



## INTEGRATION OF INTERACTIVE MULTIMEDIA LEARNING SOFTWARE INTO MECHANICAL ENGINEERING COURSE'S

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### Abstract:

The integration of Information Technology in the applied educational activities of mechanical engineering, offers an excellent opportunity of improving the level of understanding achieved by the students. This paper describes the progress and results of our project, in testing the use of specific pedagogical resources in the teaching process of basic engineering disciplines, such as Fundamentals of Mechanical Engineering, Mechanics of Materials and Mechanical Vibration, in the inter disciplinary laboratory-classroom.

**Keywords:** interactive desktop applications, virtual laboratory modules, computer based simulations, Java Applets

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### 1. INTRODUCTION. CURRENT MECHANICAL ENGINEERING EDUCATIONAL SOFTWARE

The complexity of many of current mechanical systems has been growing exponentially. Unfortunately, it can be said that, generally, the Romanian higher education system has not kept pace with these needs. Existing undergraduate and graduate science and engineering programs need to incorporate more material on engineering educational software. An approach to using computers to enhance engineering mechanics education at our faculty involved the use of computer interactive desktop applications, virtual laboratory modules and experiments, computer based simulations, Java Applets, etc. This approach was motivated by the fact that the concepts taught in introductory engineering mechanics courses are often difficult for students to visualize and fully grasp. According to [6], an effective multimedia program should clarify abstract topics that are difficult to understand using traditional teaching media and focus on teaching concepts rather than entertaining students with shallow special effects. Software is currently being developed for Mechanics fundamentals, Dynamics and vibration and Strength of materials which focuses on illustrating theory, presenting relevant examples, and supplying quizzes for users to work. Many students first encountering mechanics have problems identifying what is wanted, how to decompose the problem into simpler segments, and what information they need to solve the problem. For such students, the authors believe that a directed learning procedure similar to that presented as examples in this paper is an appropriate procedure.

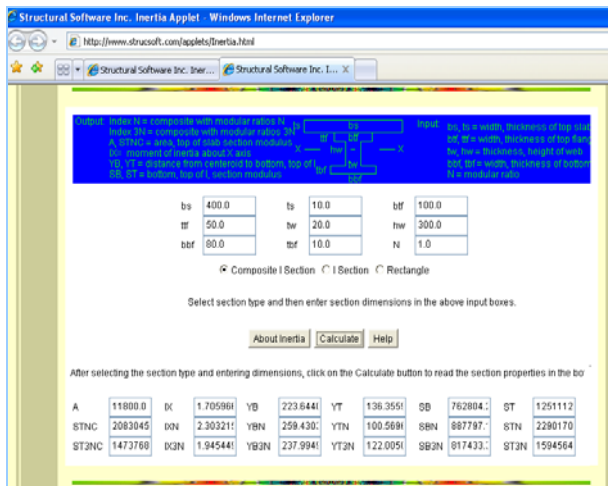
### 2. THE CASE STUDY

As a teacher team that has expertise in engineering of mechanical systems field, we have proposed two year ago a project for an interdisciplinary virtual laboratory-classroom equipped with computers network and educational software. This laboratory is currently operational in our faculty and is dedicated our students, future mechanical engineers, who can use here innovative and advanced educational software solutions. In this interdisciplinary laboratory, over the winter semester of the current academic year, we have developed a test program regarding the use of specific pedagogical resources in the teaching process of basic engineering disciplines, such as Fundamentals of Mechanical Engineering, Mechanics of Materials and Mechanical Vibration. This test program is continued during the summer semester in aim to investigate how educational soft wares can aid our students to involved their design and structural analysis competences.

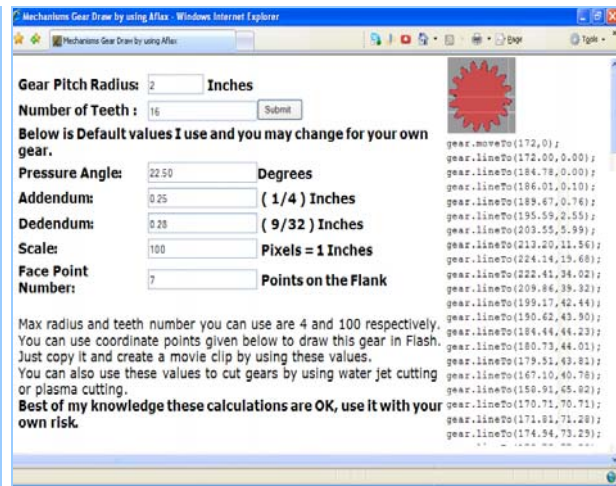
During the preparation period of this test program, our team devotes considerable resources to identifying the latest developments of dedicated and, if it is possible, free accessible software's, in order to update and review the packages installed on the network. In Figure 1a-1f and Figure 2a-2d, we are exemplified some of teaching resources used in our virtual laboratory-classroom.

