Capabilities

Communicating the Science of Prosthetics and Orthotics

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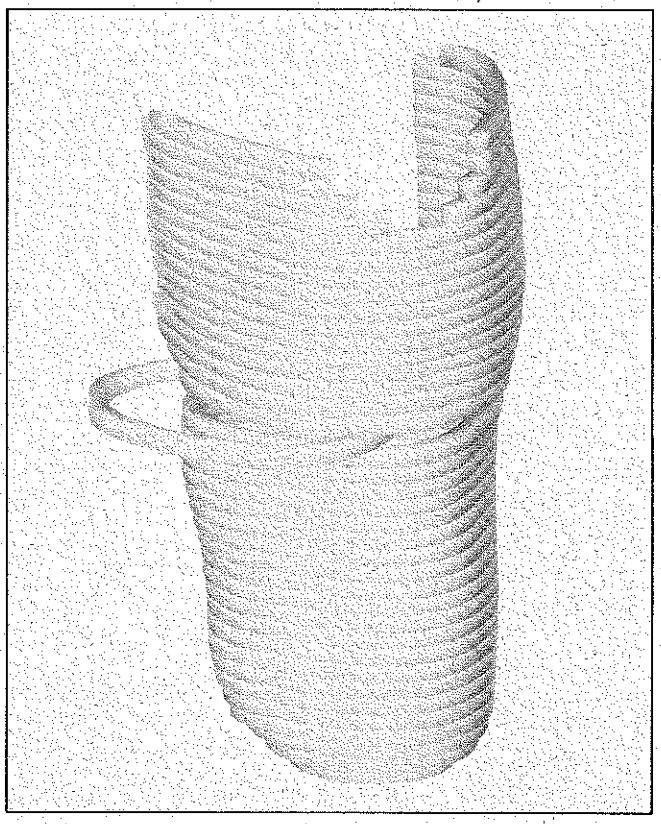
Rapid Prototyping and the Future of Prosthetics and Orthotics

by Joshua S. Rovick, M.S.

We are investigating rapid prototyping as a means for making prosthetic sockets and orthotic geometries. Rapid prototyping is a term given to a new technology allowing production of physical objects from computer-generated geometrical databases in a fraction of the time that would be required using conventional machining, modeling, or molding operations. Great strides have been made in the last decade in the industrial sector with the proliferation and general use of computer-aided design, computer-aided manufacturing, and computer-aided engineering [CAD/CAM/CAE] systems. Chief among these advances have been the ability to visualize design concepts prior to fabrication, perform detailed analyses, and easily alter the designs if changes are needed or desired. However, the ability to visualize a design on a computer, while valuable, has not eliminated the need for physical prototypes to test the assembly, fit, and other mechanical aspects of the design. In order to speed the production and reduce the cost of prototyping, the industrial sector is focusing their attention on rapid prototyping technology.

Stereolithography (see *Capabilities*, vol.1 no. 1, April 1991) is the trade name given to the first rapid prototyping system to become commercially available. Since this November 1987 introduction, six additional systems have been introduced in the United States and many more are in development for either commercial or in-house use. These systems and techniques go by various proprietary names such as Selective Laser Sintering, Desk Top Manufacturing, Laminated Object Manufacturing, Ballistic Particle Manufacturing, Photochemical Machining, SOMOS, Optical Fabrication, Fused Deposition Modeling, Solid Base Curing, Three-Dimensional Printing, Solid Object Ultra-Violet Laser Plotter, Solid Creation System, and others. One thing common to all of the current systems, however, is that the object to be created is built up on a layer by layer basis.



A computer generated image demonstrates the concept of a layered object. In this view of a below-knee prosthesis socket, one layer has been partially removed.

The concept of a layered object is illustrated in the accompanying figure. To fabricate a layered object it is first necessary to describe the contours of each individual cross-section. The contour is then physically reproduced as a layer with a given thickness. Perhaps the simplest illustration of layered production would be to cut each contour out of a sheet of material such as plastic, plywood, corrugated cardboard or paper, and then to stack up the contours and glue the layers together. In fact the Laminated Object Manufacturing (LOM) system from Helisys

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In This Issue

Resource Unit

RU Presents Poster at NSIT

In May, 1991, the Resource Unit was a featured poster presenter at the 6th Annual National Symposium on Information Technology (NSIT). As stated in the program, "the intent of the NSIT is to provide a forum for exchange of ideas for the use of information technology for improving the delivery of services to persons with disabilities." The individuals and groups attending the conference are involved in information and referral services much like the Resource Unit.

As project director, I had the opportunity to network with others doing the same tasks I am and to gather new ideas for the Resource Unit. Although past conferences have, I'm told, focussed more on technology tools, this year's focus seemed to be more on information delivery and how to use information. The conference consisted of lecture sessions, poster sessions, and exhibits created by participants of the conference. The Resource Unit poster was well received, and during the poster exhibition time I also was able to distribute many *Capabilities* newsletters and Resource Unit brochures. Attendees of the conference were pleased to learn of an information service strictly for P&O. This is a real motivator to keep our RU services up-to-date, innovative, and comprehensive.

The importance of the NSIT is that it points to the ever-increasing need of our society for information; information that is accessible, usable, and timely. At the RU, we also believe that *information provides support*. Conferences like the NSIT also acknowledge that consumers and others have a right to information, and reminds us that sometimes, all we have to do is ask. The resources available to prosthesis and orthosis users, and persons with disabilities, is vast and growing, as shown at the conference. To find out more about the NSIT, its participants, or to order a copy of the conference proceedings, contact: NSIT, Center for Developmental Disabilities, U. of South Carolina, Benson Bldg. First Floor, Columbia SC 29208 (or call 803-777-4435.)

