Simulation-Driven Teaching and Research

Academic products from ANSYS at release 11.0 are helping train future engineers.

By Paul Lethbridge, Academic Product Strategy and Planning, ANSYS, Inc.

Today's undergraduate students are tomorrow's engineers and researchers. Deploying software from ANSYS, Inc. as an integral part of the engineering curriculum allows academia to train the future work force with world-class simulation tools and technology and familiarize them with Simulation Driven Product Development processes. It is also critical in that it ensures that academic research continues to push the technology envelope.

ANSYS offers two broad product license categories — commercial and academic — the primary difference between the two being the terms of use. Commercial product licenses are intended for use by for-profit companies and organizations in which the analysis work performed is often proprietary in nature. Academic product licenses, on the other hand, are intended for use by academic organizations, such as universities, for nonproprietary teaching and research.

The differences in these terms of use allow ANSYS to provide academic licenses at significantly reduced cost compared to the commercial licenses, which in turn helps to meet academic budget requirements (Figure 1).

Academic products from ANSYS are also packaged differently from commercial products, with product names and license files that differ from the commercial product portfolio. Academic products are bundles of analysis technology, often incorporating many commercial products and add-on modules, with some containing more than 10 commercial products in a bundle. A single academic product license may contain multiple tasks (such as five, 25 or 50 tasks) in which each task maps to a separate user.

With a few exceptions, the academic products are derived directly from the commercial products. For a release such as ANSYS 11.0, both commercial and academic products are included. In use, the academic products have exactly the same look and feel as the commercial products. For example, a user accessing the ANSYS Multiphysics capability bundled with an academic product will have the same GUI, workflow, pre-processing, post-processing and solver as the commercial product. This helps ensure an easy transition for the user from academia to the workplace. In most cases, the academic user will actually have access to many more features than the average commercial user.

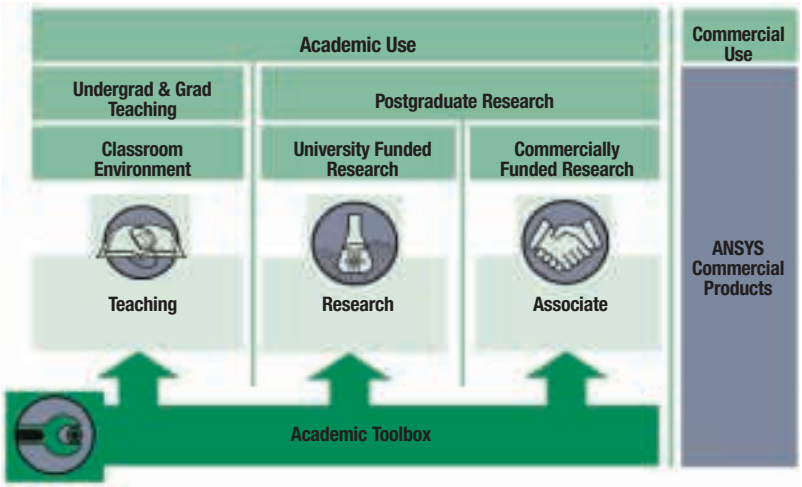


Figure 1. The intended use of academic products from ANSYS

Product Name
ACADEMIC ASSOCIATE
ANSYS Academic Associate
ANSYS Academic Associate AUTODYN
ACADEMIC RESEARCH
ANSYS Academic Research
ANSYS Academic Research CFD
ANSYS Academic Research LS-DYNA
ANSYS Academic Research AUTODYN
ACADEMIC TEACHING
ANSYS Academic Teaching Advanced
ANSYS Academic Teaching Introductory
ANSYS Academic Teaching Mechanical
ANSYS Academic Teaching CFD
ANSYS Academic Teaching AUTODYN
ACADEMIC TOOLBOX
ANSYS Academic Meshing Tools
ANSYS Academic CFD Turbo Tools
ANSYS Academic LS-DYNA Parallel
ANSYS Academic Mechanical HPC
ANSYS Academic AUTODYN HPC
ANSYS Academic CFD HPC

Figure 2. The academic products from ANSYS release 11.0. Refer to academic solutions Web page for details on features for academic products: www.ansys.com/academic

	Structural & Thermal	Direct Coupled Field	LF Emag	HF Emag	FLOTRAN	DesignSpace	CFX	AUTODYN	TAS
Academic Teaching Advanced	256K	256K	512K	1024K	1024K	∞	512K		∞
Academic Teaching Introductory	32K	32K	64K	512K	512K	∞	512K		∞
Academic Teaching CFD							512K		
Academic Teaching Mechanical	256K	256K				∞			
Academic Teaching AUTODYN								50K	

Figure 3. Numerical problem size limits for the academic teaching level products (Note that the limits vary by physics, with higher limits assigned to external field physics such as electromagnetics and fluid dynamics.)

