

Advanced simulation of 3D glass bottle forming with Abaqus/CAE, Abaqus/Standard and Abaqus/Explicit

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Abstract: Production of glass bottles requires blowing of the glass after entrance of a gob of molten glass in the blank mould. The final shape of the bottle is highly dependent on the viscosity of the glass, the blow-pressure and the temperature distribution in the glass and the mould and simulation of this complicated process enables optimization of the process conditions. During simulation of blowing of the glass, the mesh has to be adapted due to the extreme deformations of the mesh. Using the existing ALE-technique for this kind of applications requires a lot of user-intervention and trial-and-error to create a mesh that suits both the initial and final topology of the glass. To reduce the user-time and to be able to run this kind of analyses automatically based on an arbitrary base-geometry, a completely automated remeshing/rezoning procedure is set-up. In this procedure the A/Explicit analysis is divided in a number of sub-analyses after each of which a new (3D) geometry of the glass is created based on the deformed mesh (using ABAQUS/CAE). Using a map-routine the solution from the previous analysis is mapped on the new mesh such that continuation of results is ensured. Using the automated remeshing capability, simulations of the glass bottle forming process have successfully been performed, enabling for example optimization of process settings. Due to the generic set-up of the remeshing procedure it can easily be used for other simulations that require adaptive meshing as well.

Keywords: Coupled Analysis, Glass Forming, Remeshing, Scripting, Viscoelasticity, Visualization.

1. Introduction

Current container glass manufacturing is mainly driven by experience and craftsmanship rather than scientific knowledge. There is a lack of understanding of the complex glass forming process as well as of the application of (scientific) knowledge and tools. Troubleshooting at the design and production stages is based on experience and new container designs are introduced by trial and