

## Development of CD-ROM based lessons for ProEngineer™

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### Abstract

This paper describes how a series of CD-ROM based instructional lessons for the ProEngineer™ Computer Aided Design program were developed. These lessons consist of “on screen” examples of techniques that ProEngineer™ uses to construct three dimensional solid models. Various multimedia techniques were used in order to produce a product that focuses the student’s attention on the graphical user interface of the ProEngineer™ software.

These CD-ROM based lessons provide a tool that enhances student learning. Students are able to consult these CD-ROM based lessons at almost any time and from almost any location (on or off campus) that has a Windows based PC that contains a CD-ROM drive. This allows students to study at their own pace and to investigate and review issues of their own choosing. It is not expected that these lessons will entirely replace the traditional setting of having students attend class on campus. They will, however, provide a portion of the instruction that is currently covered in the lecture as well as a portion in the laboratory.

Details of how a combination of three-dimensional images, animation sequences, and audio narration are used to enhance a student’s understanding are explained in detail. This includes an overview of the overall design of the project, as well as a detailed look at how various software packages were used to perform screen captures, audio narration, video editing, and then how these various multimedia components were combined and delivered on CD-ROM.

### Introduction

The ProEngineer™ Computer-Aided-Design (CAD) program was adopted three years ago by the Department of Mechanical Engineering Technology as their “high-end” CAD program. It is used in the MET328–CAD/CAM for Mechanical Design and Drafting course, as well as by many students during their senior projects. Enrollments in the MET328 class have increased during the past several semesters due to the widespread use of ProEngineer™ within industry. While it is well acknowledged that ProEngineer™ is one of the leading CAD programs in industry today, the program is also well known for its steep learning curve. These two criteria presented an excellent situation in which to develop a computer-aided instructional tool.

## Project Objectives

The goal of the project was to develop a CD-ROM based multimedia product that would enhance traditional classroom instruction and improve student learning. In order to achieve this, the product was designed to coexist with and supplement the text<sup>1</sup> that is used in the course. It was felt the product would be used by students to review topics presented during lectures and/or covered in the book. The multimedia capabilities available with a CD-ROM based product would allow many of the limitations that exist in conventional textbooks to be overcome. Multimedia based lessons, like the one discussed in this paper, have the advantage that more than one type of media can be used to simultaneously present information. Conventional textbooks access only one learning modality (static visual) to present information. This often leads to misinterpretation of the concept being presented<sup>2</sup>. By properly using a combination of color graphics, video, animations and audio narration, limitations normally associated with traditional black and white printed media can be overcome<sup>3</sup>.

The combination of audio, graphic images, and animation sequences displayed at a screen resolution of 1024 x 768 (the ProEngineer recommended minimum resolution) produced digital video files (*avi's*) that often exceeded 20 Mbytes and required data rates of up to 190 Kbytes/second. Due to the limited bandwidth of the internet, it was ruled out as an acceptable means of distribution.

The lessons were designed to run independent of the ProEngineer™ program. Students will be able to use these CD-ROM based lessons at almost any time and from almost any location (on or off campus) that had a Windows based PC that contains a CD-ROM drive. This would allow students to study at their own pace and to investigate and review topics of their own choosing.

