TECHNISCHE UNIVERSITÄT DRESDEN

AirMetro
Research Training Group
2947 at TU Dresden

T2: Smart-Grid Materials

Numerical Modelling of Structural Components based on Smart-Grid Materials

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Motivation

Modelling of integrated smart-grid materials has particular importance for:

- **risk minimisation** as a result of robust and effective location as well as of monitoring of AAM devices,
- ensuring **structural-mechanical requirements** when equipping with smart grid networks.

Holistic modeling at component and material level is essential for:

- the efficient use of existing component cross sections,
- reliable functional expansion of standard components.

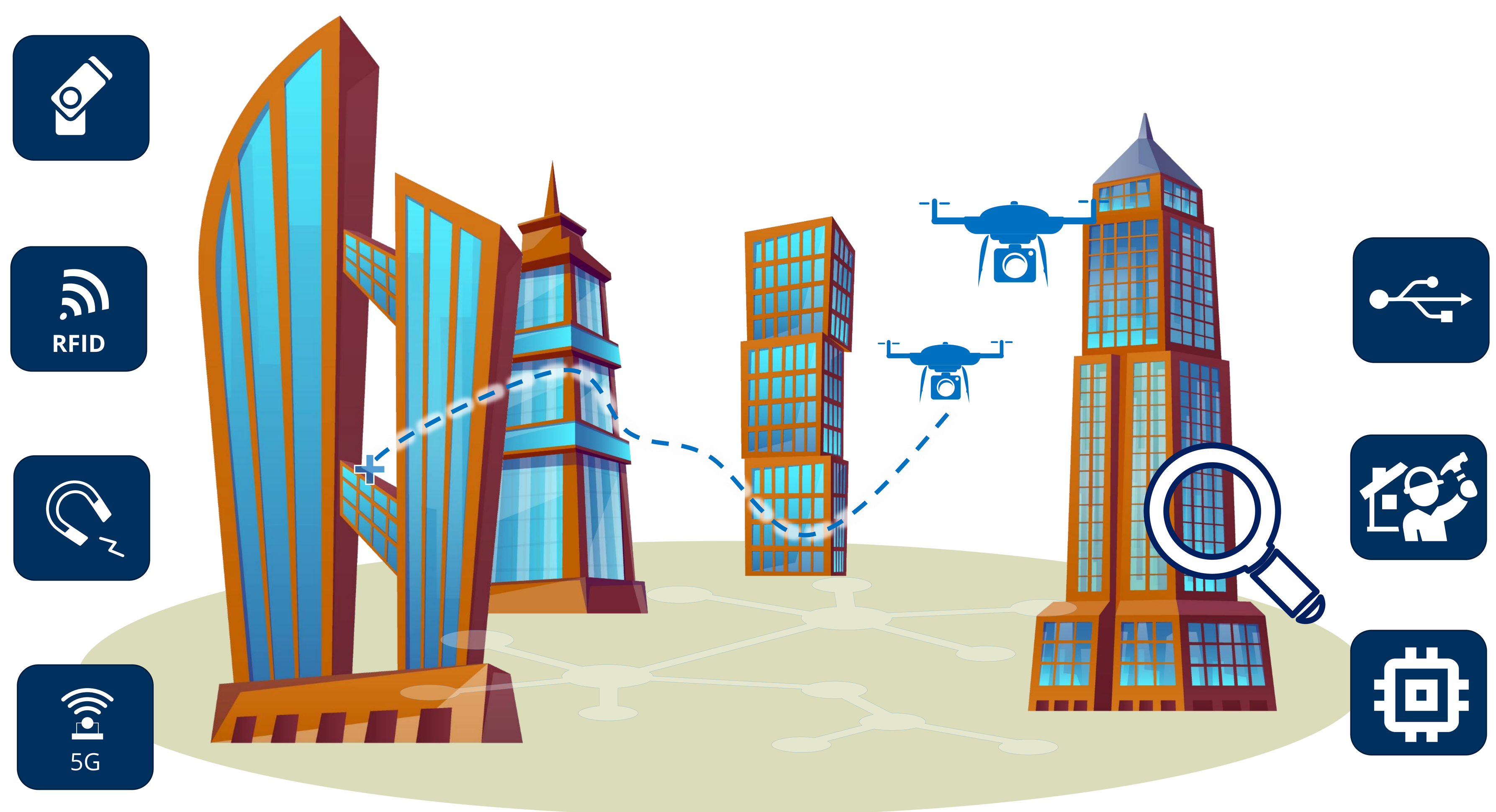

Figure 1: Active and passive interaction between AAM device and integrated smart grid

Methods

Modeling smart-grid building materials and components requires:

- integration of smart grid elements at component or material level,
- numerical analysis of the **smart grid functionality**,
- numerical calculation of the functional and load-bearing capacity using the **Finite Element Method** (electro-magneto-mechanically coupled analysis) and
- evaluation of the long-term characteristics under environmental influences using **time homogenization** [1].

