Implementing 3-D Modeling for Engineering Freshmen

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Abstract

Kettering University has begun a process of replacing the existing 2-D CAD software (AutoCAD) and replacing it with an integrated set of CAE (SDRC Master Series) and PDM software. The integration of a single source of data for many CAE operations allows the faculty to teach using a powerful set of tools beginning in the freshman year.

Solid modeling techniques, which stress the design intent of the model, enhance the skill set of freshman engineers and excites their interest on the mechanical engineering process. As a 100% co-op educational institution, the Kettering student skill with 3-D modeling tools early in the education process makes them more valuable to their co-op sponsor. Many of the University major sponsors have focused their CAE environment with a single data solution that eliminates the need for data translation and enhance their global communication.

I. Introduction

Communicating graphical engineering design intent from one person to another has been difficult for thousands of years. The designers and builders (engineers) of the pyramids in Egypt to the great churches in Europe constantly struggled with the laborers (manufacturing) to maintain the design integrity and intent of the structures. Unfortunately, the builders of old also had the bad luck to be placed at the top of any structure they designed during construction. If the structure gave way, typically the monarch would be looking for a new builder.

During the last ten years, many engineering education institutions switched from manual drafting for communicating design during the freshman year to 2-D drawing programs like AutoCAD, and CADKey. Recently, due to information and advice provided by engineering departments Industrial Advisory Boards and surveys (http://singer.kettering.edu/graphics_thread_employers.htm) , solid modeling programs such as Pro/Engineer, UniGraphicsII, I-DEAS Master Series and Catia have been introduced to the engineering drafting/drawing programs in the freshman years as shown in the picture on the right.

Manual drafting and detailing continues to remain a critical need of the engineering industry, but

additional topics are finding their way into freshman engineering graphics curriculum, such as GD&T, spreadsheet analysis, and even word processing and presentation graphics. Many entering engineering students at Kettering are more adept using software like Microsoft Office and AutoCAD than the Faculty. These issues present serious problems for faculty that teach graphics using traditional techniques. This paper introduces a new course, ME-100 Engineering Graphical Communication that can bring together a number of related topics in a cohesive package.

II.   Kettering University 2000

Kettering University (formerly GMI Engineering & Management Institute) is a 100% co-op engineering educational institution. More than 95% of the entering freshman class are engineering students, the remaining students split between Management, Applied Math and Environmental Chemistry. The 180 credit engineering programs are accredited by ABET. Each student rotates through a three-month school term and a three-month work co-op term. The freshman class size averages between 600 to 700 students, roughly 20% minorities and women. For the last two years (1998 and 1999), Kettering University's Mechanical Engineering Department graduated more undergraduate ME's to industry than any other ME department in the country.

The introductory engineering classes, associated with such large numbers of students, are challenging. Upwards of 180 students per term have taken the introductory classes. The physical resources necessary for this effort are significant and must be highly efficient. Kettering University has adopted the Virtual Team model (ASEE Paper #1197) to ease the burden of Product Data Management (PDM) and Team Data Management (TDM.)

The hardware facilities at Kettering include a 35 seat dedicated WindowsNT I-DEAS Master Series Lab, a mirrored (exact same software) 35 seat WindowsNT Applied Mathematics Lab, a 40 seat general purpose WindowsNT Lab, two 18 seat UNIX Advanced CAE Labs, and a Heterogeneous Team (HT) version of I-DEAS Master Series 7m2. The HT (shown in the picture on the right) version of Master Series allows the students to access their data from any lab location inside the University without regard to operating system platform.
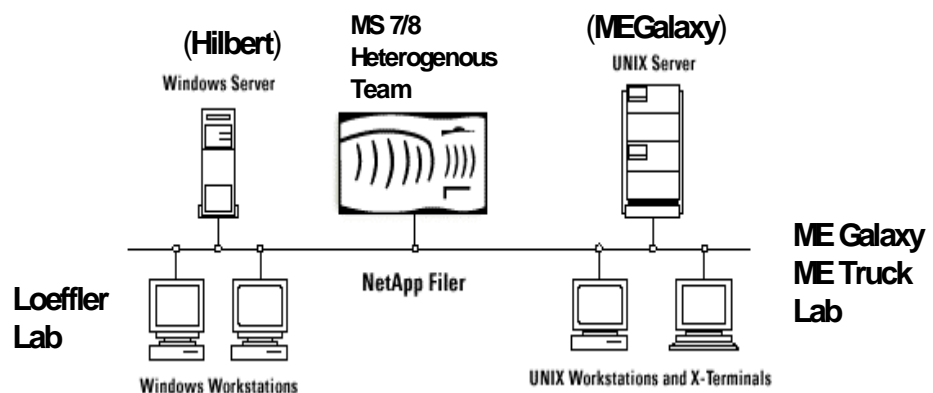

