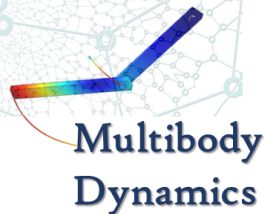
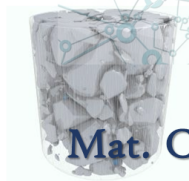
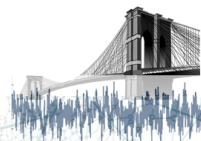


**Applied Mechanics & Data Analysis**  
**Faculty of Engineering Tecnology**

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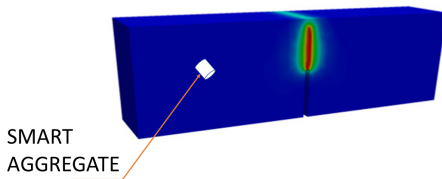
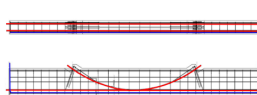
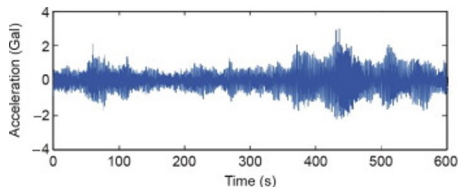


# Structural monitoring



# Sensing

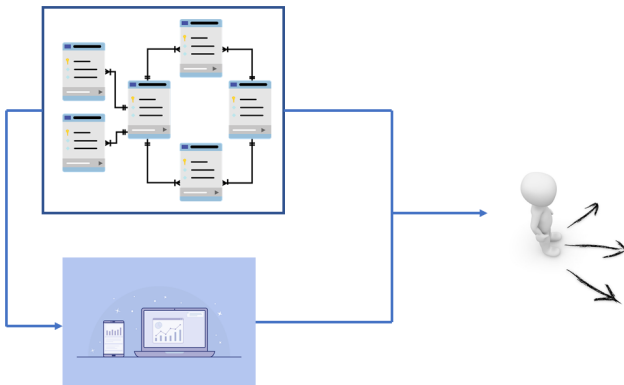
- non-destructive sensing:
  - ▶ vibration
  - ▶ ultrasonic
  - ▶ electromagnetic induction
- destructive sensing
  - ▶ tension, compression
  - ▶ 3d point bending test, etc.
- smart concrete
  - ▶ piezoelectric sensors
  - ▶ optical fibers



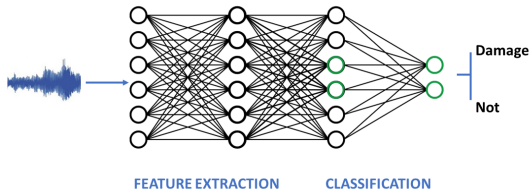
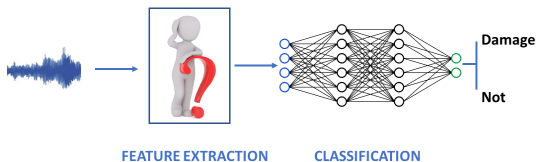
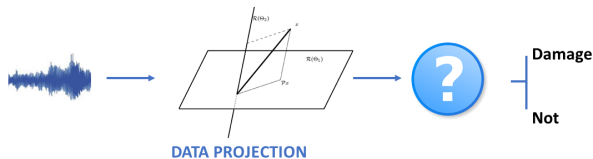
Cooperation with University Paris-Est, IFSTTAR, and Inst. of App. Mech., TU Braunschweig

# Data driven learning

- a lot of sensing data (usually of heterogeneous nature)
- no direct theoretical knowledge about the system
- still, the data are modelled ("analytically")
- decision driven by programme

