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OPTIMAL PLACEMENT OF ACTUATORS BASED ON LOAD CARRYING BEHAVIOR

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Summary: The use of adaptive elements in civil engineering can enable large savings in terms of material and energy. Taking advantage of non-constant physical properties the maximum forces for various load cases can be reduced and less material is required to carry the same loads. Adaptive structures can be advantageous to account for extreme load cases or for moving loads straining different parts of a structure. The key idea of this presentation is the development of a method for optimal placement of actuators based an mechanical insight into the load carrying behavior of structures.

First of all insight into the load carrying behavior helps to design structures that are well suited for effective adaptation. Without specifying the positions of the actuators the space of adaptability can be determined on the basis of simple structural analyses. The eigen modes of this vector space directly indicate in which parts of the structure and to what extent forces can be influenced by adaption.

It is desirable to achieve an optimal reduction of forces for a large number of load cases with a minimum number of actuators. So the actuators need to be placed carefully. Based on the space of adaptability and the redundancy of the structure, favorable positions for the actuators can be found without application of complex and time consuming optimization algorithms.

For selected two-dimensional examples the reduction of the maximum forces will be compared to the reduction possible for an optimal actuator placement found by complete enumeration.