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UNIVERSITÀ DEGLI STUDI DI
MODENA E REGGIO EMILIA

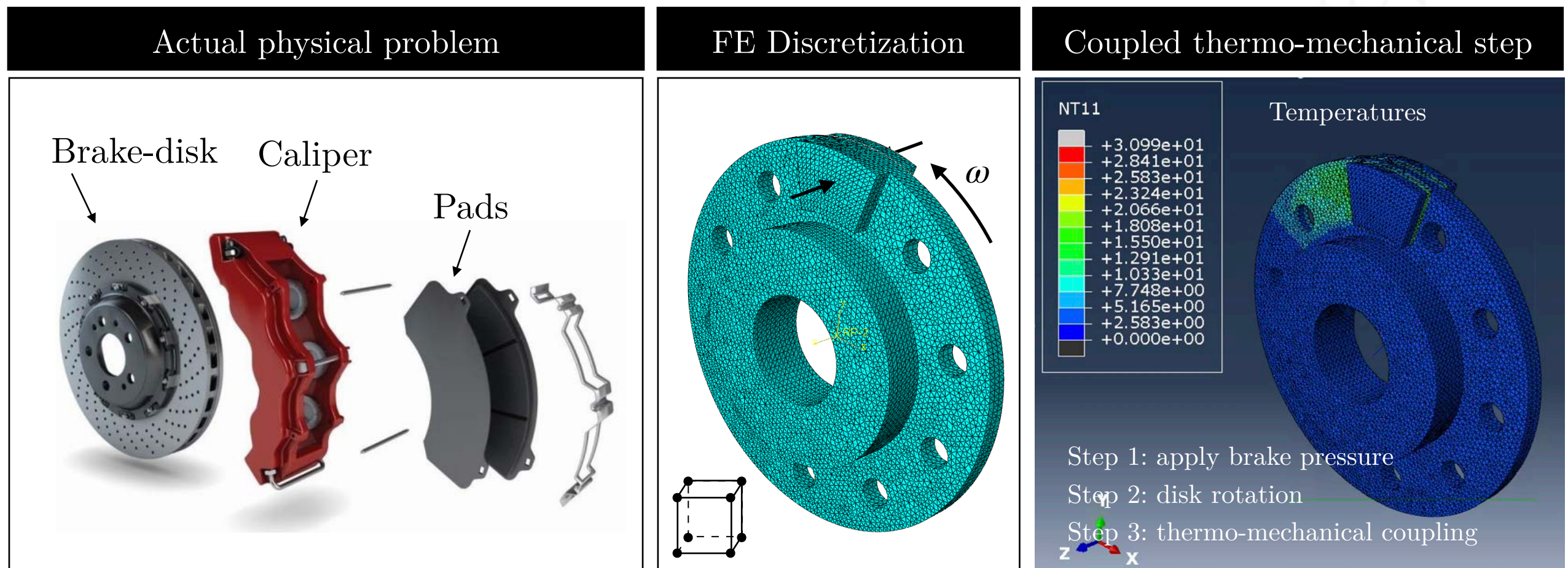
Digital multi-physics simulations for machine design | DAE-014