The ANSYS 11.0 academic product portfolio includes ANSYS Multiphysics, ANSYS CFX, ANSYS ICEM CFD, ANSYS TAS and ANSYS AUTODYN products, plus a broad selection of computer-aided design (CAD) geometry interfaces (Figure 2). The Fluent academic products are not part of the release 11.0 academic portfolio, but some will be integrated in the ANSYS 12.0 release, creating an academic product portfolio that includes all major technologies from ANSYS. The guiding philosophy is to provide academia with very high value bundles of analysis technology, negating the need to purchase multiple products while reducing complexity and improving scalability.

Academic products from ANSYS are organized into four product subfamilies — Teaching, Research, Associate and Toolbox — with each subfamily having specified terms of use and capabilities. The Teaching subfamily is the lowest priced and includes entry-level products intended for undergraduate and graduate class demonstrations and hands-on instruction. Teaching-level products have numerical problem size limits, which vary by physics, with higher limits assigned to external field physics such as electromagnetics and fluid dynamics (Figure 3). The Research and Associate subfamilies have broader terms of use and can be used for both research and teaching. They have no problem size limits, providing unlimited numerical headroom for doctoral and post-doctoral research work. The Toolbox subfamily addresses high-performance computing (HPC) and specialized pre-processing concerns.

Each academic product can be purchased in defined task increments, with a task defined as a single user. For example, a 25-task license will allow a maximum of 25 simultaneous users. Any combination of these tasks is allowed, and volume discount is built in. The academic product licenses are floating local area network (LAN) licenses, utilizing a single designated server. Since the majority of the academic products are multiple task licenses, this means that all of the tasks are floated on the server's LAN. The products can be installed on an unlim-ited number of machines connected to the LAN, but the number of users who can simultaneously access the software is limited by the number of tasks purchased (one, five, 25, 50, etc.).

ANSYS is at the forefront of providing simulation software worldwide for academic users — for both teaching and research applications. Academic products from ANSYS are used by thousands of universities and colleges in more than 60 countries, with hundreds of thousands of users. ■

ANSYS® Intro to FEA, Germany

"…The academic products from ANSYS have very good documentation and help tools. The products help us to solve the different tasks within our practical-oriented design projects as well as within the students´ scientific diploma and master theses." Professor Otto Huber, Fachhochschule Landshut, University of Applied Sciences, Bavaria, Germany

The classes and projects taught by Professor Huber at the University of Applied Science in Germany focus on structural physics. Professor Huber has created his own tutorial to introduce the students to the principles of finite element analysis. For practical coursework, the students use academic products from ANSYS to compare analytical and experimental results with FEA solutions. Students also use the products to design several devices. A typical project for undergraduate students is to test the endurance strength of pallet carriers. To enable realistic experiments, it was necessary for students to create a new testing device for the servo-hydraulic test rig. The students optimized and designed the components of the testing device using academic products from ANSYS. Professor Huber estimates that approximately 100 second- to fourth-year undergraduate students have been trained since these classes were made available.

Reverse Engineering

"The demonstrated depth and breadth of fundamental finite element modeling technologies together with the tight integration and ease of use makes the ANSYS Workbench platform ideal for use in an academic classroom/research setting." Professor Kent Lawrence, Mechanical and Aerospace Engineering, University of Texas at Arlington, U.S.A.

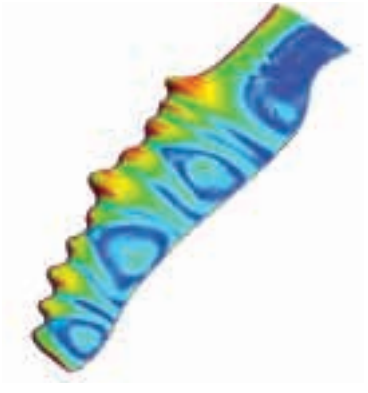
In the classes offered by Professor Lawrence at the University of Texas at Arlington, there is a focus on structural and thermal physics, and students are exposed to both the ANSYS Workbench platform and the traditional GUI interface. Academic products from ANSYS are used exclusively, together with two textbooks authored by Professor Lawrence and published by SDC publications. A typical project for undergraduate students is a reverse engineering task in which they generate part and assembly models of actual devices. A specific example is the analysis of an automotive valve spring compression device (Figure 4). To accomplish this task, students use the ANSYS Workbench platform to perform structural and thermal analyses. In addition to the above classes, academic products from ANSYS are used for research in the following areas: structural response, failure mechanisms in composite structures, and thermal and structural behavior of electronic packages. Professor Lawrence estimates that 2,000 undergraduates and 900 graduate students have been trained since the classes were made available.

Deformation of an automotive spring compressor

Undergrad Fluids Lab

"We have found ANSYS CFX software to provide consistent and accurate results. In some cases, extensive validation against experimentally measured data was performed to assess ANSYS CFX performance with positive outcomes. In the past years, our lab has evaluated and employed in research a multitude of commercial CFD solvers. At the present time, we believe that for our research applications, ANSYS CFX software is the industry leader." Professor Len Imas, Department of Civil, Environmental and Ocean Engineering, Stevens Institute of Technology, New Jersey, U.S.A.

