November 17, 2011
A Penton Media Publication
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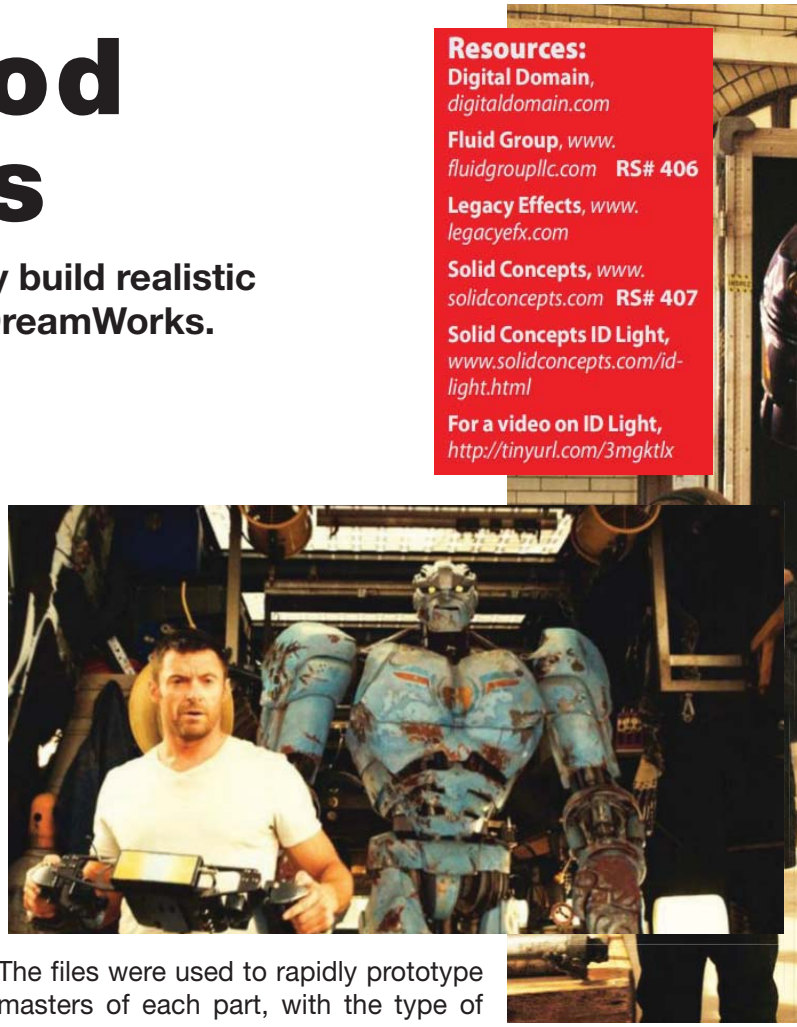
Hollywood's High-tech Rock'em Sock'em Robots, page 20

How Hollywood Builds Robots

Rapid prototyping helped filmmakers quickly build realistic boxing robots for "Real Steel", a movie for DreamWorks.

Machine Design - November 2011

Resources:
Digital Domain, *digitaldomain.com*
Fluid Group, *www.fluidgroupllc.com* **RS# 406**
Legacy Effects, *www.legacyefx.com*
Solid Concepts, *www.solidconcepts.com* **RS# 407**
Solid Concepts ID Light, *www.solidconcepts.com/id-light.html*
For a video on ID Light, *http://tinyurl.com/3mgktlx*