Master Degree in Digital Automation Engineering
Curriculum: Digital Design

Prof. Marco Alfano

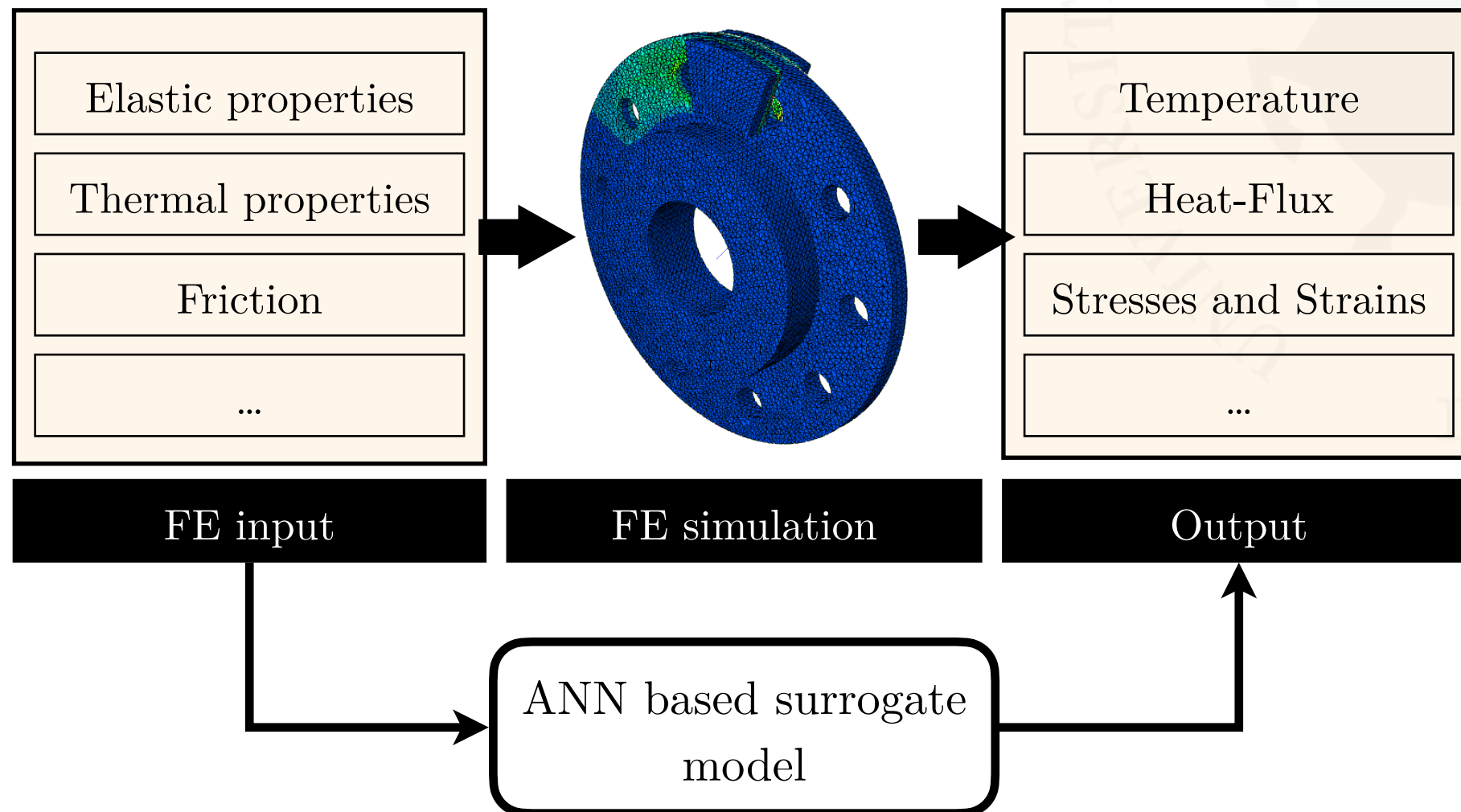
Digital multiphysics simulation for machine design

- ❖ A focused, application-driven course centered on finite element (FE) methods
- ❖ It builds a solid foundation in FEA
 - ➔ FEA enables predictive, data-driven design of smart and reliable systems.
 - ➔ It's a key technology for digital twins, simulation-based automation, and design optimization.
 - ➔ Emphasis is placed on thermo-mechanical coupling—one of the most relevant and illustrative forms of Multiphysics in machine design.



Where DAE-014 fits in your automation skillset

- **AI & Data Science:** FEA provides physics-based data for training and validation of optimized engineering models (e.g., digital twins). For example:



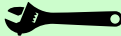

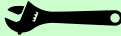

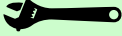

- **Multibody Simulation:** FEA complements system-level models with detailed stress, deformation, and modal behavior.
- **Robotics:** design of thermally and mechanically robust components.
- **Electric Drives:** coupled thermo-mechanical behavior in electromechanical components.

Course structure and contents

Duration: 54 hrs → 6 modules × 9 hrs

Format: \~40% theory + \60% labs with ABAQUS

Modules

- FEA Foundations (solid mechanics, weak form)
- Static structural analysis 
- Modal & dynamic simulation 
- Nonlinear modeling 
- Thermal & coupled problems  
- Automation, scripting & mini projects 

➡ No prior mechanics or FEA required — we build it up from the basics

Grading policy (subject to change, please [**click here**](#) for detailed info)

Home works: 3x mini-projects

Final Exam: blend of multiple-choice (5x) and short open-ended questions/problems (3x)



Thank you for your attention!

Want to know more? Contact me at marco.alfano@unimore.it