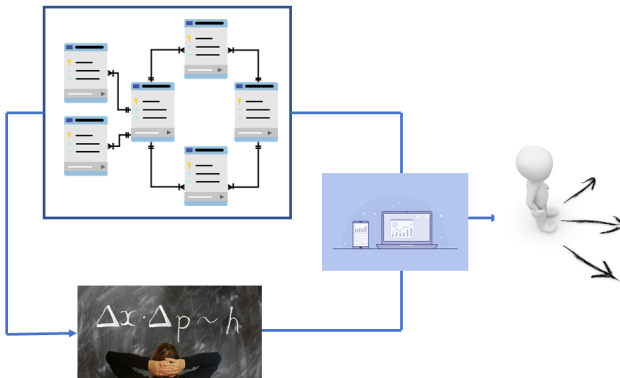


# Data driven modelling

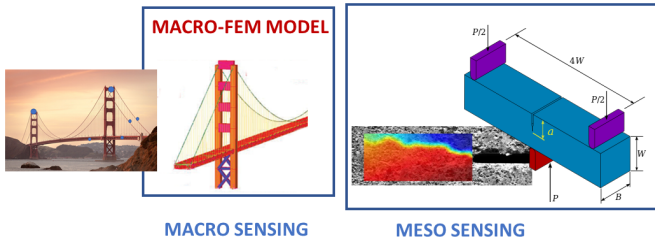


# Data informed learning

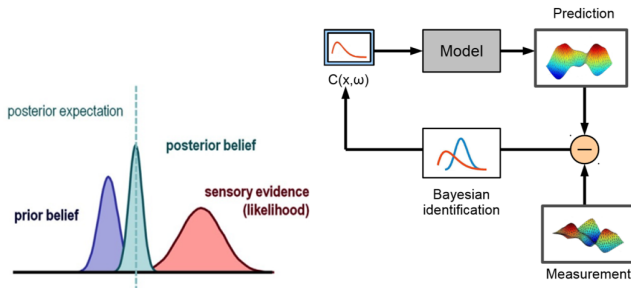
- Physics based modelling:
  - ▶ a good understanding of the system
  - ▶ works also with small sets of data
  - ▶ not only predict what will happen, but why it will happen.



# Data informed learning on macroscale

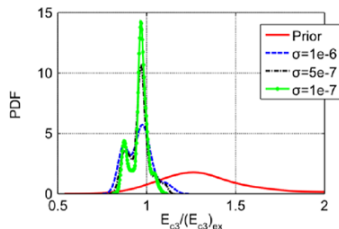
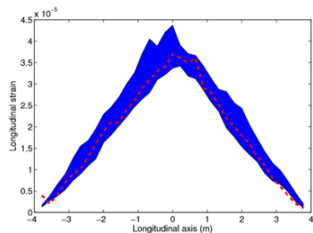
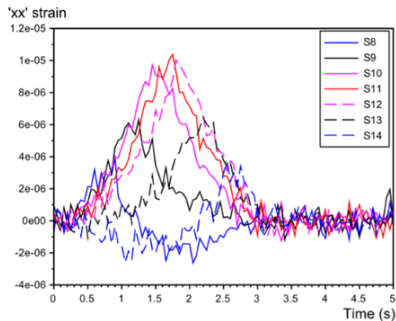
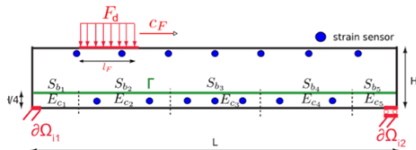


