UNIVERSITÀ DI TRENTO | Dipartimento di Ingegneria Industriale

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ROOM A108, POLO FERRARI 1 - VIA SOMMARIVE 5, TRENTO

Each time the finite element method (FEM) is used to solve partial differential equations, computers follow a fixed sequence of operations—mainly assembling and solving linear systems—without drawing on previous experience. This means that regardless of how many similar problems a system has solved, it approaches each new one as if for the first time, leading to inefficiencies. In contrast, humans often reuse or adapt known analytical or numerical solutions to address new but related problems. Current FEM solvers lack this adaptive learning capability. However, recent progress in machine learning (ML) and dedicated hardware presents an opportunity to revolutionize this process. ML can enable computers to learn from previously solved FEM problems, allowing them to generalize knowledge and accelerate future simulations. This approach holds particular promise for nonlinear problems—such as elastic-plastic stress analysis near notches—where solutions are computationally expensive and the problem domain is well-parameterized. These problems often involve iterative procedures and are highly sensitive to boundary conditions, making them ideal candidates for ML acceleration. This seminar will introduce the basics of ML and demonstrate how state-of-the-art methods can be integrated into the FEM framework, with an emphasis on structural applications, to enhance computational efficiency and mimic human-like reasoning in numerical problem-solving.

Speaker: Ing. Tommaso Grossi
University of Pisa, Italy

Learning from past simulations: AI meets finite element analyses

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