

# Modelling and Analysis of Welding Processes in Abaqus using the Virtual Fabrication Technology (VFT) Analysis Software developed by Battelle and Caterpillar Inc

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**Abstract:** *The ability to accurately model welding processes in order to predict residual stresses and distortions is becoming increasingly important in the engineering industry. Abaqus can be used to model the welding process but this has been found to be considerably time consuming and requires a large number of assumptions to be made. Virtual Fabrication Technology is an analysis software suite that is designed to allow Abaqus to accurately model complex welding procedures. It was developed by the Battelle Memorial Institute in conjunction with Caterpillar Incorporated in the USA. The software is centred on a Graphical User Interface that is used to assign welding paths, parameters and material properties to FE models that have been imported from Abaqus/CAE. A closed form analytical thermal solver (CTSP) and advanced user material subroutine (UMAT35) are also included in the package. The final structural analysis of the welded component is carried out using Abaqus/Standard. This paper presents the results of an extensive evaluation of the VFT software package conducted by Rolls-Royce Marine. This was carried out in order to ascertain the capabilities of this software and to determine how it improves on the weld modelling methods currently available using Abaqus stand-alone. This evaluation has shown that VFT significantly enhances the ability of Abaqus to model welding procedures while providing significant savings in both the user and computer time required. A large benefit is seen in the further integration of this software into the Abaqus/CAE package.*

**Keywords:** *Assembly Deformation, Design Optimization, Experimental Verification, Forming, Heat Transfer Optimization, Post processing, Residual Stress, Seam Welding, Thermal Stress, Third-Party Software, Visualization, Welding.*

## 1. Introduction

There is currently a large market for Finite Element (FE) software designed specifically for modelling welding procedures. This is mainly due to the increased interest in welding residual stress and distortion that has occurred over the past decade. Most of the new welding simulation software packages currently available are designed to act as stand alone packages. Many engineering companies though require a welding simulation solver that works and interacts with their current FEA software. This allows their current analysts to work with the new software