In the domain of mechanical engineering, most of the current existing educational software can be grouped, generally, in the following categories: tutorials, worksheets, and basic analysis packages.

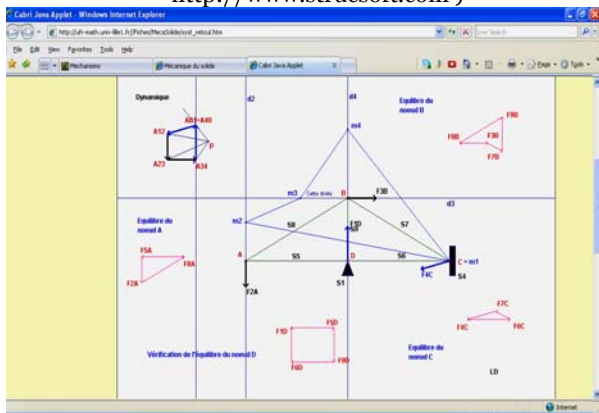
- ✚ Tutorials direct the student through a series of prepared screens, each focused on a specific concept or skill. In this manner, tutorials are like lectures delivered in a different format. Tutorials such as the Multimedia Engineering series feature impressive presentation complete with animation, video clips, and audio files. [2]. Despite excellent presentation, however, tutorial products are limited in applicability. The student must follow the sequence of the tutorial presentation in the same way that they would follow along in a lecture. Also, the student must master the concept presented by the tutorial and then apply that concept to the particular problems that they are asked to solve in their homework assignments.
- ✚ Worksheets for equation-solving software such as Mathcad, MATLAB, etc, have also been developed to supplement the mechanics engineering courses [3]. One drawback of worksheets is that the student must be somewhat familiar with the host software package in order to use the worksheet. This disadvantage can also be viewed as an advantage since worksheets encourage the student to develop some command of the equation-solving software, and familiarity with the equation-solving software is a skill that is useful in later engineering courses. However, to the student whose immediate goal is learning the mechanics of materials concepts, the added burden of gaining proficiency with the equation-solving software can be daunting.
- ✚ Basic analysis packages have been included in several widely available mechanics of materials textbooks such as [4], [5]. These programs are useful as tools for assisting students in fundamental skills such as plotting shear and bending moment diagrams or performing Mohr's circle calculations. Basic analysis programs may require students to define nodes and elements and to assign section properties and material constants to the elements.



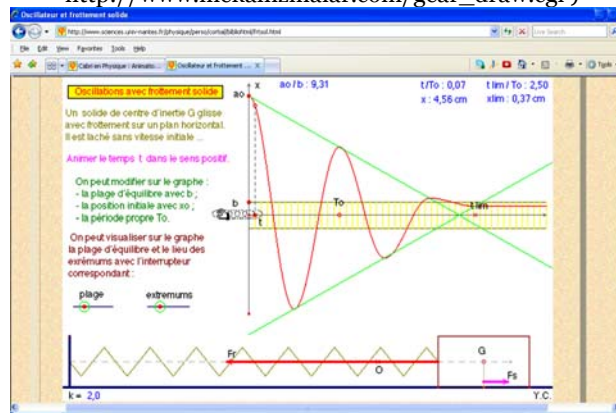
a. Inertia.class Applet  
(source Structural Software, Inc.,  
<http://www.strucsoft.com>)



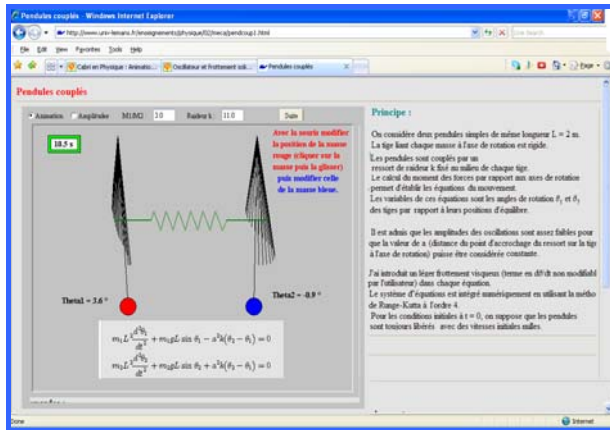
b. Mechanism Applet Index, Linkage Mechanisms, Gears, Pneumatic Systems (source of the applet [http://www.mekanizmalar.com/gear\\_draw.cgi](http://www.mekanizmalar.com/gear_draw.cgi))



