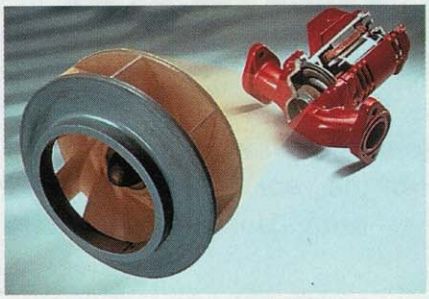
Technology Today

Alan Pierce

Rapid Prototyping & Manufacturing

In the movie *Small Soldiers*, the body for each toy warrior was produced by a shower of laser light that solidified liquid plastic into each toy's final form. The storyline called for toys that were on the cutting edge of technology, and Steven Spielberg wasn't going to disappoint his viewers. Therefore, each toy was given an artificial intelligence computer chip, a miniature speech synthesizer, a lifelong battery, and a body that was solidified from liquid plastic by a series of laser beams.



Photos courtesy of 3D Systems

In this month's column, we will look at the laser beam method of manufacturing shown in the movie. Without the Hollywood special effects, Rapid Prototyping (RP) and Rapid Manufacturing (RM) lack some of the movie glitz. However, the dramatic effect that Spielberg's Dreamworks created for the movie actually exists as a prototyping and manufacturing process.

In 1988, a California company named 3-D Systems Inc. introduced a machine that could convert computer drawings directly into plastic models. This technology today makes it possible for designers to move beyond a screen image and actually hold their future product designs in their hands. The photographs accompanying this column show some of the objects that 3-D Systems has made by this process for other manufacturing companies. The process was used by NASA to create the *Sojourner* Martian landscape for simulated testing of the vehicle, and it has also been used to create parts for stress testing in the actual environments the parts were designed for.

The software part of this modeling and manufacturing process slices Computer Aided Drawing into thousands of very thin layers. In the process that most resembles the Dreamworks movie sequence, the thin layers are then built into an object from the bottom up.

First, a laser projects the outline of the outer boundary of the bottom layer onto the surface of a vat of special photosensitive resin. With the first pass, the laser solidifies the outer shape directly out of the photosensitive material on the surface of the vat. The laser then moves in to solidify all the solid areas in that layer. The solidified layer is now pulled slightly below the surface of the photosensitive resin so that the laser can build the object's next slice right on top of the first.

If you have already seen the movie, the sequence described above should bring back memories. In a sense you are watching the process run backwards at warp speed.

At the cutting edge of this technology, some of our national laboratories are using 1,000 watt YAG lasers to go directly from a CAD drawing to the final product. These objects are made of powdered tool steel, titanium, tungsten, or other high-tech powders. The parts themselves have been subjected to operating temperatures as high as 2,400°. One thing about this process is that you don't have to think small. In the future, such companies as Lockheed Martin hope to use this process to make large airplane and military tank sections with toy soldier speed and accuracy.

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Recalling the Facts

1. Describe how objects can be directly made from CAD drawings.
2. How were models made before this process was developed?
3. Describe the role of the laser in the process described above. TD