## Steps in Creating the CD-ROM Lessons

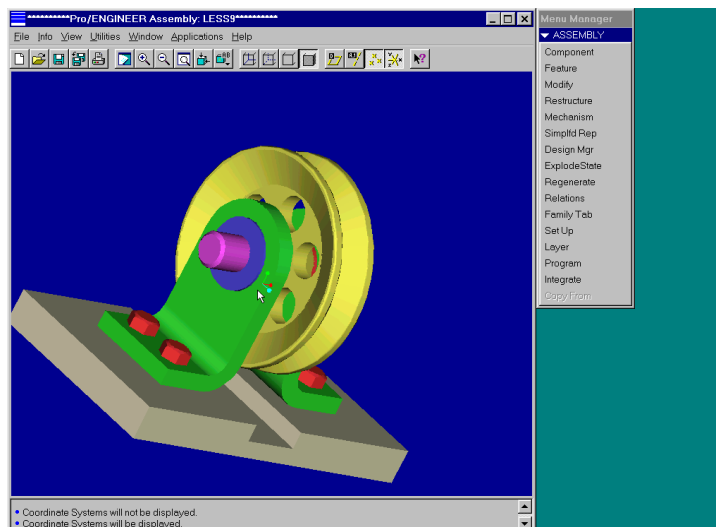
The first task performed in the creation of each lesson was to outline the steps that would be covered. From this outline, a script was written based on the actual step-by-step process of running the program. The narration of the script, done by a graduate student was captured electronically as *.wav* files. The Sound Forge program was used during the recording process and the resulting file was a 44kHz, 16bit-stereo sound file. This sound file was then edited to break the file into small multiple files which allowed mistakes to be deleted and to easily move the “sound bites” back and forth along a time line in order to correctly match the corresponding image being displayed.



**Figure 1** Audio narration being recorded in a sound booth

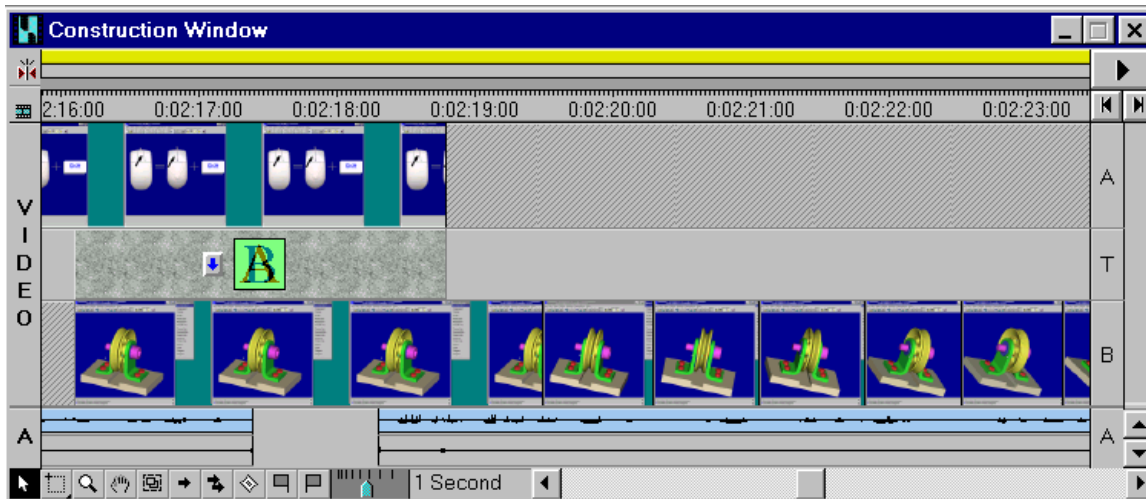
Since the CD-ROM was intended to illustrate how ProEngineer™ works, the next task was to capture screen images in a video format, thereby illustrating the sequence of steps that a user performs when running the program. These captured screen images would have to correspond to the audio track that had been created. The method that was used involved a program capable of capturing screen images over a period of time. The images can be saved either as individual bitmap files, or as a Video for Windows (.avi) file when images are saved at specified time intervals. The program Snagit™<sup>4</sup> was used for this task, although several other similar programs exist on the market<sup>5,6</sup>.

The first attempted process of having the Snagit™ program run simultaneously with the ProEngineer™, capturing images at a specified time interval, proved to overwhelm the capabilities of the 233MHz machine that was being used. This was because the speed at which ProEngineer™ ran, when the Snagit™ program was capturing images in the background, was not comparable to running the program by itself. The resulting .avi files did not reflect a realistic example of running the ProEngineer™ program. In addition to the problem with speed, the image quality of the resulting .avi files was not acceptable. In order to overcome these two problems, the Snagit™ program was used to capture one screen image each time a user-defined key or combination of keys was pressed.



