# Redundancy distribution in elastostatic beam and surface structures

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## ABSTRACT

The degree of statical indeterminacy is a fundamental property in structural mechanics of discrete truss and beam structures, exploitable in analysis and design. While further specifications, like e.g. subdivision into an internal and external part or determination w.r.t. special load directions, are well-established, the property is today mainly understood as an integral property of an entire structure (or entire substructures), without quantified information about its distribution in space and w.r.t. load-carrying types.

The redundancy matrix, introduced in [1, 2] and extended in [3], provides information about the distribution of statical indeterminacy in discrete truss and beam structures. This gives an additional valuable insight into the load-carrying behavior. In [3] also the redundancy distribution for one-dimensional continua is introduced and computed analogously to the redundancy matrix in discrete truss structures. A generalization of the redundancy concept to spatially continuous, linear, elastostatic representations of structures is given in [4]. The quantification of redundancy distribution considering geometrically non-linear behavior is approached in [2, 5]. These works are limited to discrete representations of truss structures with prestressing.

We present an extension of the concept of redundancy to beam and surface structures using a finite element framework. We also discuss ideas on how to consider geometrically non-linear behavior. There are numerous applications like e.g. robust design of structures, quantification of imperfection sensitivity, evaluation of adaptability, assessment of actuator placement as well as optimal control in adaptive structures.

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