Efficient Inverse Methods, Calibration and Training Procedures for Real-time Impact Monitoring Systems based on Passive Sensing Networks

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Problem Statement

- Real-time Impact Monitoring as one important SHM strategy
  - Goals
    - → detection / localization / quantification of impact events on composite structures
    - → to trigger diagnostic systems for local damage detection
    - → rapid damage prognostics based on reconstructed impact loads and numerical simulation
  - Problems to be considered
    - → efficient and reliable solution of the according inverse problem
    - → efficient calibration of passive sensing networks and numerical models
    - → reliable training procedures

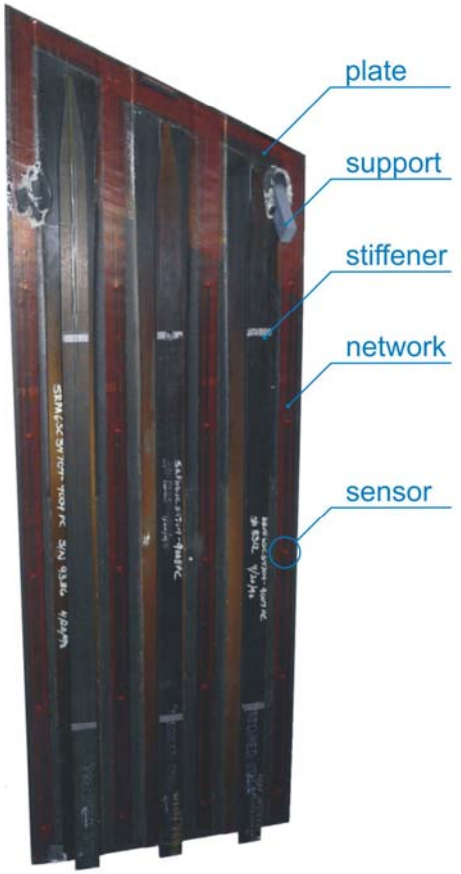
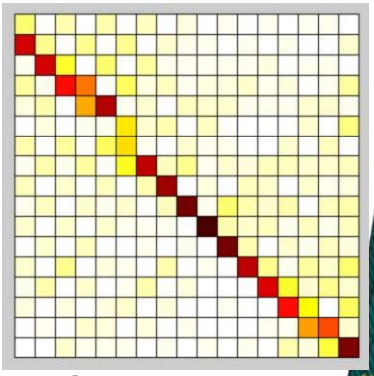


Figure:
Composite Structure with Passive Sensing Network

Method of Approach

- Sensor / Model Calibration
  - global / local calibration based on computational model update methods
    - → iterative minimization of model errors
    - → basis: I/O Data or OO (in-flight) data
    - → global: calibration of model parameters
    - → local: calibration of sensor gain factors



MAC Matrix

- Reliable and Efficient Training of ARX Models for Inverse Analysis
  - highly efficient training of ARX models based on calibrated FE models
    - → various sets of ARX data for different load conditions
    - → average and stability analysis for ARX parameters

