



Deep Learning for Damage and Load Identification in Structural Dynamics

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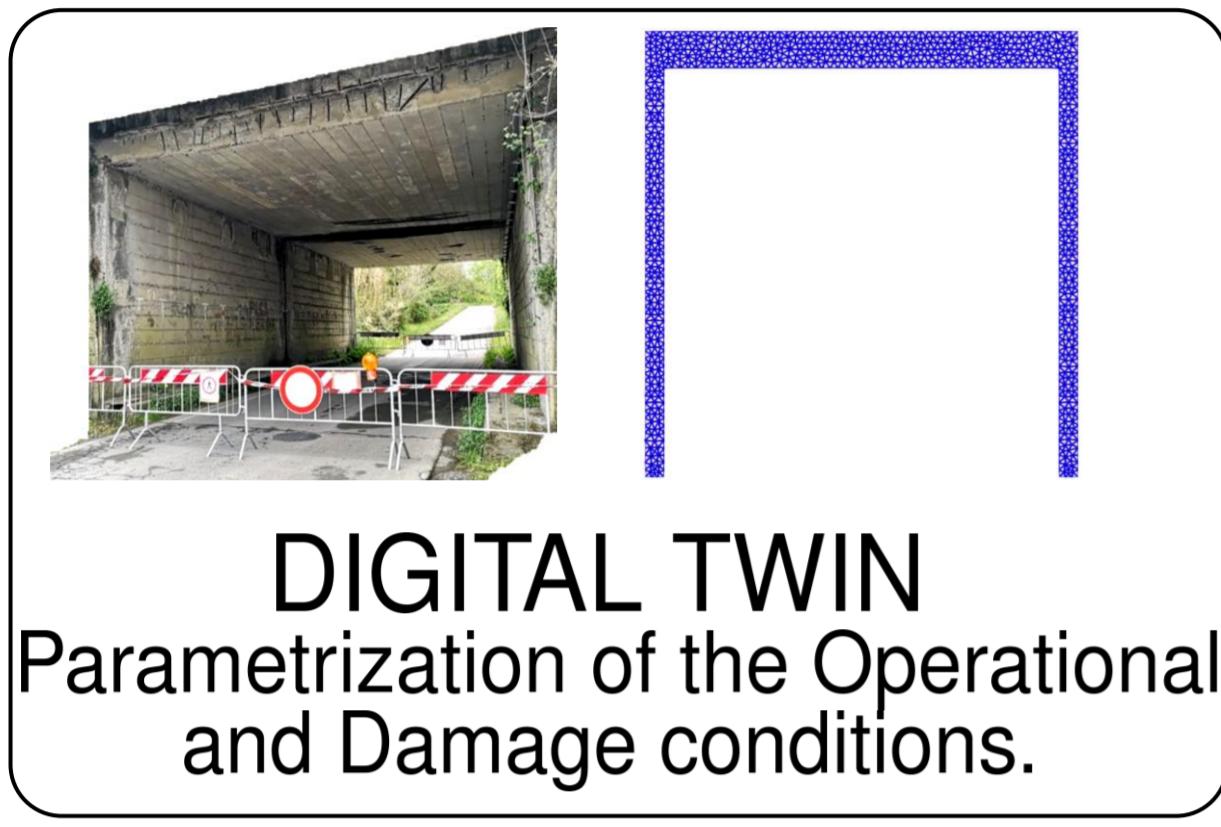
Structural Health Monitoring (SHM) aims to assess the damage state of structures.

Vibration-based SHM operates by analysing displacement and/or acceleration recordings shaped as Multivariate Time Series (MTS).

Damage identification consisting in detecting, locating and identifying damage.

Load Identification to improve the effectiveness of the SHM system (operational conditions affect the vibration response).

