GM BoltStudio: A Suite of Extensions to Abaqus/CAE for Simulating Bolted Assemblies at General Motors

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Abstract: General Motors, in conjunction with SIMULIA Great Lakes, have developed a studio of Abaqus/CAE plug-ins designed to increase the efficiency of their analysts in the definition of their model assemblies. These plug-in are written to bridge the gaps and to enhance the usability of native tools in Abaqus/CAE specifically for bolt joint assembly simulation. The main advantage of the plug-in studio is improved efficiency, both in terms of time saving and modeling accuracy/consistency. Secondary benefits include the ability to enable less experienced users leverage the complex modeling methods encapsulated by each plug-in. This paper presents a few of the developed plug-ins, describing for each the process captured. One of these tools, the 'bolt library' is available to the wider Abaqus user community.

Keywords: Bolt Loading, Scripting, Customization.

1. Introduction

Robust and efficient bolt joint design is critical to vehicle structural integrity and performance. At General Motors, CAE analysis plays an important part in guiding the design and evaluating the performance, applied not only to isolated joints, but also to vehicle subsystems with detailed modeling and bolt-preloading incorporated at the key joints. To consolidate and integrate a number of bolt joint analysis tools/practices from its CAE organizations into a single modeling/simulation environment, General Motors and SIMULIA cooperated in developing a tool suite, named GM BoltStudio, as plug-in in Abaqus/CAE for simulation by Abaqus/Standard. The objectives are to: i) streamline the workflow for best practice and productivity; ii) push these types of analysis upstream in the design process as "standard work" to be performed by less-experienced users; iii) lay a solid basis in terms of modeling quality and consistency for more advanced reliability synthesis.

Abaqus/CAE provides general capability of pre/post-processing Abaqus models. For its application to bolt joint analysis in General Motors, Abaqus/CAE still has some functional gaps (for example, lack of direct interface for UG import), and a number of its native tools are somewhat labor-intensive or not intuitive to use. Nevertheless, GM chose Abaqus/CAE as the basis to consolidate the CAE bolt assembly simulation workflow mainly for the following reasons: