15th World Congress on Computational Mechanics (WCCM-XV)
8th Asian Pacific Congress on Computational Mechanics (APCOM-VIII)
31 July–5 August 2022, Yokohama, Japan

Reduced Order Modeling for modular anisotropic Structures based on Proper Orthogonal Decomposition and Mesh Tying

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Key Words: Proper Orthogonal Decomposition, Mesh Tying, Anisotropy, Interpolation

A model order reduction technique in combination with mesh tying is used to efficiently simulate a large number of different structures that are assembled from a set of substructures. The stiffness matrices of the substructures are computed separately and assembled into a global stiffness matrix with tied contact formulation. The computational time can be further decreased by reducing the degrees of freedom of each substructure with a projection-based model order reduction technique. The precomputations to obtain the mode matrices are computationally cheap because they can be carried out on each substructure separately. For the development and optimization of new construction strategies for fiber reinforced concrete, a large number of different combinations of the modules have to be tested. The nonlinear anisotropic material behavior, like the primary directions of orthotropic materials [1], leads to parameter-dependent mode matrices. The precomputations can only be done for a relatively small number of parameters. For all other parameters, the mode matrices have to be adapted with interpolation methods to obtain an accurate solution [2].

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