Methodology



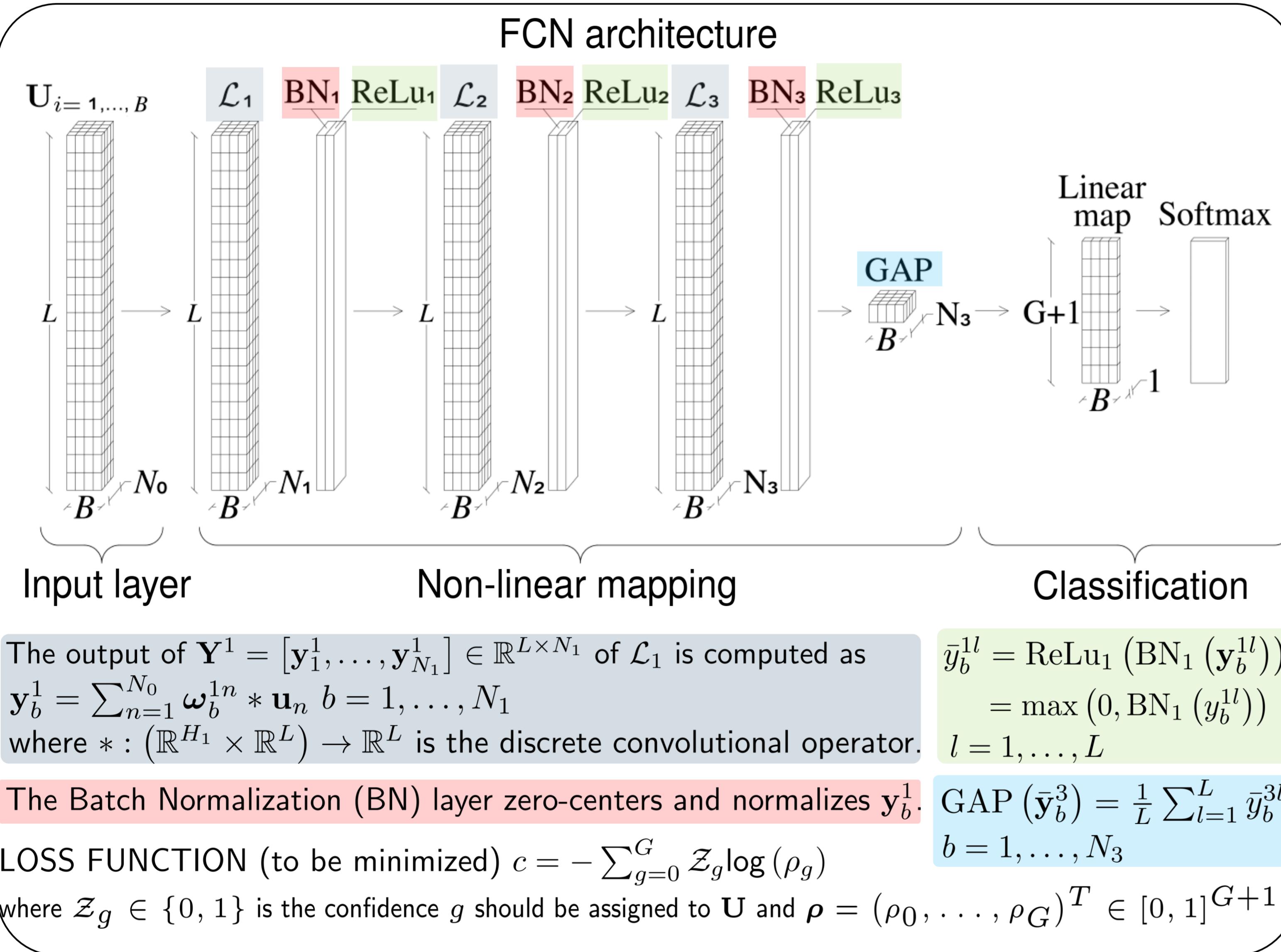
construct D
DATASET CONSTRUCTION

DEEP LEARNING DL
tune Neural Network (NN) weights ω for the minimization of a loss function $c(\omega)$.