## Bayes's rule



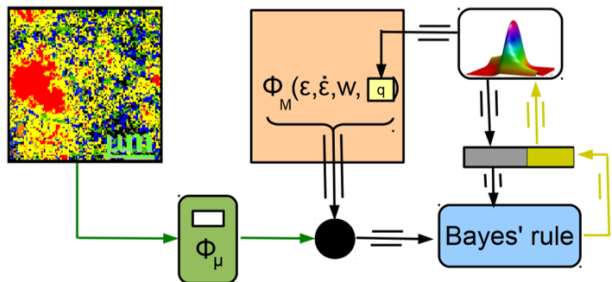


# Data informed learning on macroscale

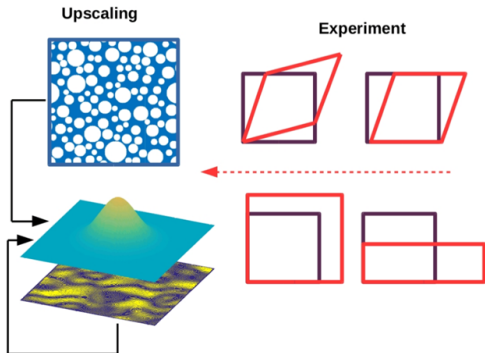
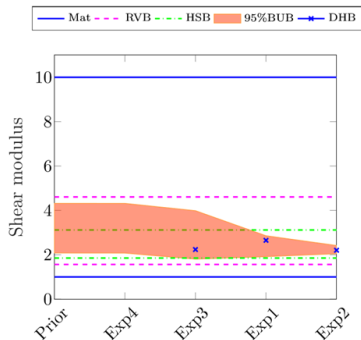


(a) Young modulus

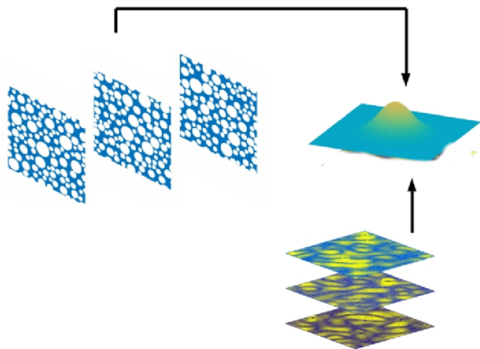
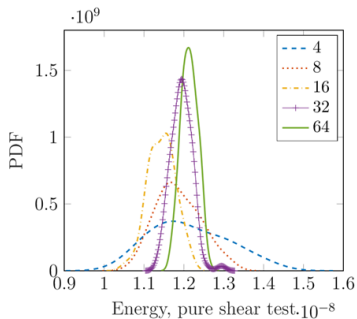
# Data informed learning on finer scales



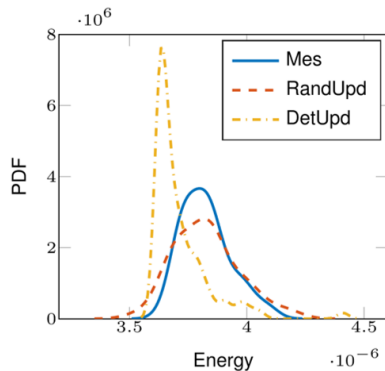
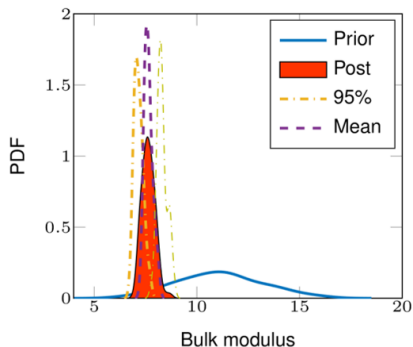
# Data informed learning on mesoscale



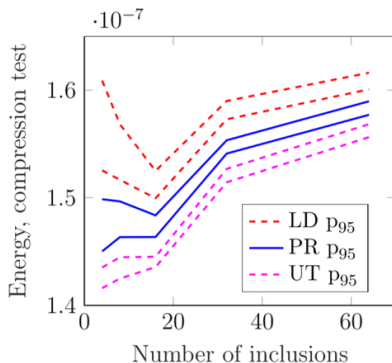
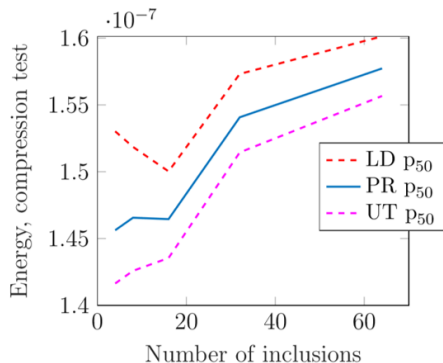
# Data informed learning on mesoscale



