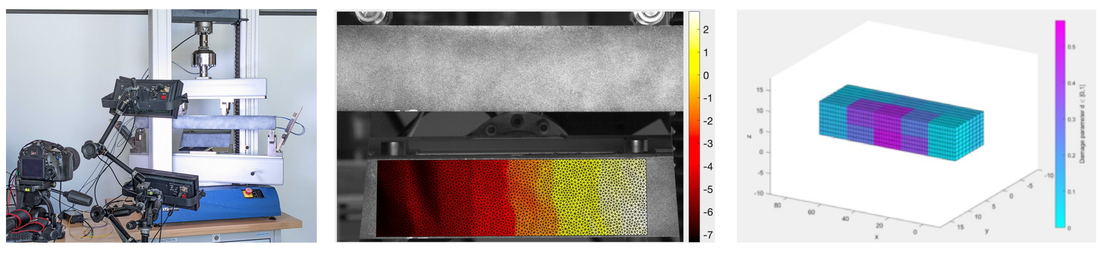
- Advanced sensing (network of optic fibers)
- High-fidelity hybrid modelling (physics-based + data-based)
- Powerful numerical methods (model reduction, Kalman filtering, MPC,…)

Key Research Topics

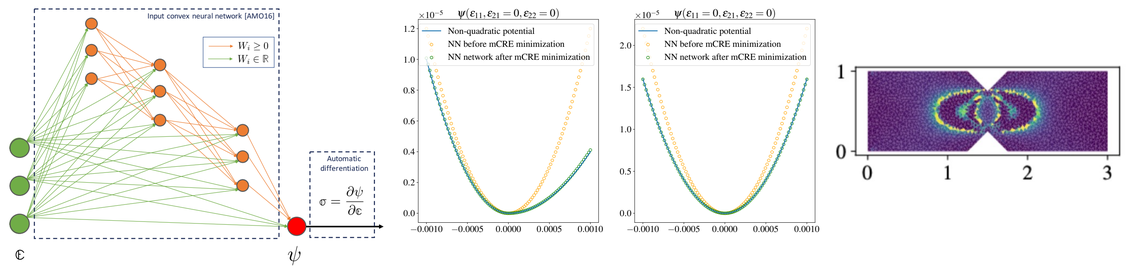
- **Optimal sensor placement**
  (information entropy, B-Splines, UQ)



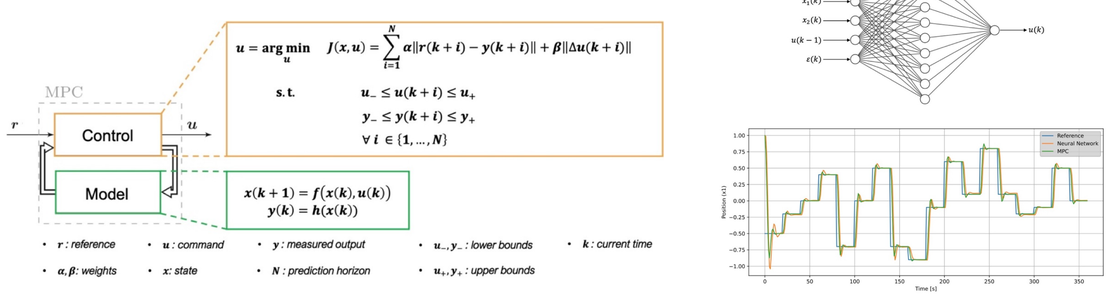
- **Sequential data assimilation**
  (modified dual KF, sparse regularization, multi-fidelity modelling)

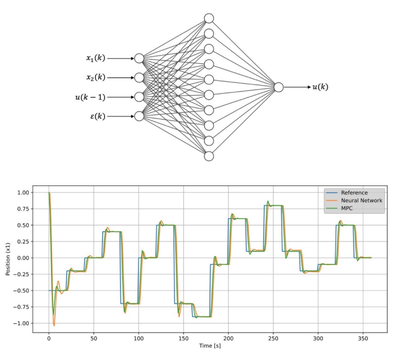


- **AI-based model enrichment** (with physics-augmented NNs)

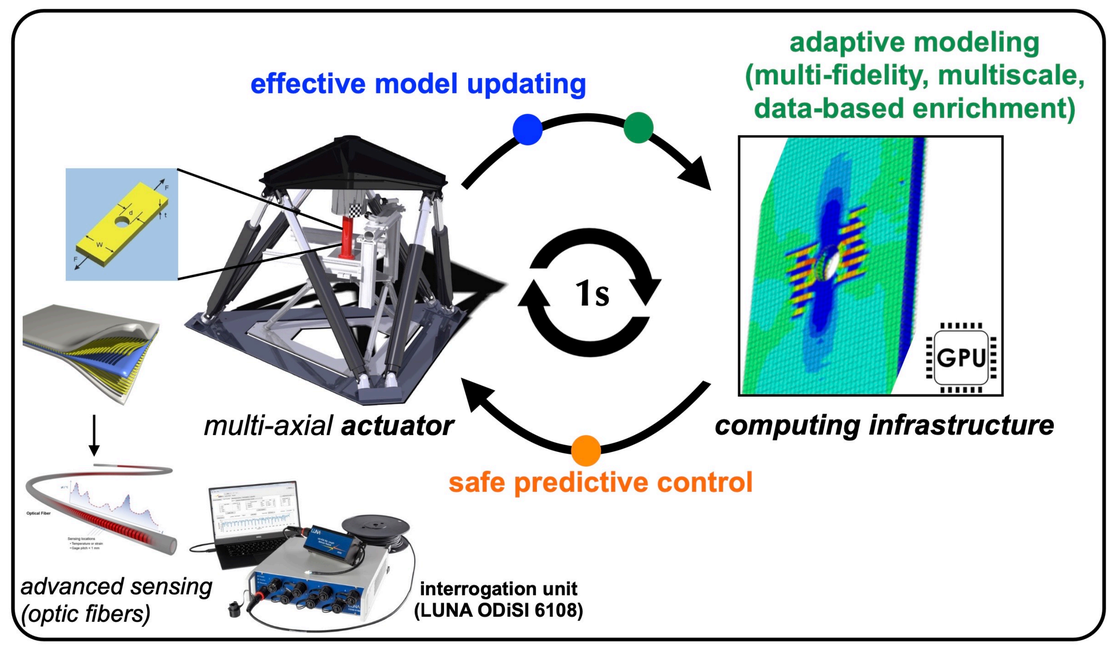


- **Predictive control** (Deep Learning MPC)





Proof-of-Concept



➡ Analysis of the safety region

➡ Operation at performance limits, for various damage states

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