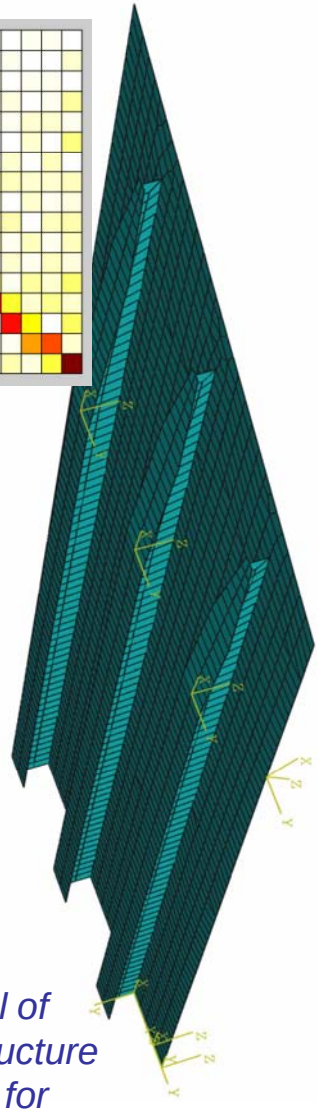
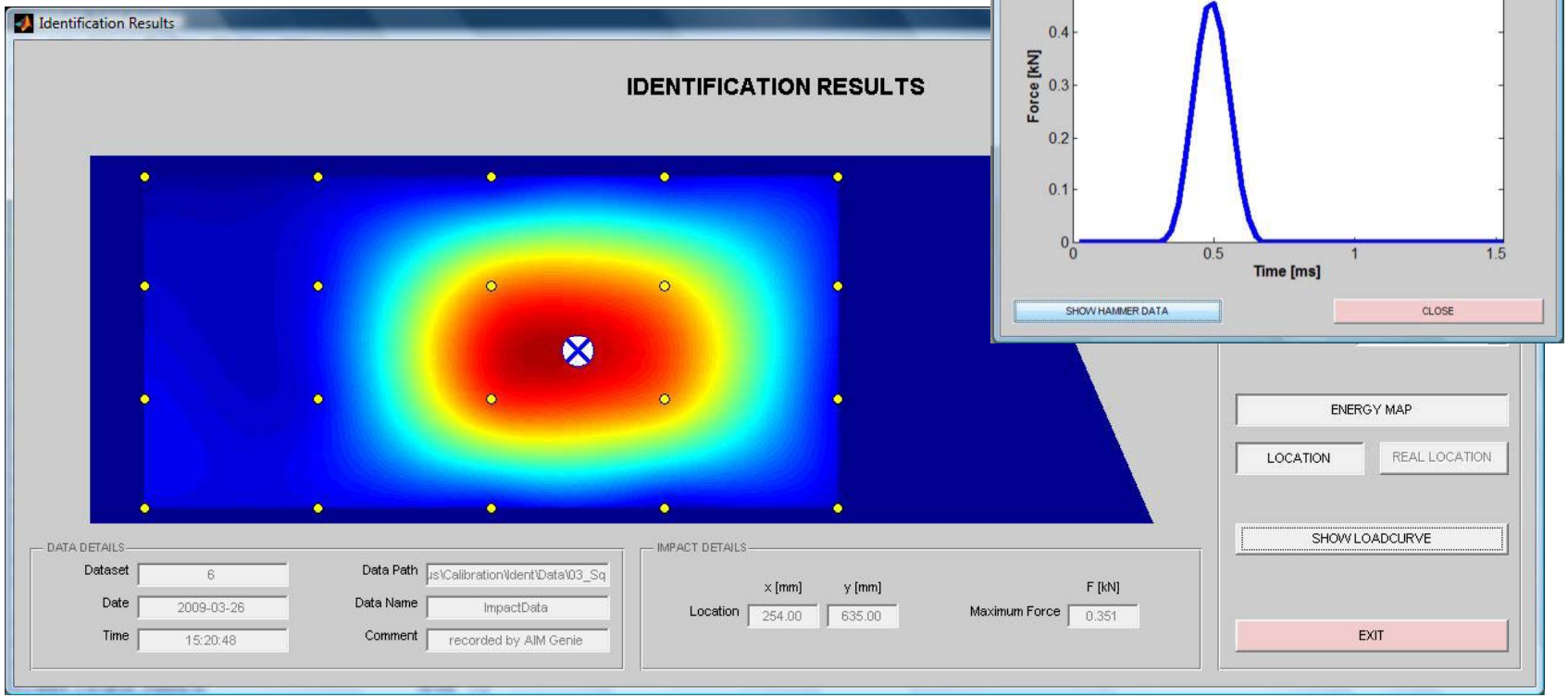


Figure: *Numerical Model of a Composite Structure and MAC Matrix for Model Calibration*

