ALPEN-ADRIA UNIVERSITÄT KLAGENFURT

Invitation to the Doctoral Seminar

Dr. Fabian Key
Technische Universität Wien

"Novel Approaches to Structural Design Optimization Using Quantum Annealing"

N.1.12 | Wednesday, 11 March 2026 | 12:00 p.m.

Abstract

Structural design optimization is a representative mixed-variable engineering problem: it blends discrete design decisions (e.g., topology, member selection, cross-section catalogs) with continuous physical state variables (e.g., displacements, stresses). The combinatorial nature introduced by the discrete design decisions motivates the use of so-called Ising machines, including quantum annealing (QA), as specialized optimizers for discrete models. At the same time, accurately handling continuous state variables alongside discrete choices remains a challenge, as these solvers operate natively on binary variables. Still, addressing both aspects jointly is crucial; a tightly coupled design–analysis treatment offers the potential to reach global optima across the combined discrete–continuous space. To this end, our approach builds a single objective by coupling energy-minimization-based analysis with design variables, yielding an overall minimization problem that can be expressed as a quadratic unconstrained binary optimization (QUBO) model. We validate the approach on current hardware using a small-scale benchmark (size optimization of a 1D rod), introduce an adaptive number representation for continuous variables that improves accuracy

within a fixed binary budget, and extend the formulation to 2D settings via a spline-based stress-function approach.

Barbara Kaltenbacher and the Department of Mathematics look forward to seeing you at the talk!