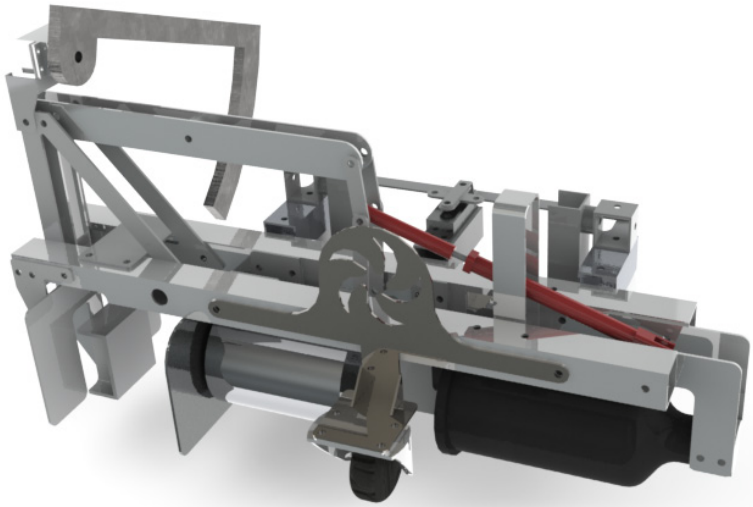
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Conducting "the mother of all robot contests" course with SolidWorks software



Using SolidWorks software, each student in MIT's 2.007 Design and Manufacturing I course designs and builds their own robot.

Frequently ranked as the top engineering university in the United States, the Massachusetts Institute of Technology (MIT) has established a reputation for innovation by using technology applications to achieve educational objectives. By combining the pursuit of academic excellence with genuine and practical applications, MIT provides future engineers with the experience, skills, and knowledge they need to succeed in a global economy.

This approach led the university to establish a robotics design contest more than a decade ago as the foundation of its initial design and manufacturing course. Known at MIT as "the mother of all robot contests," the 2.007 Design and Manufacturing I course has become so successful and so popular that engineering schools worldwide are replicating it. The class requires each student to design and build an individual functional robot—based on a specific theme that changes each year—in one 15-week semester.

When Daniel D. Frey, associate professor of mechanical engineering at MIT, assumed responsibility for teaching the class, he decided to evaluate the design and engineering software that students had at their disposal. "I was not required to continue with the legacy tools when I took over," Frey recalls. "But after reviewing available options, I decided to continue using SolidWorks® 3D CAD software as the primary tool in the course because students find it easy to use and to learn, yet it also can handle the more demanding modeling tasks students undertake later in the course.

"We need 3D parametric solids for developing robotic assemblies," he adds. "Because it is so easy for the students to learn and use—and runs efficiently on their laptop computers—SolidWorks software gives us the flexibility we need to expand the amount of time we actually spend on learning.

"We have been extremely successful using SolidWorks software in the class, and our students benefit from an experience that is more representative of authentic mechanical engineering practices," stresses Frey.

Challenge:

Help engineering students meet the demands of MIT's 2.007 Design and Manufacturing I course, which requires each student to design and build an individual functional robot in just one 15-week semester.

Solution:

Begin the class with a crash course on SolidWorks 3D design software and use SolidWorks software to support student design and engineering work.

Results:

- Shortened CAD learning to just six sessions
- Established milestones for individual robot development
- Automated use of sophisticated manufacturing equipment
- Enabled undergraduate teaching assistants to accelerate learning

SOLIDWORKS

A crash course in CAD

The 2.007 Design and Manufacturing I course not only requires students to attend lectures, complete homework, and take exams, but also challenges them to learn SolidWorks software. That way, they can use the software to design and build a robot to perform a designated task, using a set of materials provided by MIT. At the beginning of the course, each student receives a copy of SolidWorks Education Edition, six CAD instructional sessions, and roughly 25 hours of homework on SolidWorks software.

"Like many universities, we used to teach CAD as a separate effort," Frey notes. "But because SolidWorks software is easy to learn, we now give the students less time on just CAD and encourage them to learn how to use the tool through actual work. The evidence we have that this approach works comes in the form of the beautiful models that the students create by the end of the course."

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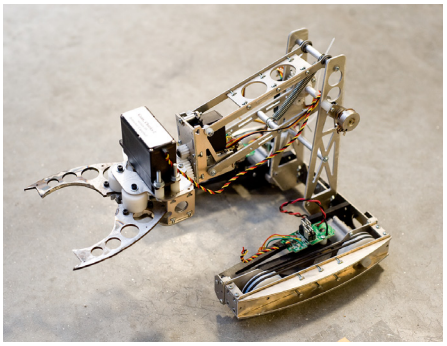
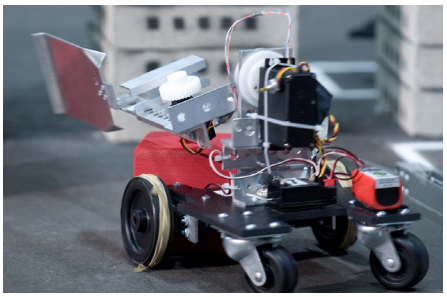
Daniel D. Frey
Associate Professor of
Mechanical Engineering at MIT

From idea to robot in just 15 weeks

Following a crash course in SolidWorks software, the students dive into designing and building a robot that can perform a task related to the contest theme, which changes each year. In 2009, students had to design robots that would help a planet recover from an ecological disaster. In 2010, the AZTECH theme challenged students to create robots that can ascend an Aztec pyramid or play an Aztec sport.

Using SolidWorks Education Edition, students are able to achieve specific milestones for the course—such as completing a solid model of their robot design's most critical mechanism or an integrated CAD model of the entire robot. They can also automate the sophisticated manufacturing equipment used in class, which includes rapid prototyping and fused deposition-modeling systems. "The students take the time to use SolidWorks software to design the complexity they need in their parts, while avoiding fabrication difficulties, instead of relying on cutting and milling rework later on," Frey says





With SolidWorks Education Edition, MIT students quickly move from learning how to use CAD software to designing and building robots.

Design communication essential for class

An important element of the class—and the reason why the students are so successful in completing their robots on time—is the ability to communicate design concepts with peers and undergraduate teaching assistants (UTAs). Although students are responsible for their own individual robot designs, they benefit from the valuable feedback they receive from their classmates and the UTAs, who have already taken the class.

"The students do engage in a peer-review process, through which they are encouraged to provide input, critique designs, and share ideas," Frey explains. "SolidWorks software allows the students to communicate in 3D and simulate motion, which facilitates this process."

Massachusetts Institute of Technology

Massachusetts Institute of Technology (MIT)
Department of Mechanical Engineering
77 Massachusetts Avenue
Cambridge, MA 02139 USA
Phone: +1 617 324 6133
www.mit.edu

Dassault Systèmes
SolidWorks Corp.
300 Baker Avenue
Concord, MA 01742 USA
Phone: 1 800 693 9000
Outside the US: +1 978 371 5011
Email: info@solidworks.com
www.solidworks.com

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