CAP Welcomes New Members

As well as welcoming back former CAP members for another two year term (see April 1991 issue of *Capabilities*), the Prosthetics Research Laboratory and Rehabilitation Engineering Program is pleased to welcome two new Consumer Advisory Panel members:

Johnnie P. Pearson is a State Service Officer at the North Carolina Division of Veterans Affairs. Mr. Pearson offers us this personal statement: "There is life after amputation. You, the individual, have control of how much you allow the disability to become a handicap to your life. The world was going to keep turning whether I was on it or not. I had things to do and places to go, therefore, I wanted to keep turning and went on with my life."

Hector Torres is an Occupational Therapy Technician with the University of Tennessee Medical Group. His story is featured in the *Consumer View* column below.

We look forward to working with these gentlemen and with the returning members of our panel. ◆ *by Else M. Tennessen, M.S.*

Consumer View

Team Approach Provides Rehabilitation and Support

by Hector Torres

On a rainy January day in 1988, I suddenly found my life completely changed. In a split second a drunk driver had smashed into my car, which quickly erupted into flames. Somehow I got out alive, with only 65% of my body burned, a left below-elbow amputation, severe cardiac contusion, and a right sciatic nerve disruption. My most significant loss, however, was my family: wife, Linda; son, Garry; daughter, Phillina; and nephew, Mike.

Due to the below-elbow amputation, my previous career as a contract driver was no longer possible. Due to burns, I would require significant therapy to increase my strength and motion. Throughout what most people would view as a crisis, I managed to stay motivated and plan for a new and different future. My sense of wanting and needing to get well came from the wonderful medical *team approach* that was provided by my doctors and therapists.

With the Team's help and support, I recovered from my burns and received training to proficiently use several

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1990 Annual Report Now Available

The Annual Report describing activities at Northwestern University's Prosthetics Research Laboratory and Rehabilitation Laboratory in 1990 is available FREE to interested parties. To order, send a written request plus $2.50 postage/handling for each report to: Bonnie Collard, NU REP-PRL, 345 East Superior St., Room 1441, Chicago IL 60611 USA. Allow 4-6 weeks for delivery.

ISPO Update

The International Society for Prosthetics and Orthotics (ISPO) cordially invites you to attend its Seventh World Congress in Chicago, IL, June 28 to July 3, 1992. This triennial event offers a unique opportunity for you to meet leading practitioners and researchers from all over the globe. The society's multidisciplinary nature means you'll be able to meet people from many disciplines associated with P&O. You'll learn what is available worldwide in prosthetics and orthotics technology, tools, and practice at the Congress exhibits. Take advantage of this 1992 opportunity in America's Heartland—Chicago!

The Congress will feature a daily program of instructional courses, commercial workshops, commercial and scientific exhibits, a video/film program, general sessions on state-of-the-art practice, and poster and paper sessions covering scientific, technical, and clinical advancements in the field.

There will be an active program for accompanying persons, and a full social program is planned. This includes a welcoming reception hosted by the American Orthotics and Prosthetics National Office, a reception and tour of the Rehabilitation Institute of Chicago (including Northwestern University's research and educational facilities), an evening of square dancing, technical and sightseeing tours, a Congress banquet with dancing, and the World Assembly of ISPO.

The Congress Committee invites you to plan your vacation schedule around the Congress. Chicago is a great place for a vacation—bring family or friends. The home of the skyscraper is where you can go to the top of the world's tallest building. Plan to swim or sail from fresh water beaches located downtown; shop Michigan Avenue; visit the Shedd Aquarium, Field Museum, Adler planetarium, the Art Institute, the Museum of Science and Industry; have a good time in a great city. As Lorenz Hart wrote, "...This great big town/On that great big lake/Is America's first/and Americans make/Chicago."◆

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types of below-elbow prostheses. The Team supported me through the grieving process for my family.

I believe that anyone sustaining a significant injury or illness should receive treatment through a team approach. Each Team member, knowledgeable in their specialty, provided me with the information, therapy, and training I needed to become an aggressive, energetic prosthesis user. The team approach accelerated my return to a productive lifestyle.

In my work as an Occupational Therapy Technician with the University of Tennessee Medical Group, I have daily contact with clients who have suffered burns, amputation, or family losses, and their families. Now I work as a member of the Team to support and guide our clients back to a productive lifestyle.◆

Hector Torres is a member of Northwestern University's Rehabilitation Engineering Program's Consumer Advisory Panel. He works as an Occupational Therapy Technician in the University of Tennessee Medical Group.

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has automated such a process using adhesive backed paper as a material and cutting the contours using a laser beam. This system, as with all of the other rapid prototyping systems, uses very thin layers to reduce the stair-stepped appearance of the finished object and improve the dimensional tolerances. Thin layers result in many layers per object, and therefore a long production time. Long production times are inconsistent with prosthetics and orthotics applications.

Our experiences with computer-aided design and manufacture in prosthetics have demonstrated that acceptable dimensional tolerances in prosthetic socket design are far less critical than those typical in the industrial sector. We believe that by relaxing the tolerances held by the current rapid prototyping equipment, that this technology can become practical as a fabrication tool in prosthetics and orthotics. The computer-aided design systems, which are gaining increasing support and usage in the prosthetics field, are ideally suited for layered object production. Socket shapes are stored in three-dimensional geometric databases which can easily be sectioned into layers of any desired thickness. In our laboratory, we are actively exploring rapid prototyping technology tailored to the specific needs of the prosthetic / orthotics field. A fully automated rapid fabrication system is consistent with the CAD/CAM trend of the field. The perceived benefits are to reduce the burden of the manufacturing task on the prosthetist / orthotist, reduce the time and materials waste of the fabrication process, and at the same time provide suitable accuracy and reliability of the finished product.◆

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Fill out the information below, then send this coupon to:

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