"The wide range of Connex350 Digital Materials enabled us to produce a fully functional hyper-redundant robot for real world physical testing in a matter of days"

Alon Wolf, Ph.D.,
The Founder of the Biorobotics and Biomechanics Lab at the Technion

Case Study

Objet's Connex350 3D Printing System Enables Real World Physical Testing at Biorobotics and Biomechanics Lab

Using Objet 3D Models to Go Beyond CAD

At a Glance

Company: Faculty of Mechanical Engineering at the Technion, Israel Institute of Technology
URL: http://brml.technion.ac.il/
Location: Haifa, Israel
Industry: leading mechanical engineering education and research center, with a specialty in biorobotics and biomechanics

Challenges

- Creating structurally complex parts that can withstand real world physical testing and functional use
- Finding a 3D Printing System that enables printing of multiple materials with unique characteristics in one build process. This can not be done with any other RP technology and is difficult and expensive to do with tooling
- Create models quickly and cost effectively

Solution

Connex350 3D Printing System from Objet Geometries

Results

- Can now create accurate, structurally complex models that can withstand impact and absorb shocks
- Able to create intricate over molding structures that work
- Reduced response time for modifications and changes
- Achieved desired results in the shortest time with the lowest costs

BRML's interest in kinematics and mechanism design is motivated by the belief that many designers are overly dependent on computer-aided design tools and software results. In contrast, BRML focuses on asking meaningful questions and searching for fundamental understanding of the problems and processes being studied. Fascinated by the depth and complexity of the art of analysis and synthesis of bodies in motion and mechanism design, Dr Wolf and his team use kinematics tools, such as 3D models, to provide insight into their modes of operation.

BRML develops mechanical structures, control strategies and motion planning for hyper-redundant mechanisms. A redundant robot has at least one extra degree of freedom (DOF) than required, in order to compensate for simple constraints, i.e., using an elbow up versus an elbow down configuration, to reach a target position. Hyper-redundant robots have many more DOF than required, enabling them to handle more constraints, such as those presented in highly convoluted volumes, while at the same time enabling them to perform a variety of tasks. BRML uses Objet's Connex350 3D printer to create robust, fully functional models that investigate the kinematics, design criteria, and control strategy for these complex mechanisms. They focus on hyper-redundant robots which are either mounted to a fixed base (like an elephant trunk), or are unconstrained (like a snake robot).

The lab focuses on kinematics and robotics in areas that can impact and directly contribute to science and society. For example, its work in medical devices and robotics enhances and enables executions of new medical procedures that were not possible before; and its work in search and rescue robotics enables better and faster detection of survivors while reducing the risk of injury for the search and rescue personnel. For these applications, and others, BRML uses Objet's Connex350 3D printer to create the high-quality, working robotic models needed.

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Connex350 Multi-Material 3D Printer Fits BRML's Tough Requirements

The advanced, multi-material Connex350 3D printer is currently tested in the faculty of mechanical engineering mainly for research of vast variety of fields, serving all the faculty's researchers, as well as researchers from other faculties in the Technion. Other fields in which the Connex350 has already been used include Medical Robotics, BioRobotics and Biomechanics, and Aeronautics. The Connex350 is also used as a tool for various students - projects and for a range of instructional uses.

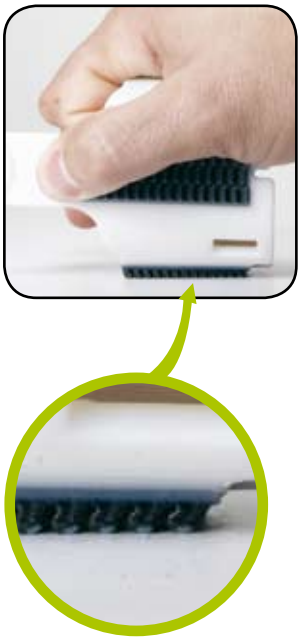

Figure 1

After a comprehensive study of the available 3D printing technologies around the world, BRML found that Objet's Connex350 3D printer to be the optimal system to fit their broad range of research fields. This is due to the printer's high layer resolution and smooth surfaces. Combining these traits with a wide range of mechanical properties, such as tensile, flexural and impact strength, in one build process results in significantly improved strength of printing materials. This extra strength has enabled BRML to create durable parts for real world physical testing and functional use.

The Connex350 system allowed BRML to print complex structures that cover most of the design and structural requirements, in one build process. For example, the lab needed to produce a rigid casing with a protective coating, so it used FullCure720 material for the casing and rubber-like TangoPlus for the coating, to provide shock absorption, impact resistance and the required dynamic friction coefficient (figure 1). According to the team's extensive research, the Connex350 is the only 3D printing system in the world that can deliver this kind of combination of physical properties in a single build.