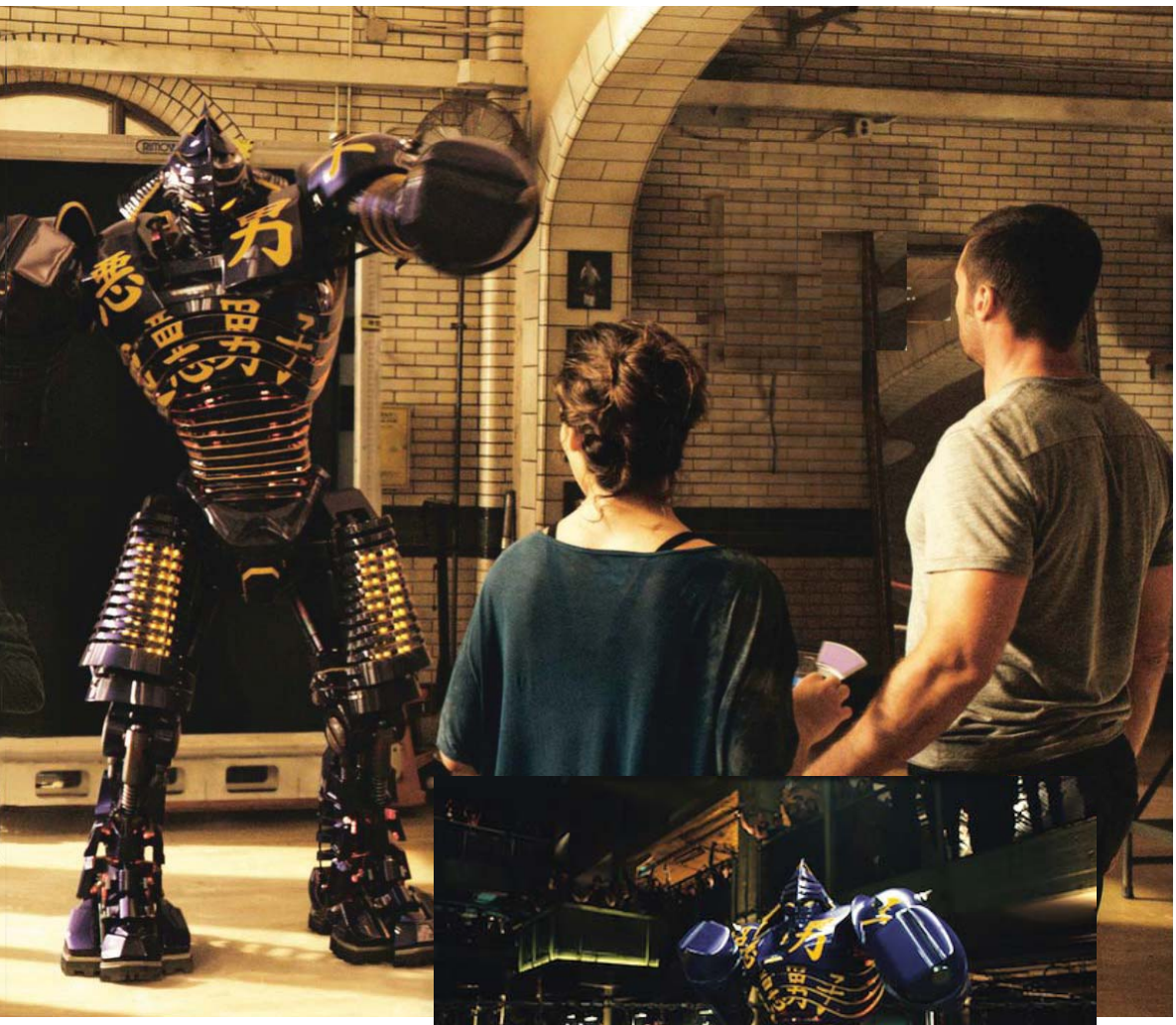
In the sci-fi world of the hit movie "Real Steel" from DreamWorks, much of the action revolves around 2,000-lb boxing robots with names like Atom, Ambush, and Noisy Boy. To make the action in and out of the ring more realistic, film director Shawn Levy, together with his special-effects team, decided to mix computer-generated graphics and effects with footage of actual full-sized models of robots, some with moving limbs and other features. In all there were 27 robots which were practically characters in the movie, one partially destroyed robot, and 20 robots seen mostly in background shots. While eight were nonmoving, the other 19 incorporated motion of some kind.

All of the robots were designed and fabricated at Legacy Effects in San Fernando, Calif. Technicians there have years of experience in building live-action effects for movies, television, and commercials. But before Legacy could get to work building robots, Tom Meyer, the film's production designer, had to provide them with drawings that would convey the look and feel the director was going for with the various mechanical boxers. Artists at Legacy Effects took those designs to their computers, embellishing them and fleshing out how they would really function, all the while maintaining the approved look.

Each part was digitally sculpted using a variety of software packages including Maya, Z Brush, and Max 2010. Legacy downloaded the computer models as STL files for rapid prototyping. The files were also shared with Digital Domain, Venice, Calif., the company responsible for making CGI versions of the robots for the film.

The files were used to rapidly prototype masters of each part, with the type of rapid-prototyping technology determined by the size of the part. For small, detailed components such as bolts, gears, and caps – anything only a few inches wide – the team used PolyJet. It sliced the computer models into extremely thin layers, then uses an inkjet-printer head to shoot out a stream of photo-curable polymer with the same dimensions as the layer of the model. UV light cures the polymer into a hard material that can be handled. The process then repeats to create the entire part layer by layer.

Medium-sized components, which included most parts such as hands, arms, feet, legs, head, and torso pieces, were created using SLA and ID-Light™ from Solid Concepts, Valencia, Calif. It uses the same layer-by-layer construction, but finished piec-



es end up having a thin skin or outer shell (0.03 to 0.04-in. thick) held in place by an internal scaffolding like matrix. Any excess polymer not solidified drains out. Legacy had used the material before and liked its ability to hold sharp tolerances and accurate forms. Finished parts also have small voids inside, so ID-Light parts require less prototyping materials and are 80 to 92% lighter than solid SLA parts. They can also be built faster.

Legacy machined large parts out of rigid foam using a computer-controlled milling machining.

Molds were made of the master parts, with the exception of some of the smaller PolyJet pieces. The molds were used to cast parts out of urethanes with the appropriate hardness.

Legacy technicians then assembled the molded parts, along with some special fiberglass pieces. If joints or parts were not to move, they were glued together. But those that needed to move – and some robots had 18 articulated joints – were bolted together. There were also limbs and heads that would be moved using remote-controlled hydraulics. For these, Legacy installed custom hydraulics so that the robots' quick motions could be precisely controlled in terms of timing and movement.

"The final urethane robots were highly durable, relatively lightweight, and had a bit of flex to them to survive the rigors of filming," says John Rosengrant, a partner and part of the engineering team at Legacy. And if a part broke or was damaged during filming or rehearsals, the team could find the master to quickly mold a replacement.