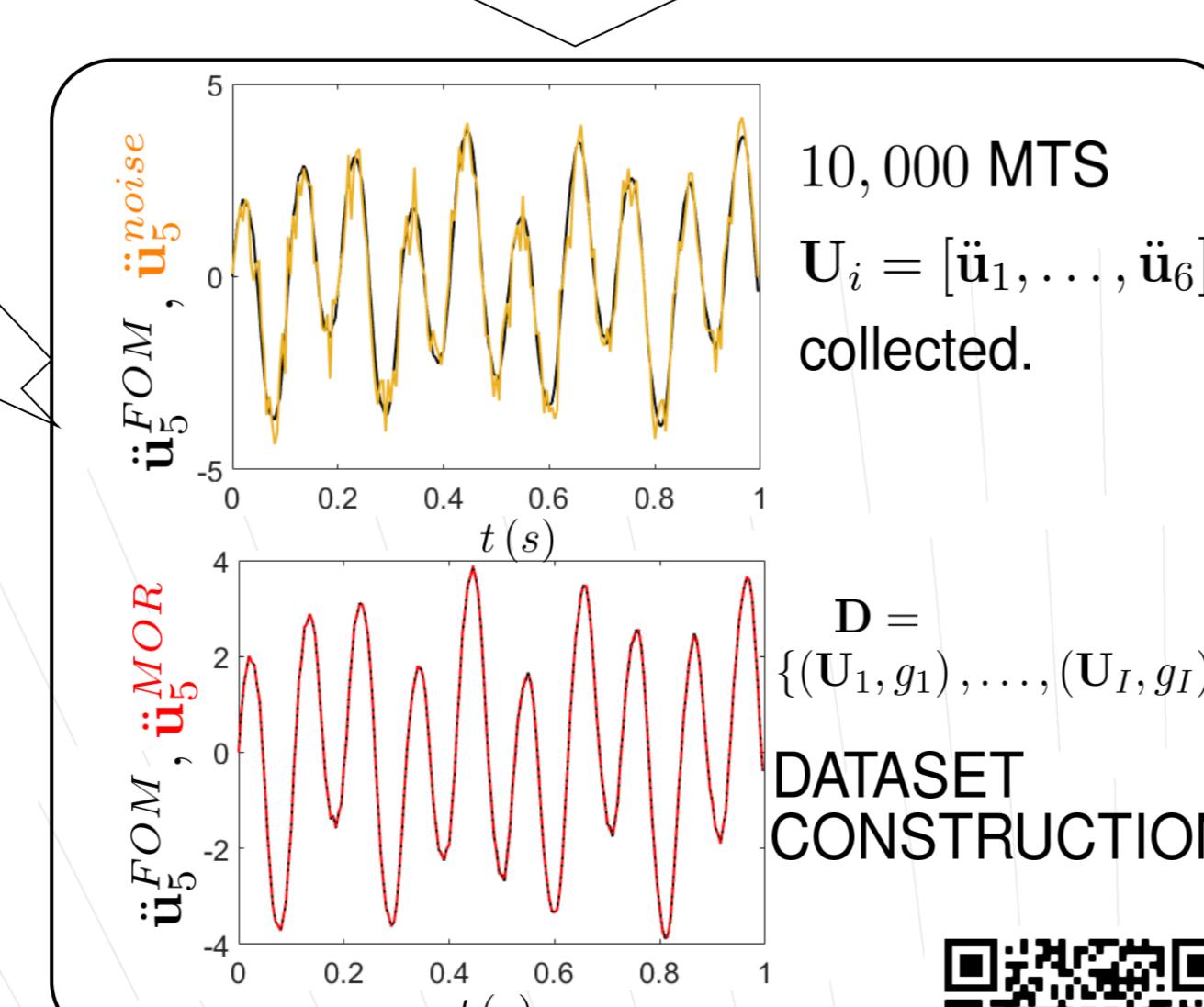
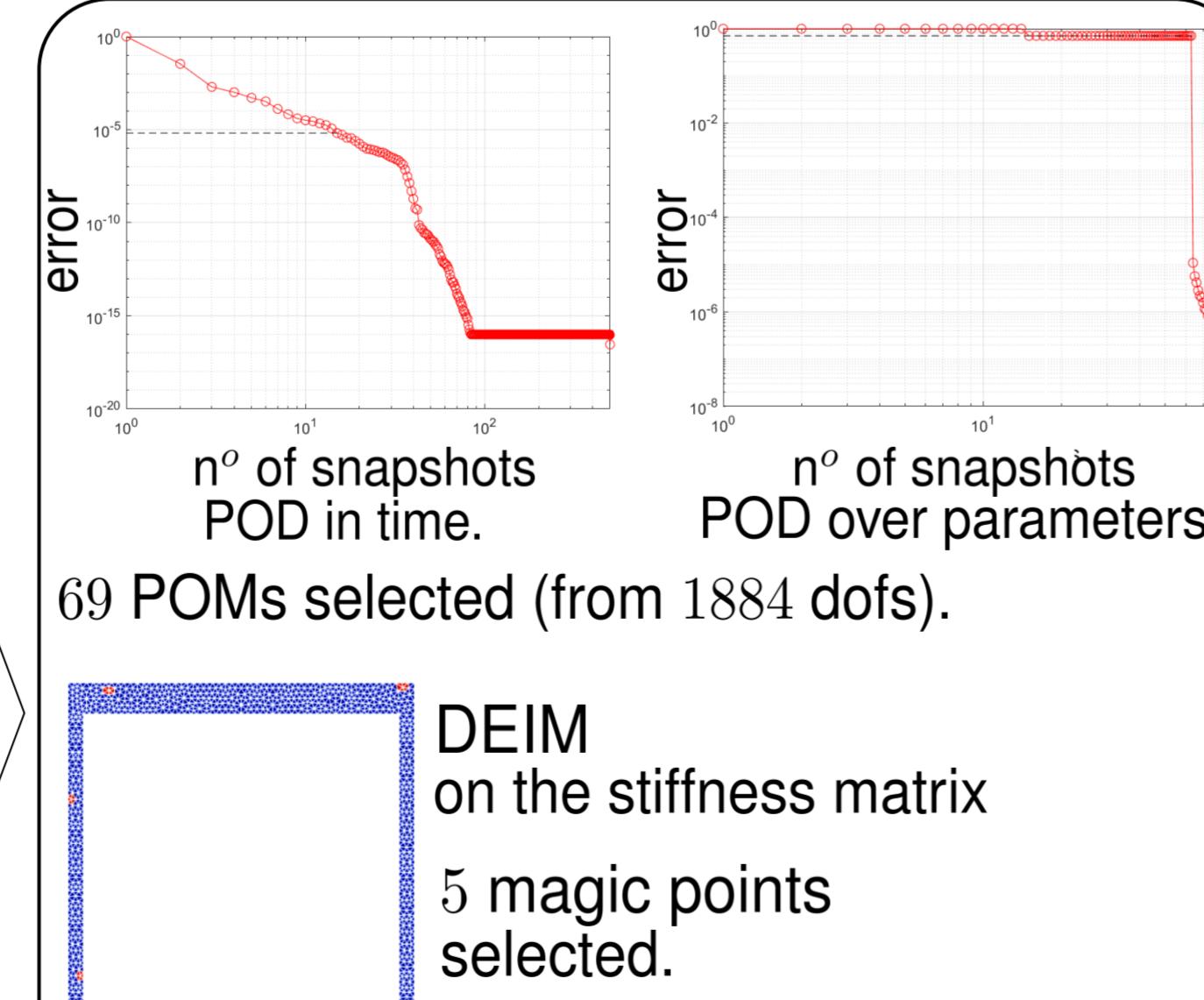