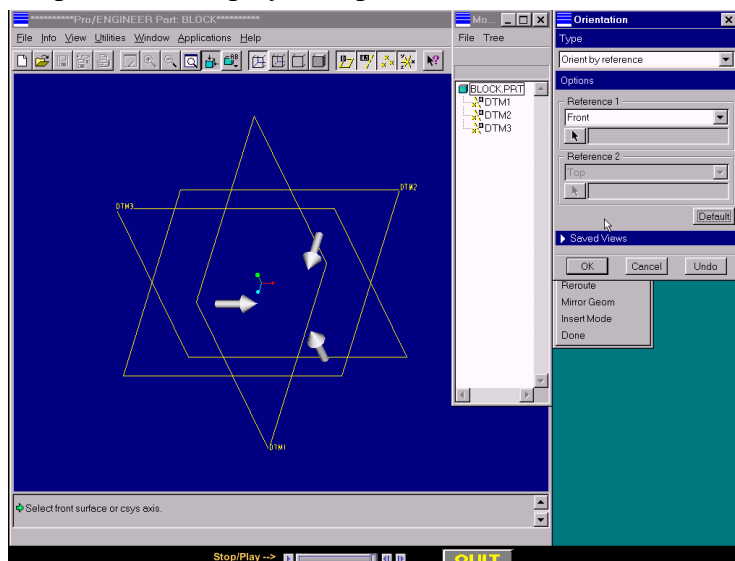
**Figure 2** Typical Bitmap Image captured by the Snagit™ program

Although it was not evident initially, advantages were realized by using the technique of capturing individual screen images and then using the Adobe Premiere™<sup>7</sup> program to construct the .avi files as compared to having the capture program construct the file. The primary advantage was the ease with which the audio narration could be synchronized with the images that appeared on the screen. The Adobe Premiere™ program allows each individual bitmap file to easily be stretched or compressed along a timeline, thereby giving the user control as to the length of time each individual image would appear on the screen. Also, Adobe Premiere™ has the capabilities to build transitions between images, which provided the appearance of images fading in or out.



**Figure 3** Adobe Premiere™ screen layout showing several three-dimensional images combined to create an animation sequence and audio narration in the lower track

Once the .avi files were created, Macromedia Director™ was used to control which lesson's .avi file should be played as well to provide the user with a VCR-like interface to play the .avi files. Included are a play and pause button along with a slider control that allow the animation and audio narration to be repositioned, replayed or paused.



**Figure 4** Screen layout showing VCR type controls

### Future Impact

It is not expected that these lessons will entirely replace the traditional setting of having students attend lectures. The lessons should, however, provide a portion of the instruction that is currently done in the traditional lecture format as well as a portion of the laboratory instruction. This should allow the format of the class to be modified somewhat so that fewer lecture and lab hours will be required. This new format will still maintain interaction between the student and

instructor and the student and his peers. This type of interaction is very important, since a student's motivation to complete a course is decreased when there is no interaction between instructor and student<sup>8</sup>.

In addition to the possible modification of the format of the course, it is hoped that an interactive self quiz will be included at the end of each lesson. This will allow students to be able to immediately assess their level of understanding of the material.

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Professor of Mechanical Engineering Technology at Indiana University Purdue University Indianapolis. Professor Zecher teaches courses in the mechanical design field as well as CAD related subjects. He is author of the book Computer Graphics for CAD/CAM Systems, published by Marcel Dekker Publishers as well as several workbooks that are used in courses he teaches. He has developed commercial software products in the CAD and finite element areas and has developed educationally related software tools that are used in Statics and Strength of Materials courses. He received his M.S. degree in Mechanical Engineering Technology from Western Michigan University and is a registered Professional Engineer in the state of Indiana. His current activities beyond the classroom include being the coordinator of a rapid prototyping lab and acting as project director of a multimedia development project.