For his undergraduate laboratory course, Professor Imas of the Stevens Institute of Technology uses academic products from ANSYS to demonstrate a numerical experiment and expects further integration of academic products during the next couple of years. For his Numerical Hydrodynamics course, the students use ANSYS CFX capabilities to demonstrate and study canonical problems involving turbulence, multiphase flows including free surface and cavitation, and fluid structure interactions. The academic products from ANSYS are used alongside other FEA/CFD tools, and the course is taught from a set of lecture notes together with tutorials. Academic products from ANSYS are also used for free surface hydrodynamics research, focusing on the hydrodynamics of sailing craft, high-speed multihulls, surfboards and whale fins (Figure 5). Professor Imas states that approximately 12 graduate students have completed the Numerical Hydrodynamics class and use academic products from ANSYS for research.



Contours of wall shear for a full-scale Reynolds number flow past a whale fin with tubercles

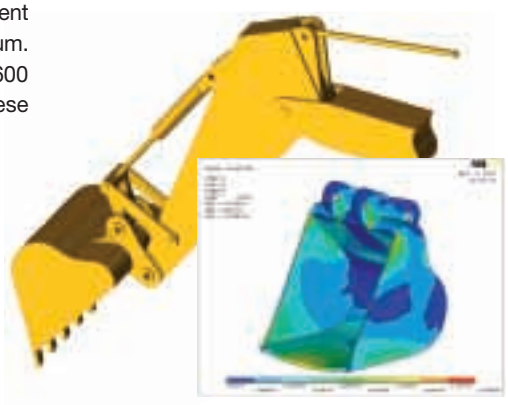
Intro to FEA, U.S.A.

"Software from ANSYS allows us to provide students with a strong foundation in the intelligent and appropriate use of state-of the-art FEA technology, an important skill for a mechanical engineer." Professor Rajesh Bhaskaran, Sibley School of Mechanical and Aerospace Engineering, Cornell University, New York, U.S.A.

Professor Bhaskaran provides his Cornell students with a basic (2-D, linear behavior) introduction to finite element analysis (FEA) using an in-house toolbox built on MATLAB®. The classes then build on this foundation using academic products from ANSYS for real-world FEA. Professor Bhaskaran focuses his classes on structural and thermal physics, both separately and as coupled field effects. Student projects have included analyzing a bicycle crank and comparing the numerical analysis results with those from physical testing. Another project has involved modeling a bucket used on a Caterpillar® hydraulic excavator (Figure 6). In this project, students analyzed the stresses under normal loading conditions and optimized the bucket's design for increased load capacity, maintaining bucket volume and a safety factor. Professor Bhaskaran has developed a suite of tutorials using ANSYS products, which can be found on the web: http://courses.cit.cornell.edu/ansys. Cornell has also integrated Fluent academic products into their curriculum. Professor Bhaskaran estimates that 600 students have been trained since these classes were made available.

Workshop

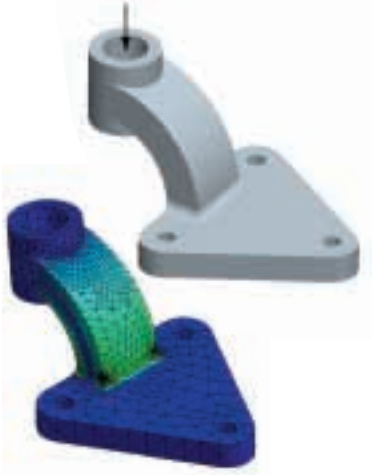
Cornell University will host an educational workshop titled "Integration of Simulation Technology into the Engineering Curriculum: A University-Industry Workshop" on July 25 to 26, 2008. The primary objective of this workshop is to promote the advancement and sharing of curriculum materials with a focus on simulation technology. More information is available at www.mae.cornell.edu/swanson/workshop2008.



Stress and deformation of a bucket on a Caterpillar hydraulic excavator used in the modeling project

Computer-Aided Machine Design

"The ANSYS Workbench environment allows the students to work with software that is tailored to product engineers." Professor Jack Zecher. Purdue School of Engineering and Technology, Purdue University, Indiana, U.S.A.



Maximum von Mises stress in a support bracket that is subjected to a 500-pound distributed vertical load

Professor Zecher's computer-aided machine design class at Purdue University focuses on structural physics. A typical project for undergraduate students is to determine the maximum von Mises stress in a support bracket that is subjected to a 500-pound distributed vertical load (Figure 7). The geometry of the part is provided in the form of an initial graphics exchange specification (IGES) file. In this class, students are exposed to the ANSYS Workbench environment and are expected to use the convergence feature of the platform. Professor Zecher uses academic products from ANSYS, along with a new textbook co-authored by Fereydoon Dadkhah and himself.

Professor Zecher estimates that approximately 500 students have received CAE training since this class was made available.