III.   Engineering Graphical Communication

The Engineering Graphics course offered by the Mechanical Engineering Department is a service course for the ME department along with the Industrial/Manufacturing and Electrical and Computer Engineering programs. The current course is offered, in many ways, as it was 30 years ago. Students entering an engineering program would not, typically, own a drafting/drawing table or have space for it in their dorm room. Due to the lack of availability of drafting tables, the graphics course would usually have a large number of lab hours for student coursework.

In addition to a graphical communication course, many programs have, in the last five years, instituted a course to bring students up to speed on current office products such as, spreadsheets, relational database managers, word processing and presentations. This introductory course would be for either little or no credit, but required for graduation. At Kettering, this course is called Introduction to Engineering (a one-credit course) and is offered each term by a diverse number of faculties from many disciplines, but never in a team format. Individual instructors would add their own flavor to the course but the continuity of course coverage is not manageable or predictable.

The proposed course, Engineering Graphical Communication, will fold the current Engineering Graphics course with the Introduction to Engineering Course and the Introduction to Solid Modeling course and will be delivered during the Summer 2000 term. The students will learn the essentials of solid modeling using the full version of SDRC's I-DEAS Master Series and will be able to purchase the Student Edition for about $100 from the bookstore. The student edition can exchange part and assembly data through the use of universal files and FTP.

Solid modeling techniques such as wireframe, extruding, revolving, sweeping and lofting are essential elements of the proposed course. Course projects (see imbedded pictures) have been developed to reinforce the materials describe during the lecture.
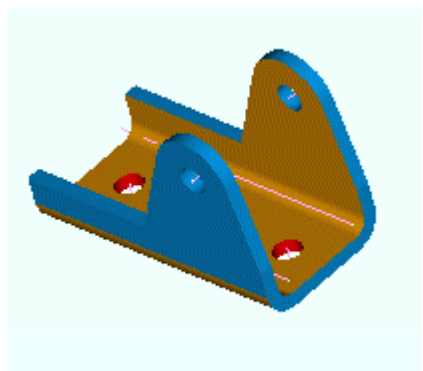
The Master Series software also has the ability to generate 2-D drafting and detailing drawings for manufacturing. Geometric Dimensioning & Tolerancing is fully integrated and describe in the course.
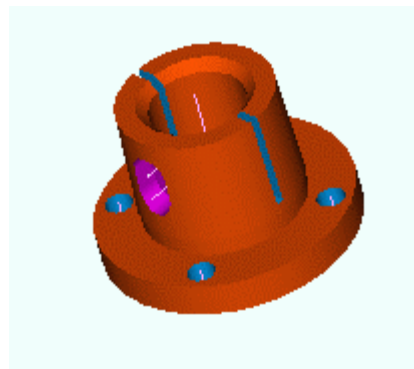
Materials and examples from disciplines other than ME, such as circuit boards and plant layout, are included to enable students from the EE and IE departments to design models. Many entering engineering students do not have a strongly developed skill set in either 2-D or 3-D visualization. These examples, drawn from their chosen field of endeavor, should motivate their sense of understanding.

Team projects and designs are included as a significant portion of the new course. The Master Series software's Team Data Management capabilities allows students to work together even if

they do not share the same lab section. This capability demonstrates to the student the global potential of team design in the world marketplace.

In addition, this course will serve the department as part of the student communication skill set. Either Sun's StarOffice or Microsoft Office suite will be used to enhance the student's ability to prepare and deliver engineering project grade reports and presentations by incorporating images and analysis results from the CAE system. Spreadsheet examples and projects have been developed to encourage basic analysis of simple engineering models and to provide cost and financial analysis for projects and reports.

The pilots for this course ran during the Fall term of 1999 and the Winter and Spring terms of 2000. Data and feedback from the students and changes to the course will be discussed pending final review of this document.

IV. Summary

The Engineering Graphical Communication course for entering freshmen will incorporate the hi-tech communication skills necessary for the engineer in the new millenium. The developers of information will be as important as are the providers of information. The information developed must add value to the corporate bottom line and add to the perceived image the company presents.

The Engineering Graphical Communication is an outcome-based class, designed to meet the goals and objectives of the department in concert with the corporate partners.

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