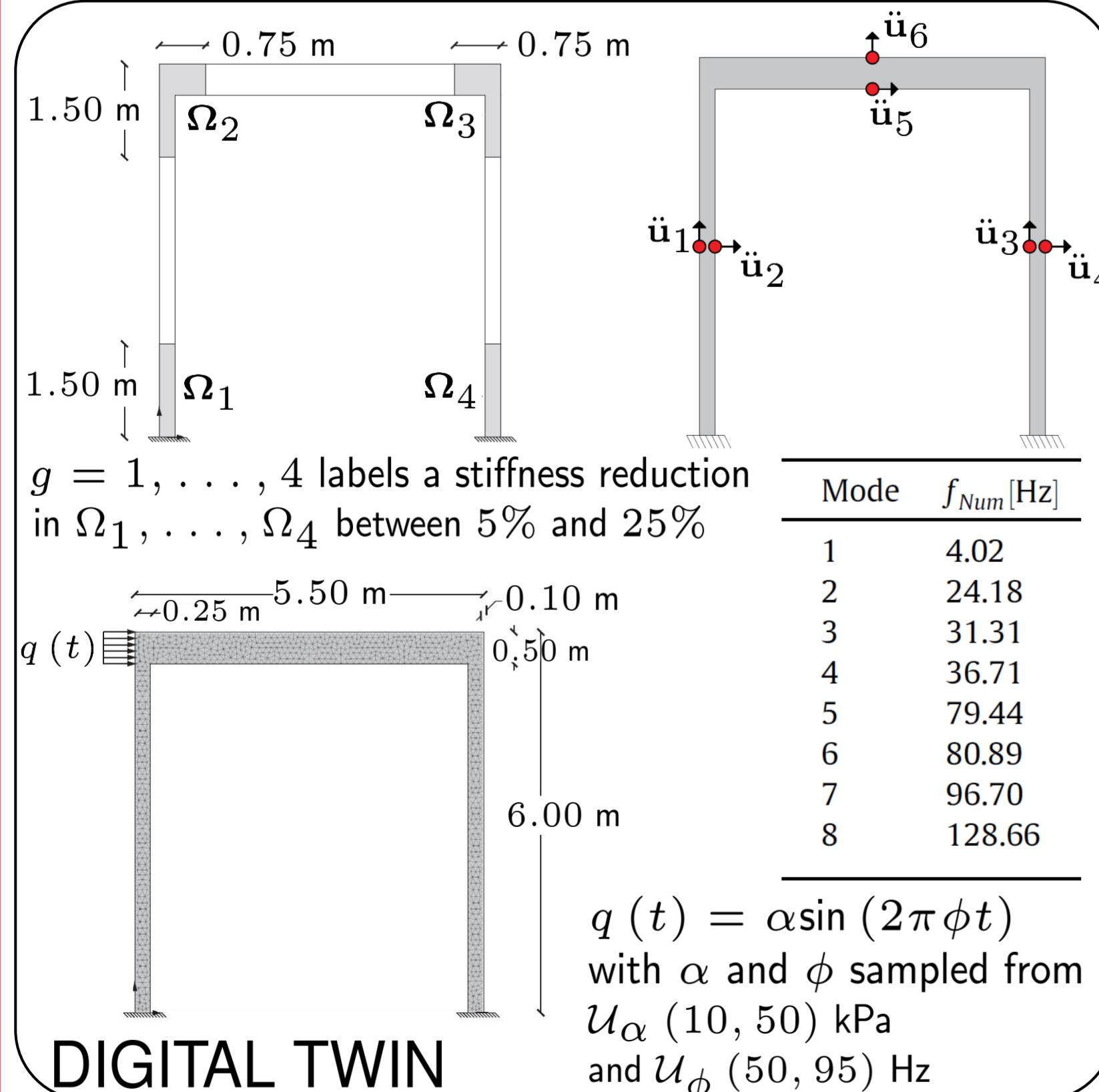
The response of a building in **damage conditions** is usually not available. Several **loading conditions** can be simulated.

