

## Modeling With Feeling

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A few years ago, the graphics community was wowed by the introduction of a unique interface called the Phantom that let users "feel," via force-feedback technology, the 3D digital objects they were looking at on screen. The product set the minds of artists, designers, and scientists reeling as they conceived lists of potential applications for the technology. The subsequent development of a software developer's kit (SDK) called Ghost, brought some of the potential applications closer to fruition. However, it's the latest product from SensAble Technologies--the company that brought the Phantom and Ghost SDK to market--that is expected to have the greatest impact on the graphics industry. Called FreeForm, the system provides the hands-on, "digital-clay" technology that animators and industrial designers in particular have been clamoring for.

FreeForm integrates a new digital-modeling metaphor with the Phantom's patented 3D Touch capability to let users create and explore form intuitively in 3D. The product is intended to supplant the last non-digital holdout in both content-creation and product-development applications: physical conceptual models. In both the engineering and entertainment domains, designers and surface modelers still rely heavily on physical models during the conceptualization process. Using amorphous clay or blue foam, sculptors create forms and shapes that are difficult to represent via math-based models. The physical models are then digitized and brought into CAD or surface-modeling software for further development. By replacing this physical-modeling component with a digital process, FreeForm eliminates the need for scanning, and the potential inaccuracies associated with the physical-to-digital conversion. Intended to complement rather than replace downstream modeling tools, FreeForm files can be exported to commercial-surfacing or CAD software for refinement.

The FreeForm interface is a stylus that serves as a handle for a sculpting tool that can be custom-developed or selected from an existing library of tools. Modelers can either use the tools to carve and smooth digital clay or to wire-cut 2D shape profiles from digital blue foam. The interface and modeling processes are intended to be highly intuitive to sculptors and modelers. "[With FreeForm], our traditionally trained sculptors are able to easily parlay their skills into the digital realm," says Derald Hunt of Klieser Walczak Construction Co., an animation production studio and FreeForm beta site that historically has relied heavily on physical sculptures to achieve organic human forms. "Our sculptors are trained to create plasticene sculptures, from which we then cast models for digitizing," says Hunt. "We've taken those same people and put them in front of FreeForm, and they're very comfortable. They can knead the model, mold it, and add to it--just as they would with their traditional tools. Then the models can go straight into another animation package. We can skip the time-consuming digital conversion." It is, he believes, a product that has the potential to "revolutionize" digital-production processes.

In addition to virtually carving clay and cutting foam, FreeForm provides features that are exclusive to digital media. Among these are six levels of undo, which give users the freedom to experiment with shapes without having to re-create the entire model at each wrong turn; a mirroring tool, which can cut the production time of laterally symmetrical models in half; and copy/paste functionality to speed the modeling of redundant components (spikes on a golf shoe, or ridges on a tire). FreeForm also lets users control such factors as clay hardness and friction. The product is particularly suited to the creation of highly stylized or organic objects, which are notoriously difficult to represent in CAD. Users can import a CAD model into FreeForm, then carve the detailed or tiny features absent from the base model. Users are also able to sculpt a model from behind, or from the inside out. In designing the eyebrow of a character, for instance, modelers typically add clay to the area, then carve it back to the eyebrow shape. With FreeForm, users can go inside the model and push out the eyebrow shape.

Because FreeForm is software-independent, any CAD or surface model that can be exported as an STL file can be imported into the system for manipulation. To export FreeForm models into CAD or surface-modeling software, users either can get a set of 2D slices from the 3D model and export the slices as IGES curves, which can then be rebuilt as a parametric surface in the CAD software, or they can output an STL file for import into an animation program. Additionally, the FreeForm polygonal meshes can be imported into one of the new third-party tools on the market that translates polygonal data into NURBS surfaces.

FreeForm, priced at \$15,000 for the haptic interface and modeling software, runs on Windows NT 4.0 and requires a dual-processor 300mhz Pentium II system with 512mb of RAM and at least 70mb of available hard-disk space. (Cambridge, MA; 617-621-0150; [www.sensable.com](http://www.sensable.com))

*Computer Graphics World* August, 1999