Results

- Reliable and Efficient Impact Monitoring
  - efficient training of ARX models with limited experimental efforts
    → reliable reconstruction of impact location and load curve
    → nonlinear effects can be included by simulation-based training



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Future Work

- Combination of different SHM technologies to Integrated Health Management System

  → impact monitoring by passive networks
  → damage diagnosis by active networks
  → prognostics and life-time prediction by numerical simulation

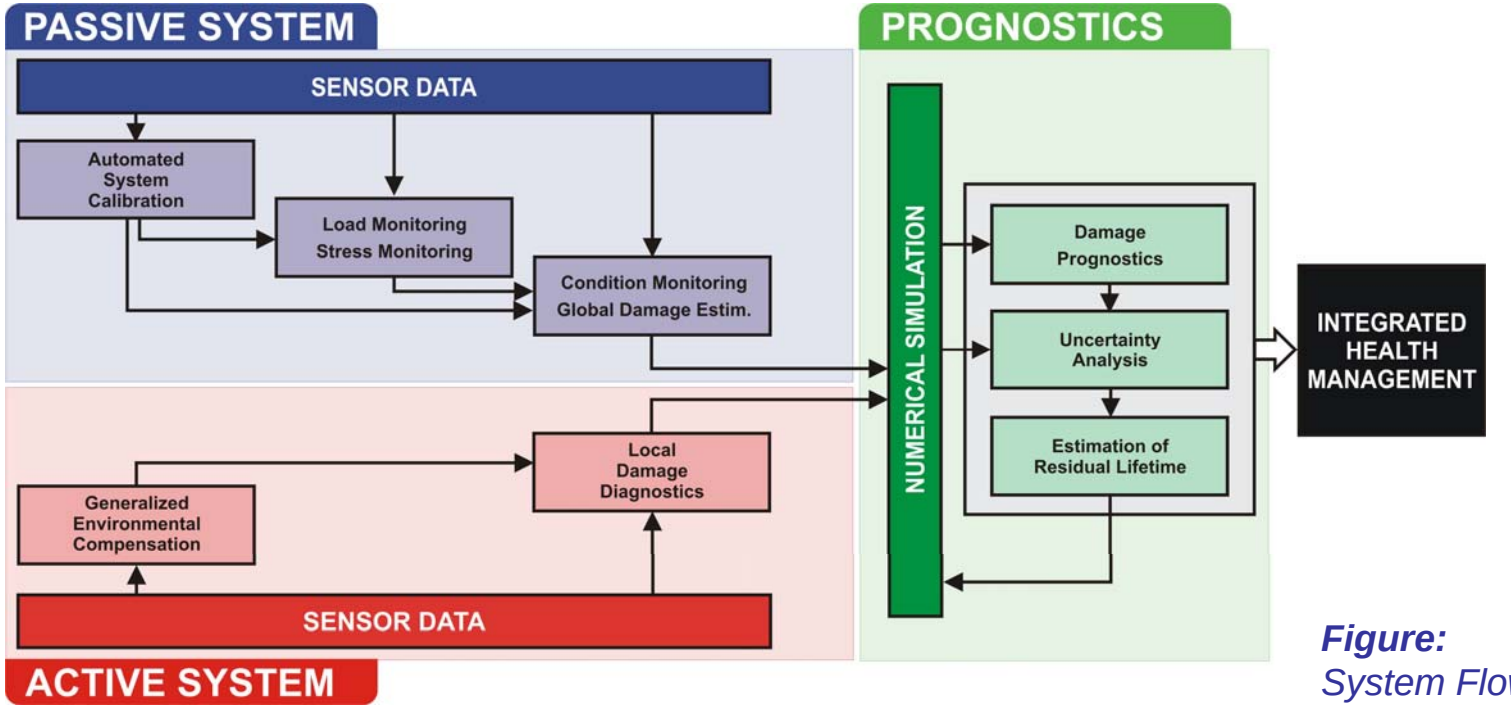

Figure:
System Flowchart

Bio

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