XI International Conference on Textile Composites and Inflatable Structures – STRUCTURAL MEMBRANES 2023

Computational sensitivity analysis of hybrid lightweight structures

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ABSTRACT

Sensitivity analysis can be used to investigate the effects of varied input variables (e.g., Young's modulus) on the variation of output quantities (e.g., stress) of structural models. Hybrid lightweight structures consist of elastic elements like beams and tensile elements as membranes or cables. To aim of this contribution is the application of computational sensitivity analysis approaches as the adjoint method [1] on hybrid lightweight structures. In that regard we face two main challenges. First, the material and cross-sectional properties of the elastic elements influence the form-found shape. Hence, the impact of those variables during the form-finding process has to be considered in sensitivity analysis. Second, hybrid lightweight structures cannot be analyzed in a single stage analysis. Instead, a sequenced simulation process which typically consists of form-finding and subsequent structural analyses is required. For this reason, computation results need to be transferred from one analysis to another one [2] which must also be considered in sensitivity analysis. In our contribution, we discuss both challenges and show the required modifications to the sensitivity equations. Furthermore, we evaluate the additional computational effort and demonstrate the application on exemplary structures.

Keywords: Sensitivity analysis, hybrid lightweight structures, form-finding, sequenced simulation process.

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