Actuator Placement for Static Disturbance Compensation in Adaptive Structures

Florian Geiger*, Jan Gade*, Julia Wagner[a], Michael Böhm[a], Malte von Scheven*, Oliver Sawodny[a], Manfred Bischoff*

* University of Stuttgart, Institute for Structural Mechanics
Pfaffenwaldring 7, 70550 Stuttgart, Germany
{geiger,gade,mvs,bischoff}@ibb.uni-stuttgart.de

[a] University of Stuttgart, Institute for System Dynamics
Waldburgstr. 17/19, 70563 Stuttgart, Germany

Abstract

In recent years, the development of adaptive structures for civil engineering purposes has been pushed forward. The Collaborative Research Center SFB1244 at the University of Stuttgart is addressing this topic since the beginning of 2017. Adaptive structures use sensors, actuators, and control to react to external influences. The use of actuation energy instead of adding material to the structure promises major advantages in terms of material and energy saving.

In this contribution, the compensation of static disturbances due to wind, snow, etc. is addressed. The idea is to manipulate internal forces or compensate occurring deformations in the structure, in order to achieve a more efficient load-bearing behavior. The performance of adaption significantly depends on the location of the actuators. We present a method for optimal actuator placement regarding static actuation using a Gramian-based cost function, see [1]. Furthermore, we use the redundancy distribution, which was first presented by Ströbel [2], as a measure to benchmark and to understand the results of the actuator layout with regard to the statical indeterminacy in the structure. The method is demonstrated by means of a numerical model of an adaptive structure.

References

[1] J. Wagner, J. Gade, M. Heidingsfeld, F. Geiger, M. von Scheven, M. Böhm, M.Bischoff, O. Sawodny, On steady-state disturbance compensability for actuator placement in adaptive structures, *at - Automatisierungstechnik*, 66(8), pp. 591-603, 2018, doi:10.1515/auto-2017-0099.

[2] D. Ströbel, Die Anwendung der Ausgleichungsrechnung auf elastomechanische Systeme, Dissertation, Universität Stuttgart, Stuttgart, 1995.