# Data informed learning on mesoscale

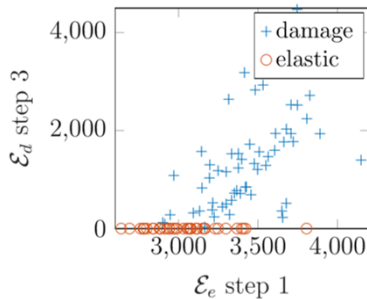
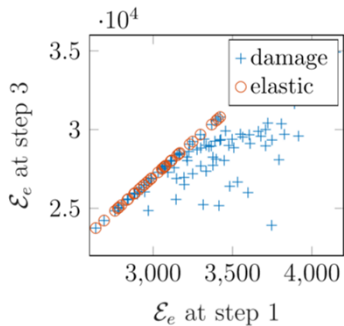


# Data informed learning on mesoscale



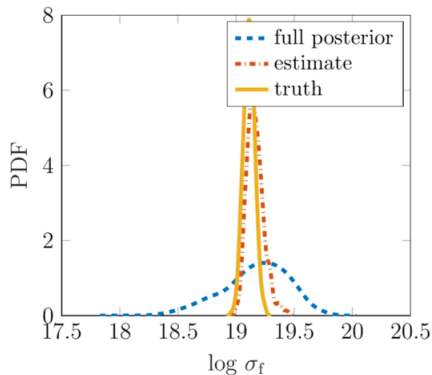
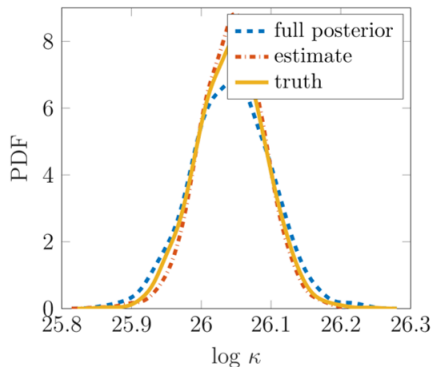
# Data informed learning on mesoscale

Nonlinear response: elasto-damage continuum model, bi-axial compression



# Data informed learning on mesoscale

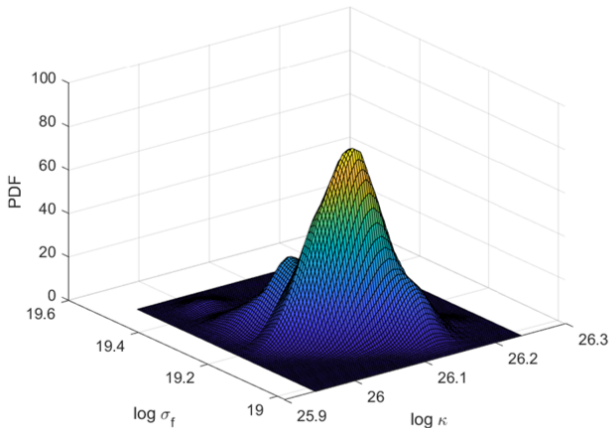
Nonlinear response: elasto-damage continuum model, bi-axial compression



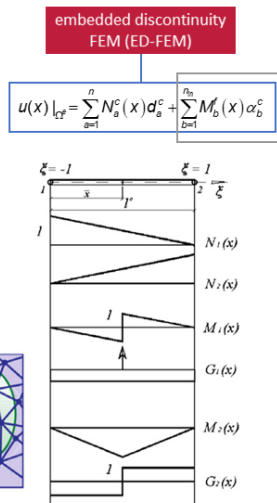
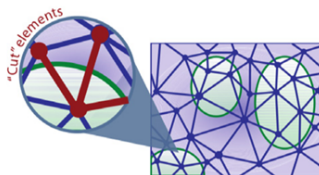
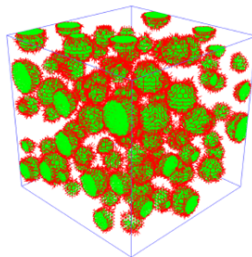
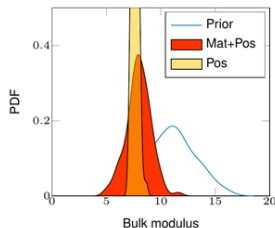


# Data informed learning on mesoscale

Nonlinear response: elasto-damage continuum model, bi-axial compression



# Data informed learning on mesoscale



Cooperation with University of Compeigne, France,  
iBMBF, TU Braunschweig

# Questions

