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DESIGN BEYOND OPTIMIZATION: WHY, WHAT IF, AND HOW MUCH?

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MINISYMPOSIUM

Computational Mechanics methods have created an impressive amount of techniques for finding optimal solutions to design problems, usually in the form of geometric structures. Designs are driven by the fundamental physics of the system, such as heat or electricity conductance, aero- or hydrodynamics, elasticity, self-assembly, chemical reactions, or photonic and phononic dynamics. Computationally, design problems are frequently addressed in a nested fashion: the inner loop solves the physical dynamics within a design and computes the objective function, while the outer loop modifies the design parameters to optimize the objective function subject to limited resources. Mathematically, this approach informs what kind of solution is optimal, but does that optimum address the original design problem?

In this minisymposium we invite contributions that study optimal design of any physical system and ask a broader set of design questions on the boundary of mathematical optimization. Why do particular features, or design rules, become a recurrent motif in solving a family of similar design problems? What if the directly optimized objective function is a poor proxy for the desired design outcome? How much does one need to modify the mathematically "optimal" design to manufacture it? How does the "optimal" solution evolve as the resource budget is continuously adjusted? How does the space of considered design solutions evolve during the design process? How many similar or distinct solutions reach the same value of the objective function? These questions often cannot be addressed within the nested loop of design optimization and instead lie on the boundary between mathematical formalism and qualitative questions.