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# MECHANICS OF STRUCTURE GENOME BASED ON THE CARRERA UNIFIED FORMULATION

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This work presents a novel approach to deal with the multiscale analysis of composite structures. The Carrera Unified Formulation (CUF) is used to solve the governing equations of the Mechanics of Structure Genome (MSG) for periodically heterogeneous materials. The MSG, developed by Yu [1], provides a tool to obtain the complete effective stiffness matrix in a straightforward manner without relying on ad-hoc assumptions and with no need of multiple loadings. This method is based on the concept of the Structure Genome (SG), defined as the smallest mathematical building block of the structure, and the use of the Variational Asymptotic Method (VAM) to minimize the loss of information between the original heterogeneus cell and the equivalent homogeneus body. The constitutive information extracted from the homogenization of the SG can be then re-utilized to recover the local solutions at any particular point of the structure. Three-dimensional SGs can be analyzed by means of refined beam models based on the CUF, see Fig. 1. Hierarchical high-order 1D models, introduced by Carrera et al. [2], are generated by using Legendre-based polynomials to expand the unknown variables over the plane normal to the fiber. Due to this approach, the size of the problem is drastically reduced and the accuracy of the micro-scale analysis is controlled by the polynomial order of the beam theory, avoiding iterative refinements of the mesh. The results obtained with the present model are assessed by comparison with already established multiscale software tools.

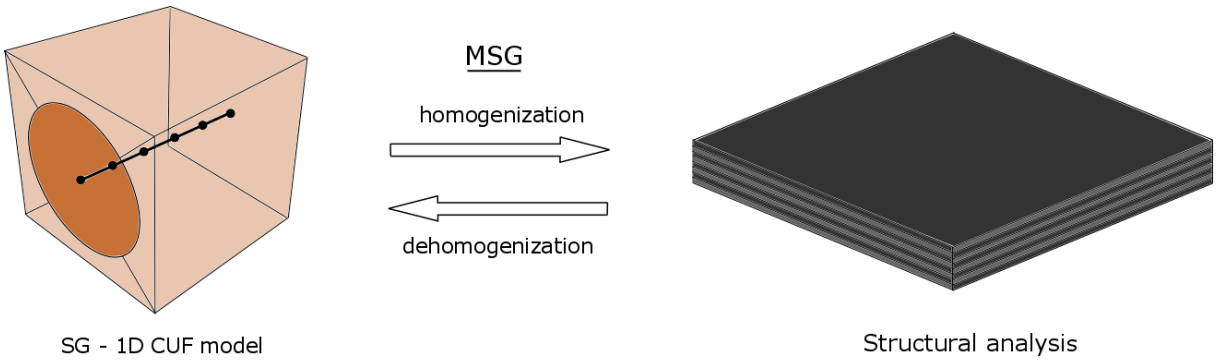


Figure 1. Multiscale analysis of composite structures based on MSG-CUF modeling.

## References

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[2] E. Carrera, A.G. de Miguel, A. Pagani (2017) Hierarchical theories of structures based on Legendre polynomial expansions with finite element applications. *International Journal of Mechanical Sciences*, **120**, 286-300.