Feature extraction and classification task are accomplished on the acquired MTS by using **Fully Convolutional Networks (FCN)**. Regression task is carried out on the reduced generative latent space determined by an **AutoEncoder (AE)** NN architecture.

DAMAGE IDENTIFICATION [1]



Numerical results



LOAD IDENTIFICATION [2]

load identification methodology detail.
Use of two NN:

- AE
- NN based regressor r

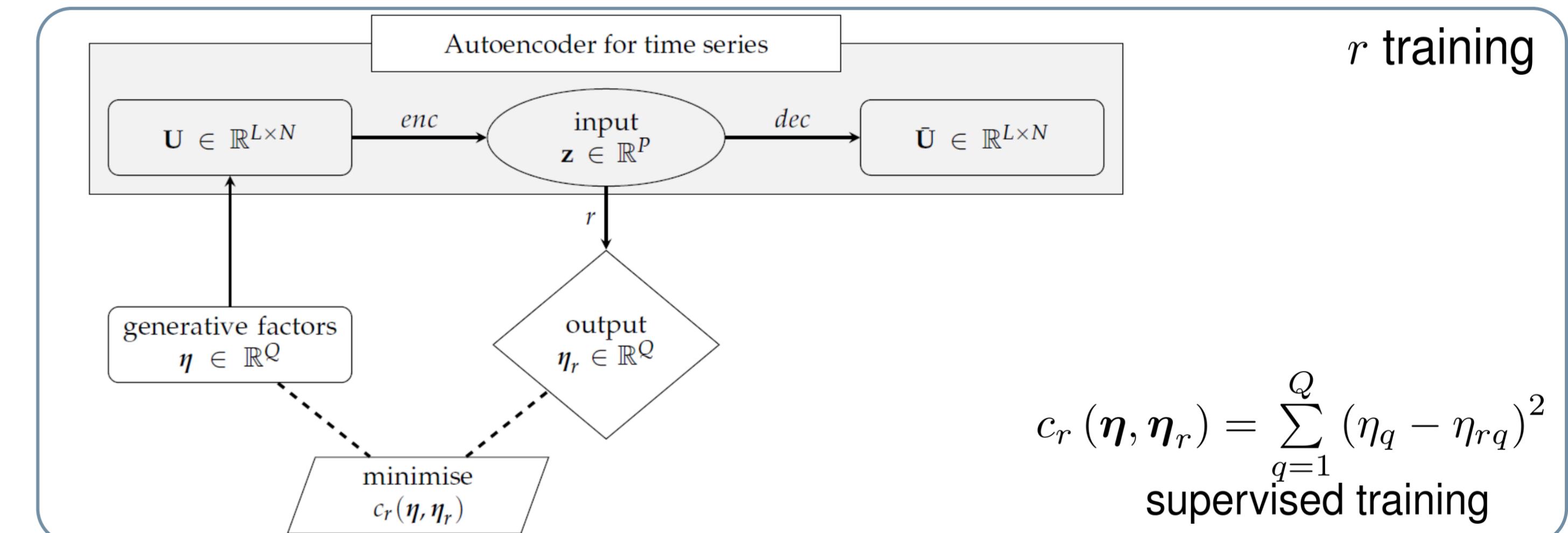
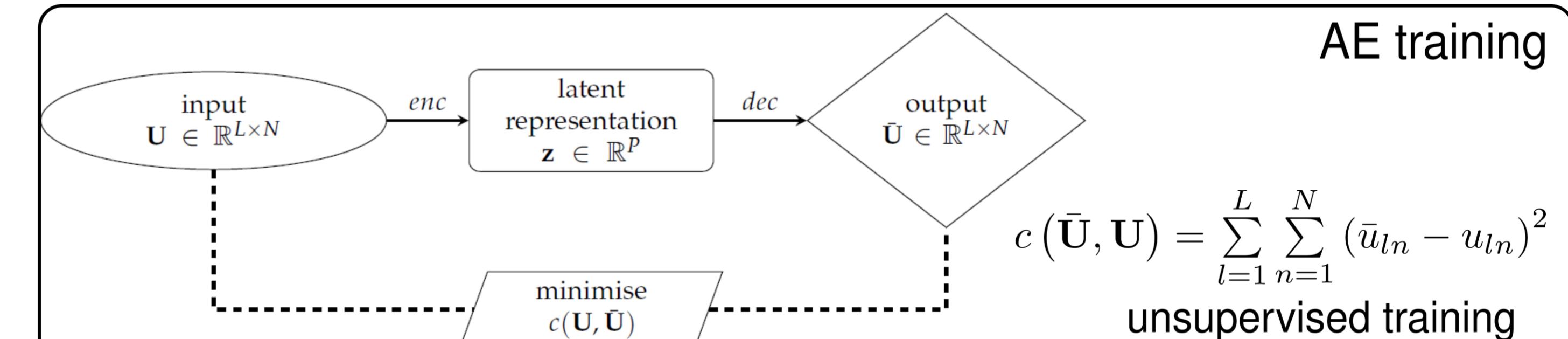
Goal:
• Train the AE $dec \circ enc$.
• Train the regression model r .

Required input:

- Dataset of vibration recordings \mathbf{U} .
- Corresponding parameters η describing the load.

Procedure steps:

- Set the optimal number P of latent variables of the AE.
- Train the AE.
Input: \mathbf{U} ; target output: \mathbf{U} .
- Train r .
Input: $enc(\mathbf{U})$; target output: η .



Numerical results