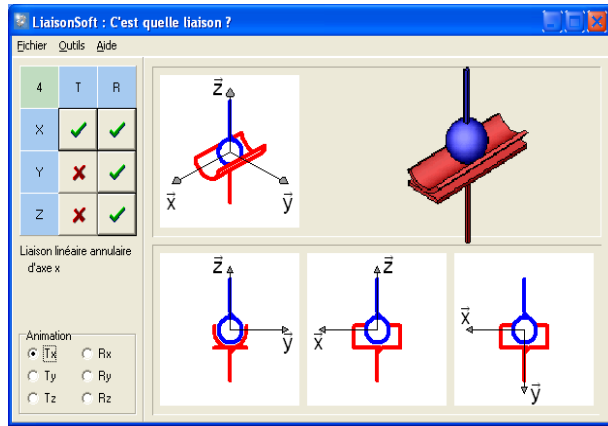
c. Cabri Java Applet Equilibre de systèmes réticulés  
(source Laboratoire virtuel- Université de Lille, France,  
[http://ufr-math.univ-lille1.fr/Fiches/MecaSolide/syst\\_retilcul.htm](http://ufr-math.univ-lille1.fr/Fiches/MecaSolide/syst_retilcul.htm))



d. Cabri Java Applet Oscillateur. Ressort avec frottement  
(source Laboratoire-Université Nantes,France,  
<http://www.sciences.univ-nantes.fr>)

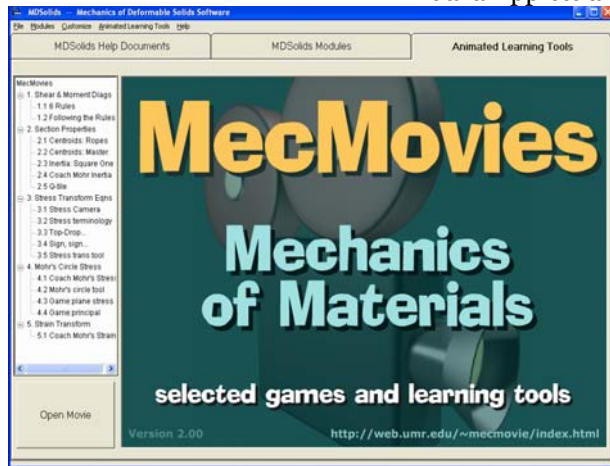


e. Cabri Java Applet  
(source Laboratoire-Université Nantes, France,  
<http://www.sciences.univ-nantes.fr>)

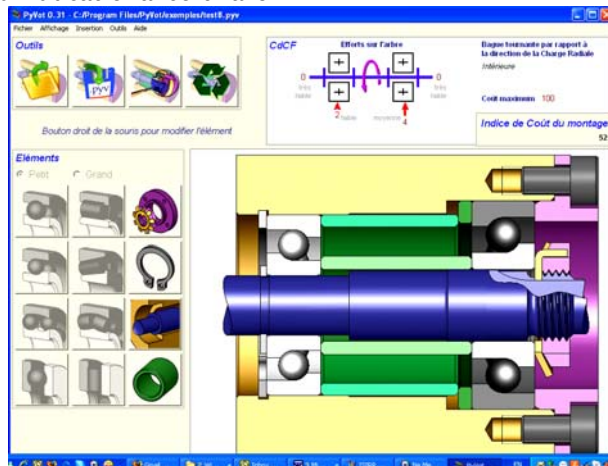


f. Educational software MecaTools  
(source Laboratoire-Université Nantes, France,  
<http://www.mecatools.new.fr>)