Results

Multi-physical simulation model for smart grid integration enables:

- evaluation of the multifunctional component properties during integration at **component level** and at **material level**,
- assessment of long-term usability along different time scales and
- an example catalog for structural components with integrated basic elements of the smart grid.

Networking in the RTG

Numerical structural modeling contributes to networking with other research topics in the RTG by:

- provides a basis for the development of safe landing sites for AAM aircraft (T3),
- provides a basis for evaluating the optimal location of landing sites for AAM aircraft (T4),
- enables the necessary data redundancy for sensor fusion and robust movement trajectories (T5, T6) and
- active and passive digital landmarks for adaptive navigation (T8).

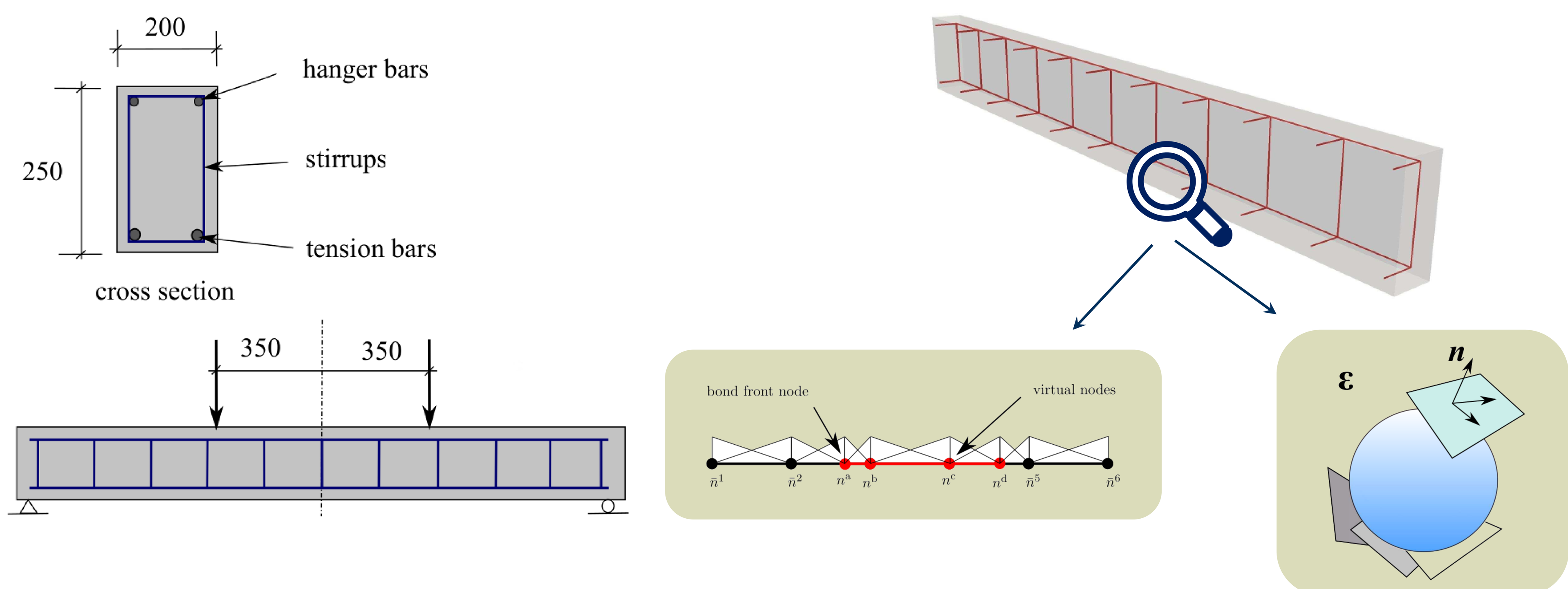

Figure 2: Holistic numerical component analysis using multi-scale models [2], [3]

Literature:

[1] Fricke, H.; S Schlosser, M.; Garcia, M. A.; Kaliske, M.: Embedding aircraft system modeling to ATM safety assessment techniques: The runway excursion safety case for runway strips with reduced strength. Transportation Research Interdisciplinary Perspectives, DOI: 10.1016/j.trip.2019.100026 (2019).

[2] Fleischhauer, R.; Thomas, T.; Kato, J.; Terada, K.; Kaliske, M.: Finite thermo-elastic decoupled two-scale analysis. International Journal for Numerical Methods in Engineering 121 (2020), 355–392

[3] Behnke, R.; Wollny, I.; Hartung, F.; Kaliske, M.: Thermo-mechanical finite element prediction of the structural long-term response of asphalt pavements subjected to periodic traffic load: Tire-pavement interaction and rutting. Computers & Structures. 218 (2019) 9-31.

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