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COMPARISON OF MULTISCALE METHODS FOR MODELING PERFORATED PLATE IN COMPUTATIONAL STRUCTURAL MECHANICS

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Abstract.

Riveted assembly areas play a crucial role in the resistance of mechanical structures subjected to shocks and impacts, particularly in the aeronautical sector. A numerical simulation analysis of the generated physical phenomena necessitates precise modeling of both the entire structure and the assembly zone. Despite advancements in computing power, simulations of this nature remain complex due to the need for highly refined modeling in assembly areas, which generates a stable time step that is often incompatible with the numerical simulation of an aeronautical structure. To address this challenge, an approach based on modeling assembly zones using plate hybrid-Trefftz displacement (HT-D) elements was therefore considered. Such elements have demonstrated significant effectiveness in the linear elastic domain only. Consequently, this research aims to develop an analogous approach to address materially and geometrically non-linear problems. Different multi-scale methods (such as Transformation Field Analysis - TFA), model reduction (Proper Orthogonal Decomposition) or machine learning (Neural Wetworks) are therefore considered to meet this need. The TFA approach is firstly considered for its capability to localize fields. However, a limitation of the TFA method is that it relies on a very fine discretization of the Representative Elementary Volume (REV) to obtain reliable results, which leads to a rapid increase in computational costs. To overcome this issue, a mixed approach combining the TFA method with the Mori-Tanaka theory is proposed. Some preliminary results indicate that the Mori-Tanaka method can significantly reduce the computational costs while maintaining the accuracy when compared to the TFA approach. The purpose of this poster is to evaluate the effectiveness of the proposed method in comparison to existing methods (HT-D and TFA methods).