

# How can a Digital Twin improve the monitoring of wind turbines?

## Structural Health Monitoring Illustrated by Wind Energy Projects

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### Digital Twin – Theoretical background

- Modeling with a direct connection to the real object via gathered data
- Usually classified by the degree of integration: *Digital Model, Digital Shadow, Digital Twin*
- Degree of integration refers to the data exchange between model and real system

### Measurement setup resulting from the finished MISTRALWIND project

- Due to the size of the system, a modular data acquisition system of 3 Data Acquisition Unit (DAU) is implemented
- Measured parameters: *3D-acceleration, velocity, temperature, strain*
- Data fusion with SCADA data to enhance the analysis possibilities
- On site data pre-processing: *Downsampling, Filtering, Synchronization*
- Determination of Eigenfrequencies in SS and FA direction
- Speed-dependent excitation frequencies of the rotor also emerge in the analysis

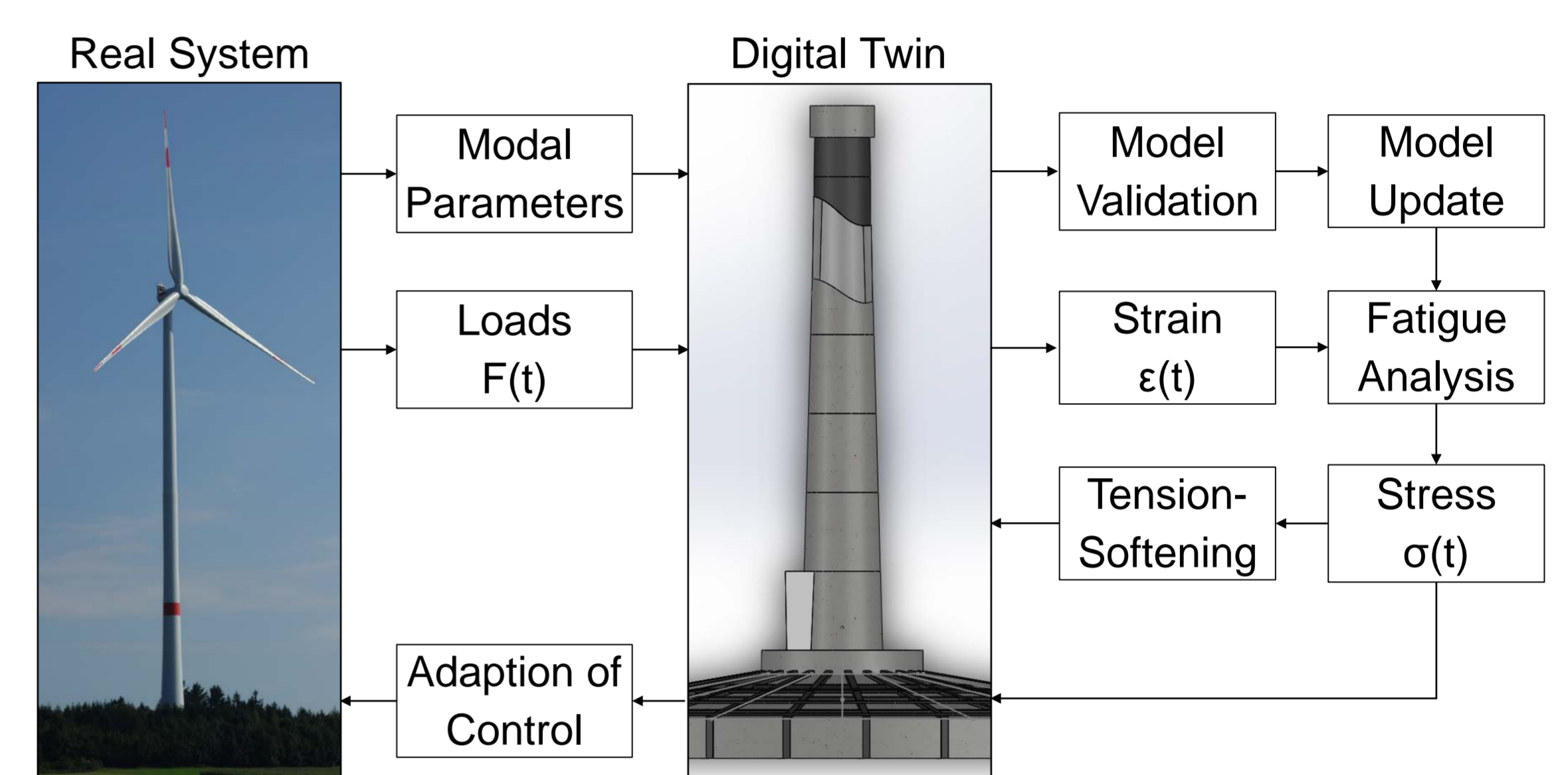


Figure 1: Schematic representation of a digital twin

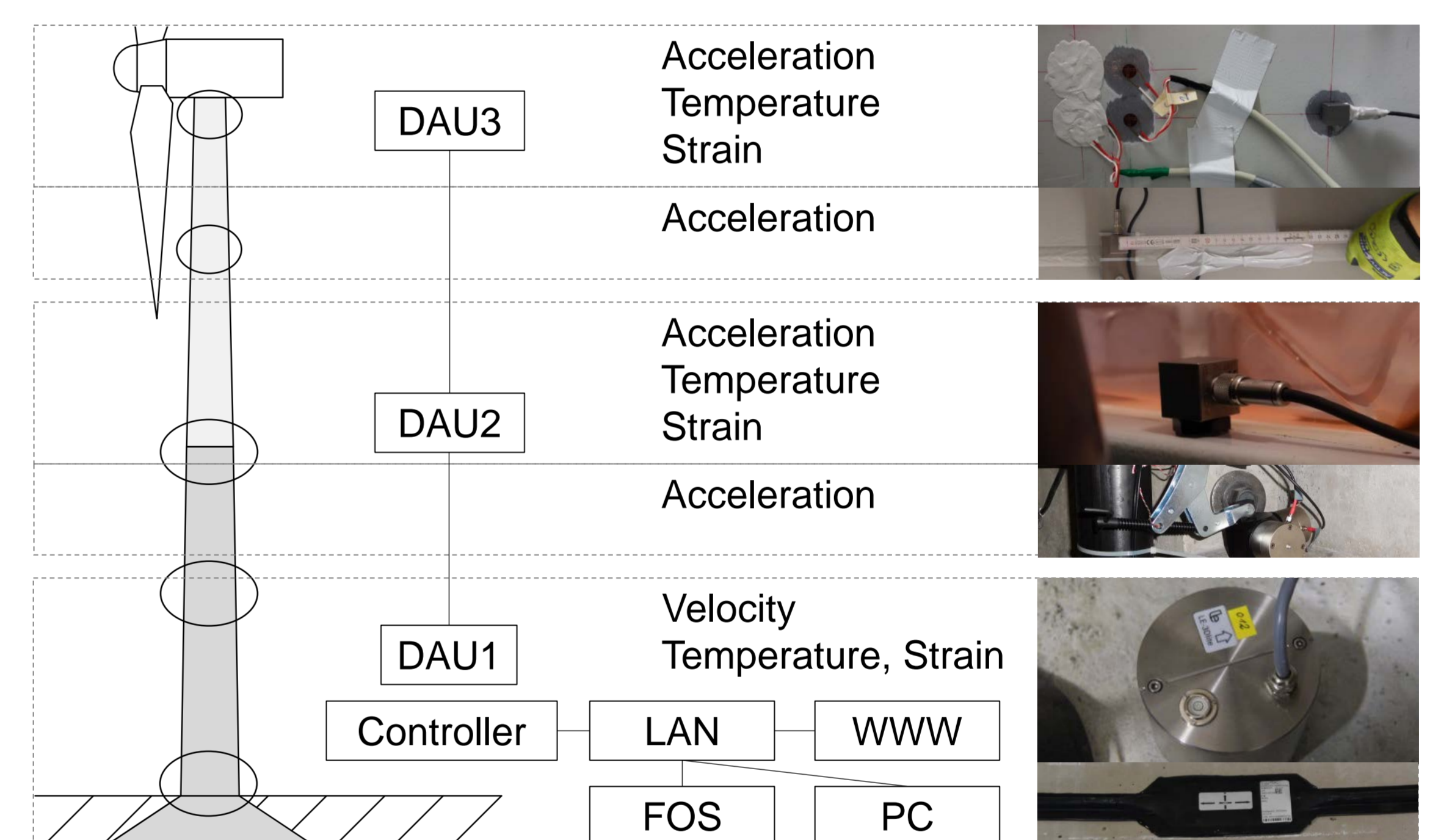


Figure 2: Measurement setup on a wind turbine in the MISTRALWIND project

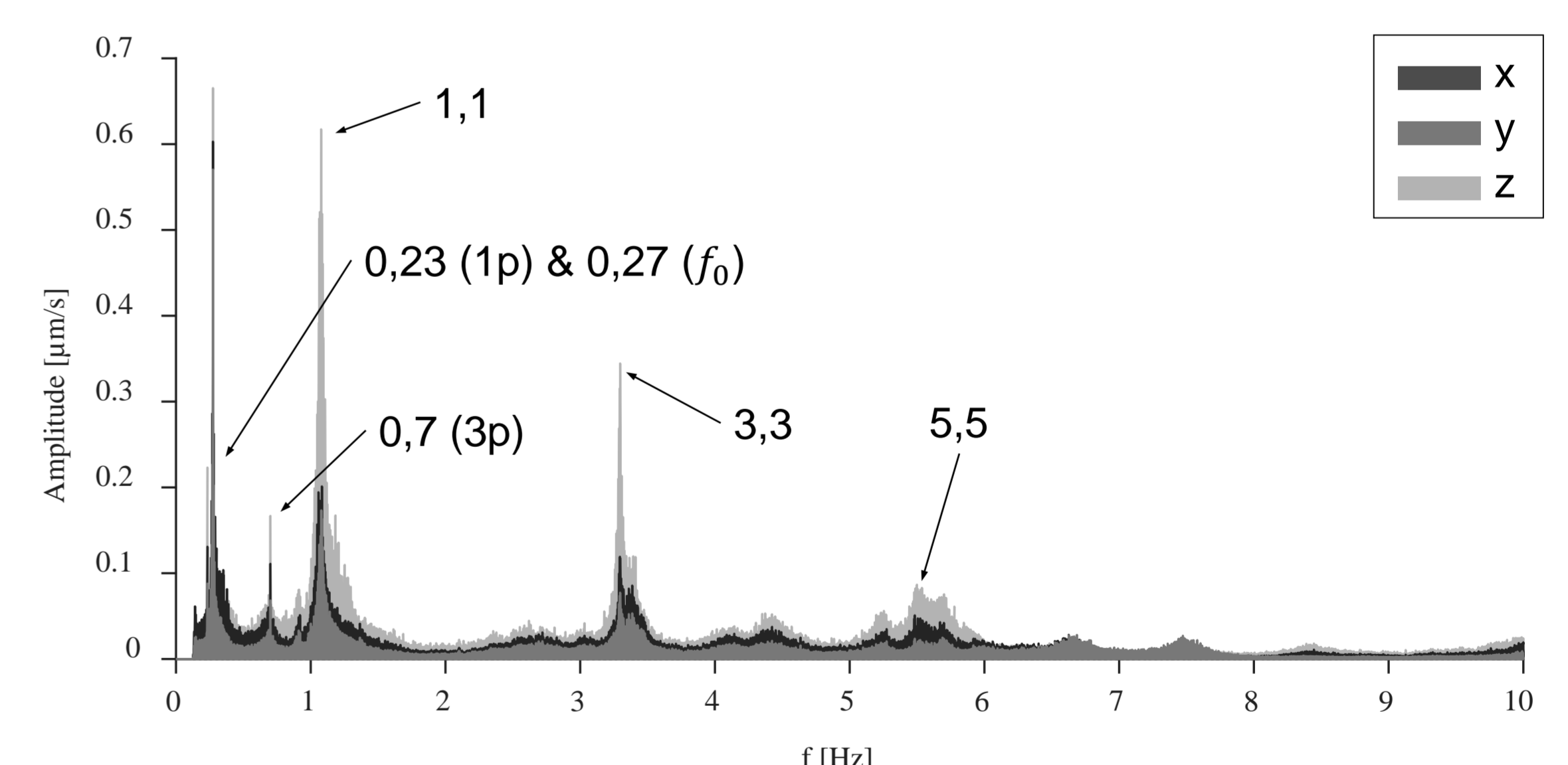


Figure 3: Evaluation of velocity-proportional seismometer data

### Development activities to be considered in the context of the ongoing IM WIND project

- Automated model update: *Representation of the real physical condition of the building*
- Damage detection: *Reduction of the inspection interval*
- Predictive Maintenance: *Avoiding downtime by forecasting failure*
- Real time movement: *Active controlling to avoid critical operating conditions*
- Remaining lifetime: *Estimation and extension beyond the designed lifetime of 20 years*
- Overall Equipment Effectiveness: *Increase of performance and availability*

