Pick-n-Place: A Virtual Reality Assembly Tool

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Visualization has long been an important tool for the understanding of complex data. The creation of a 3-D visual representation enables the highly developed human visual system to detect, among other things, trends, correlations, anomalies, and unexpected events in the data. Over the past several years, Los Alamos National Laboratory has invested in providing state-of-the-art facilities and software tools to help scientists in the Advanced Simulation and Computing (ASC) program understand and explore their data. One such facility, the LANL CAVE, driven by a Linux cluster and equipped with an optical motion tracking system, is shown in Fig. 1.

An unexplored application of these capabilities has been the design, manufacture, and assembly of complex mechanical models. These models are developed and studied by a large number of people, often in different locations. Allowing these parties to interact with an unbuilt, virtual model has the potential to tremendously transform the way the Department of Energy (DOE) complex operates. Further, performing virtual analysis on complex models before they are built, where conflicts, alternative approaches, and optimizations can be identified early on, can yield enormous savings in both cost and time. Our recent work with the Reliable Replacement Warhead (RRW) project provided an opportunity to develop and test these techniques.

As shown in Fig. 2, Pick-n-Place is a virtual reality assembly and disassembly application developed by David Pugmire using CAVELib [1], an industry-standard virtual reality platform. The application is able to read and display CAD models as well as texture-mapped polygonal models to provide realistic environments, such as

Fig. 1.
The CAVE is a five-surface (left, front, right walls with floor and ceiling) display with 33 projectors lighting 43 million pixels in a 15 x 12 x 10-ft display area, and researcers can work in a 3-D environment.

an assembly bay. Assembly constraints can also be given to specify how parts are able to be mated. Collision detection [3] is used to determine interpenetration of parts, and the stereo sound system is used to play a thud sound when parts collide. The application communicates with the motion tracking system through the Trackd [2] interface. Entering the CAVE, the user can visually inspect the components of the assembly, grab them, and try to assemble them. If parts do not fit together or are obstructing one another, both visual and auditory cues are used.

This tool proved valuable while exploring various design alternatives with personnel at DOE plants and LANL designers to integrate safety studies with plans for their assembly and disassembly procedures.

[1] CAVELib, www.vrco.com/CAVELib/OverviewCAVELib.html
[2] Trackd, http://www.vrco.com/trackd/Overviewtrackd.html
[3] T. Hudson, et al., "V-COLLIDE: Accelerated Collision Detection for VRML," Proceedings of VRML 97 (1997).

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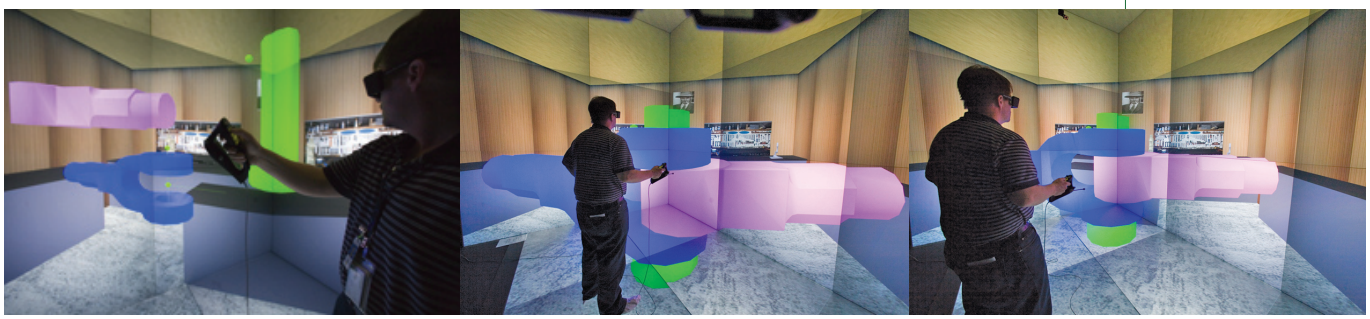

Fig. 2.
A sequence of photos in the CAVE demonstrates how the Pick-n-Place virtual reality tool can be used to assemble and analyze mechanical components.

Photos by L. Sanchez