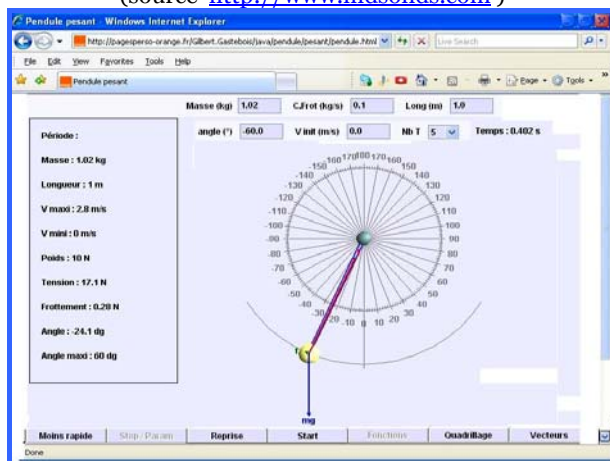
Figure 1. Teaching resources used in the virtual laboratory-classroom Java Applets and Educational software



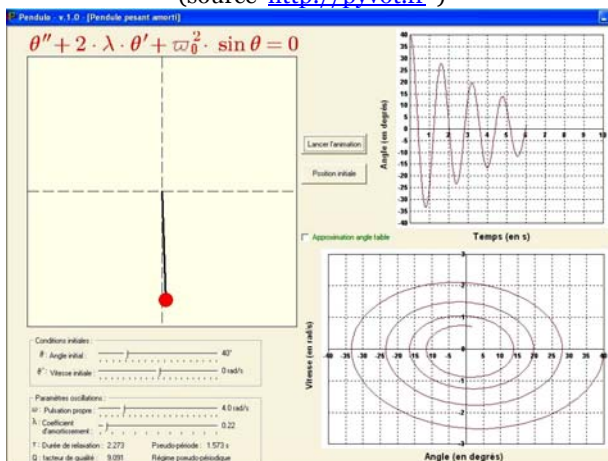
a. Educational software MdSolids  
Animated Learning Tools Module  
(source <http://www.mdsolids.com>)



b. Educational software PyVot  
Bearing assembly Analyzer  
(source <http://pyvot.fr>)



c. Educational software  
Simulations in physical sciences  
(source <http://pagesperso-orange.fr/~java/accueil.htm>)



d. Educational software Pendulo  
Engineering sciences  
(source <http://www.sciences-edu.net/>)

Figure 2. Educational dedicated software used in the virtual laboratory.

Input for these programs has typically been very text-based, often requiring a user's manual to ensure that the proper data and sign conventions are used and to help in interpreting the program output.

The novice engineer may feel overwhelmed by the attention to detail needed to set up an analysis model and may have difficulty visualizing and interpreting the resulting tables of numerical output.

### 3. ANALISES, DISCUSSIONS, APPROACHES, INTERPRETATIONS

The final goals of our work initiative in the virtual laboratory-classroom are listed below. These objectives are more detailed described in the laboratory project proposition.

1. Use hands-on and visualization tools to aid students in problem formulation and enhance learning opportunities.
2. Integrate software simulation experiences into lectures.
3. Ensure that the equipment that is developed has an impact on core courses in Statics and Solid Mechanics as well as advanced courses in the Mechanical engineering programs.
4. Improve the critical thinking and problem solving skills of students by engaging them in the learning process, allowing individual experimentation and providing for interchangeability of the tools.
5. Ensure material is taught in variety of ways to benefit students with various learning styles.

During the implementation period of the project, we consistently that, generally, a fairly consistent part of the educational softwares are developed from the professor's point of view, emphasizing lecture topics or permitting the student to perform more advanced calculations.

But, to be successful, educational software should be developed from the student's point of view. Rather than forcing the student to solve a problem posed by the software, the software should solve the problem of interest to the student. To do this, educational software must be:

- ✚ versatile in the types of problems that can be solved;
- ✚ strongly visual to illustrate the behavior of materials or of mechanical systems;
- ✚ informative in explaining how and why the calculations are performed;
- ✚ intuitive and easy-to-use so that the student is presented with just the right amount of information and analytical power.

### 4. CONCLUSIONS

Today, engineering education can be considered realizing the potential of multimedia as learning and teaching tool. The use of computer multimedia offers several tools that are useful in general engineering education and, particularly, in mechanical engineering education. Classical engineering graphics topics using a combination of animation, audio description, and interactive exercises can help the students

The most important benefit provided by multimedia can be considered the possibility of interaction. Many studies indicating that interacting with information can be a positive effect on learning since people remember/internalize more information if they interact with it (e.g. hears, see, and do). Multimedia provides an excellent means of generating interaction through interfaces that require the user to make choices and perform actions.

Results of surveys indicate that the use of multimedia educational software in the virtual laboratory-classroom was extremely well received by the students and helped with the understanding of the training material in mechanical engineering field in mechanical engineering domain.

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