

Visualization of Complex Mechanical Models

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Visualization has long been an important tool to understand complex scientific data. An unexplored application of 3-D visualization at Los Alamos National Laboratory (LANL) has been the design, manufacture, and assembly of complex mechanical models. These models are typically designed, manufactured, assembled, and tested by a large number of people, often in different locations. Allowing these groups to interact with an unbuilt, virtual model has the potential to transform the way the DOE complex operates.

Pro-Engineer (Pro-E), the DOE's Nuclear Weapons Complex production mechanical design package, and EnSight, the LANL production visualization tool, do not share a common data format, so translation is required to produce visualizations. Typically, this is done by hand in Pro-E for each part; a prohibitively time-consuming and error-prone process for models with hundreds of parts. Because the models were undergoing continual revision, and

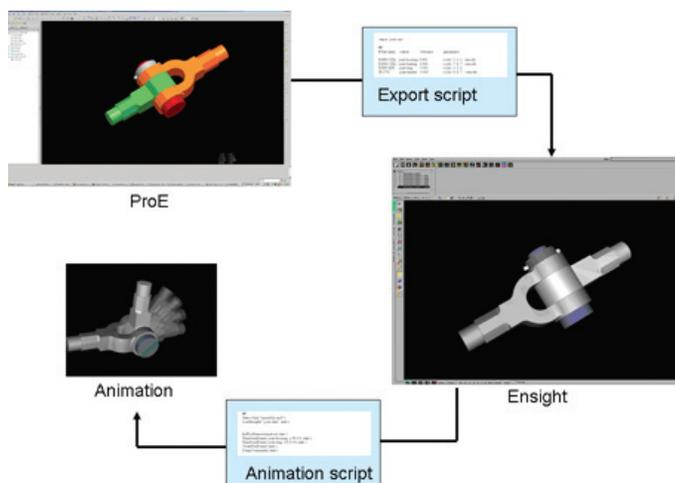
frequent retranslation was required, an automated method for translation was critical.

We accomplished this by using built-in hooks in the Pro-E user interface that allow the integration of user-written code. As shown in Fig. 1, the input to the tool is a text file that specifies the output EnSight file, the parts to be translated, translation tolerance, and display attributes. Once the model is loaded into Pro-E, the translation code is executed, producing files that can be read in to EnSight for visualization. Using this automated sequence, we reduced the time to prepare a large model for visualization from 7-8 hours to about 5 minutes.

Another key component to this project was the creation of animations that illustrated most significant aspects of the models, including assembly, disassembly, and the functioning of subcomponents.

Creating an animation that effectively conveys the intended information can be tedious and difficult with currently available tools. We developed a set of utilities with the Python scripting language that facilitates experimentation and exploration of the animation space. As illustrated in Fig. 1, once a suitable animation is completed, the utilities are capable of generating movies for a variety of output formats

Fig. 1. Data translation from the modeling tool Pro-E to the visualization tool EnSight is accomplished using an export specification script that defines the parts to be exported and their appearance. The animation script defines how the parts are moved to create the desired animation.



from audio-visual interface format (avi) to high definition, stereo, PowerWall theater, and immersive CAVE movies.

We used these tools in numerous presentations related to the Reliable Replacement Warhead (RRW) project to help illustrate key aspects of complex models, including at several meetings with assembly plant engineers where 1:1 scale models were explored and design alternatives discussed to facilitate manufacturing and assembly processes. Additionally, we analyzed assembly and disassembly animations using the actual plant tooling components inside the immersive CAVE (see Fig. 2). These tools proved to be a valuable component for the RRW project in the exploration and validation of complex models.

For more information contact David Pugmire at pugmire@lanl.gov.

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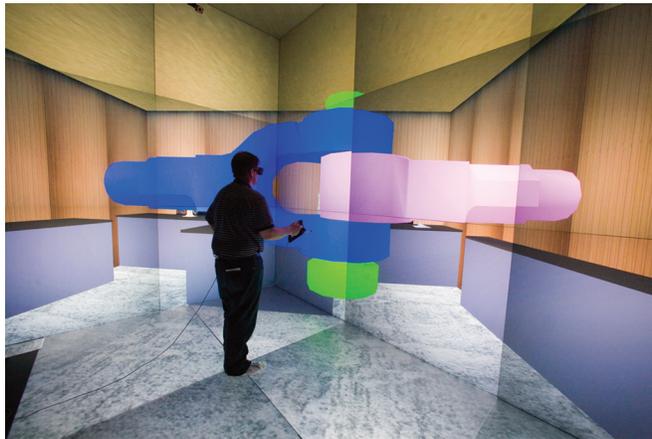


Fig. 2.

A user interactively assembling a mechanical joint inside a virtual environment in the CAVE. The glasses and hand-held wand are motion tracked to allow free movement of objects within the virtual world. This capability allows designers to test and validate design options, create and verify safety plans and provide training experience for workers.

Photo by L. Sanchez