Objet Technology Improves Research Methods

According to Oded Salomon, Biorobotics Research Engineer, it is important to "emphasize the enormous upgrade in the way we are conducting our research today as compared to a year ago .Objet's Connex350 system allows us to create real functional models, for real world physical testing, in a matter of days. This allows us to achieve the desired results in the shortest time with the lowest costs."

Today BRML is able to produce working parts, whereas in the past using conventional machine shops took a lot of time. Designing for manufacturing using Objet technology is totally different than conventional CNC, as it allows complex, over-molding models that cannot be manufactured using other technologies. As Oded Salomon explains, "Designing using CAD is nice but there is really no comparison to a handheld from a Connex350 functional model."

Today BRML can involve more complex construction considerations to their design – a result of having Objet's,"amazing matrix technology."

Saving Time and Money While Also Achieving Better Results

Objet technology compresses the amount of time it takes for BRML to get to the final product, which in robotics research means many more concepts can be checked and compared in considerably less time. This creates better models faster, which in turn saves costs. As a result, BRML is now able to have the chosen model design, fine-tuned in a shorter period of time, creating better overall results.

Using the Connex350 enables BRML to locate errors much earlier in the design round, which is beneficial when designing a snake robot consisting of many vertebras. Finding all errors in the design is crucial, early location of such errors saves a lot of money in the overall process. In addition, having a rapid prototyping system that does not require any special infrastructure enables BRML to locate it in a very accessible area. Other systems would require a separate room that complies with specific environmental requirements. Dr. Alon Wolf explains that BRML is thankful that Objet technology is free of such restraints. "Placing the Connex350 inside a regular office is even more appealing and gives a stronger meaning to the words «compression of time» and accessibility."

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Objet Technology Makes BRML a Winner

BRML made a great impact when it presented its snake robots, which were manufactured with the assistance of Objet's technology, at the recent Israeli Conference on Robotics (ICR 2008). This brought the lab valuable publicity, and has earned them attention from several science programs on Israeli TV and radio. In addition a few of the robots have been submitted to the undergraduate projects contest in the Technion, won prestigious prizes.

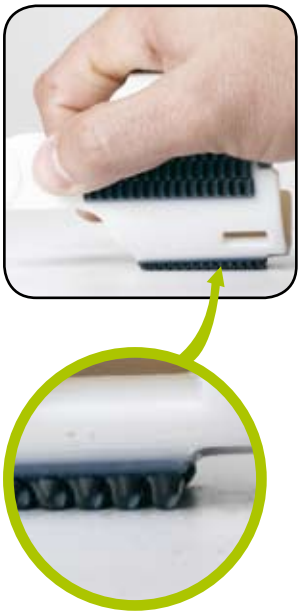

Figure 3

The individual scientists have also won thanks to their use of Objet models. Their research has been greatly promoted, and some of their discoveries have been patented thanks to the working prototypes that were manufactured using this technology. One key factor in helping this happen is having the Connex350 in-house, where confidentiality prevents further discussion.

Dr. Wolf sums up the value of having Objet 3D prototyping capabilities in-house: "Getting your hands on this kind of technology is a MUST when it comes to robotics research. When it comes to robotics research nothing compares to the ability to hold your - last night crazy idea - in your hands the very next morning."

About Objet Geometries

Objet Geometries Ltd., the innovation leader in 3D printing, develops, manufactures and globally markets ultra-thin-layer, high-resolution 3-dimensional printing systems and materials that utilize PolyJet™ polymer jetting technology, to print ultra-thin 16-micron layers.

The market-proven Eden™ line of 3D Printing Systems and the Alaris™30 3D desktop printer are based on Objet's patented office-friendly PolyJet™ Technology. The Connex™ family is based on Objet's PolyJet Matrix™ Technology, which jets multiple model materials simultaneously and creates composite Digital Materials™ on the fly. All Objet systems use Objet's FullCure® materials to create accurate, clean, smooth, and highly detailed 3D parts.

Objet's solutions enable manufacturers and industrial designers to reduce cost of product development and dramatically shorten time-to-market of new products. Objet systems are in use by world leaders in many industries, such as Education, Medical / Medical Devices & Dental, Consumer Electronics, Automotive, Toys, Consumer Goods, and Footwear industries in North America, Europe, Asia, Australia, and Japan.

Founded in 1998, Objet serves its growing worldwide customer base through offices in USA, Mexico, Europe, Japan, China and Hong Kong, and a global network of distribution partners. Objet owns more than 50 patents and patent pending inventions. Visit www.objet.com.

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