

## Research on the Integrated Implementation of Mechanical Professional Curriculum Designs Based on Virtual Prototype Technology

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**Abstract.** For the problems such as lacking close relationship among these mechanical professional curriculum designs, curriculum knowledge division alone, without integrating the relevant knowledge and failing to highlight the characteristics of mechanical major, an integrated implementation system is established for the engineering practice teaching in view of the mechanical professional engineering certification requirements. This system breaks the relatively independent practice of these curriculum designs and fuses to form a whole, as well as brings innovation design idea into the curriculum design. For the target to solve complex engineering problems, the curriculum design and its content will be set in stages based on virtual prototype technology. The teaching reform can strengthen students' abilities such as operation, practical skills, problem-solving, exploration and innovation. So the reform project for mechanical professional curriculum designs is of important academic significance and engineering application value.

### Introduction

With the rapid development of CAD/CAM/CAE technology, especially the international virtual prototype technique (in particular, mechanical system dynamic simulation technology) developed in the 1980s for the traditional mechanical design method brings a great breakthrough, the mechanical design method is transformed from the original experience design, static design and analog design into the mechanical system dynamic simulation design [1,2]. Today, in the western countries, virtual prototype technology is widely used in mechanical design or product development, China also attaches great importance to the application of virtual prototype technology, in “the tenth five-year plan of manufacturing and automation and 2015 vision”, virtual prototype technology has been listed as key technology and important direction for future research and promotion.

The rapid development of computer technology and the constantly improving of software and hardware support technology, make the product design means and methods in the event of a significant change. Computer technology and numerical technology, mechanical design combination and infiltration caused a computer aided design and computer aided engineering technology (CAD/CAE/CAM), and the CAD/CAE/CAM technology application in the engineering practice and function is increasingly significant. In order to make students better adapt to and serve the society and make them master some CAD/CAE/CAM technology, in mechanical design course design, the reform and exploration for the teaching of mechanical design course design is very necessary to improve students' ability of mechanical design and innovative [3,4].

Beginning in the 1980s, in order to improve the mechanical major students' ability to solve complex engineering problems and cultivate talents of CAD/CAE/CAM technology, the various engineering schools successively offer courses of computer aided design and manufacture for mechanical major students. With the development of production technology of mechanical processing enterprises, the computers aided design, analysis and manufacture technology more and

more occupies an important position. To training talents for the enterprise, the engineering schools are constantly groped in teaching theory and practice of CAD/CAE/CAM.

Curriculum design is one of the important teaching links, and the nature of curriculum design determines whether it has a unique advantage in the following aspects, such as carrying on the quality-oriented education for the student, cultivating students' engineering consciousness and ability to design, etc. The conventional mechanical professional each core course is designed to separate each other, and there has no contact each other, the teacher not only limits the design questions and solutions, but also provides a very complete resources, so it leads to the students' innovation consciousness is not very well developed [5].

At present, in the link of mechanical professional core curriculum design, there needs to be improved problem as follows:

(a) It lacks of close ties between mechanical professional core curriculum designs, curriculum knowledge divides alone. It has no comprehensive knowledge and no coherence and systematic, also failed to highlight the characteristics of this major, so led to the student is not very good to achieve mastery through a comprehensive study of knowledge, and lacks the ways and means to solve the problem in the face of complex engineering practice.

(b) The cohesion of series of mechanical foundation courses and professional courses is not quite close together. The cause of the defects in the final analysis is due to a lack of a coherent and comprehensive practice to link this series of courses. Therefore, it is necessary to design a systematic curriculum to fuse machinery series course knowledge of machinery and equipment, design a phased implementation of the comprehensive design practice, make mechanical equipment of each curriculum design as design object, promote the integration of knowledge, cultivate students' ability of problem analyzing and solving, engineering comprehensive and innovation.

(c) The lack of students' innovative consciousness. Due to the relative isolation to curriculum design, and each design task is relatively small, the investment of time and energy on students in the design are limited. Moreover, the lack of continuity and systemic design task, result in curriculum design itself less attractive, and not stimulate students' innovation consciousness.

(d) Design way or means lag behind. Now, the students in the various curriculum design still stay on the chart hand drawing, artificial calculation stage, not well using virtual prototype technology, the design scheme can't accurate, intuitive validation and demonstration, design result accuracy and availability cannot guarantee.

Anyhow, the core curriculum design of mechanical major should adapt to the new curriculum reform and practice, make the courses such as mechanical drawing, mechanical principle, mechanical design, mechanical manufacturing industry can organic unifies in together. Through the curriculum design to apply learned information integrated together, make the system design and detailed design of mechanical parts to better link up and strengthen the training of the mechanical system design, so as to pay more attention to students' basic skill and the cultivation of innovative thinking, more stimulate the students' learning enthusiasm and initiative, improve the design level of students, cultivate their innovation consciousness and practical ability. The teaching reform of mechanical professional core curriculum designs should meet the requirements of mechanical engineering certification, and further improve students' ability to solve complex engineering problems, training students' engineering practical ability and innovative design ability.

### **Reform Measures and Solutions**

Building the construction scheme and implementation method based on the engineering practice ability training courses, integrating the customary processes of each curriculum design and arranging all the curriculum designs, so as to meet the demand of engineering certification, to promote the engineering practice ability and innovation consciousness for the undergraduates in application-oriented universities, to improve the ability to solve complex engineering problems, to accelerate the systematic scientific and standardized process of the curriculum design, to improve the

quality of curriculum design, and to provide necessary guarantee for mechanical professional certification [6].

### **Arranging Overall Core Curriculum Design Task to Realize the Systemic and Continuity Characteristics**

Guided by the requirement of mechanical engineering certification, according to the talent training scheme to integrate various curriculum design and arrange the task of each curriculum design based on design sequence. The blueprint of integrated curriculum design is carefully constructed based on the standard of design and processing of mechanical equipment. In addition, the total quality management approach enterprise commonly used is imported and each process of teaching link is controlled, to realize having planning and guidance before the design and having a check in the design process and having a summary after the design.

### **Strengthen the Cultivation of the Students' Engineering Application and Innovation Ability**

To further enhance the ability to solve complex engineering problem, the cultivation of students' engineering application ability and innovation ability is further strengthened. In the curriculum design, teacher plays an important role for the cultivation of the students' engineering application ability and innovation ability, so need to focus on solving the problem of shortage of engineering practice experience. Aiming at these problems, measures taken have the following several aspects. The professional teacher requires must teach above 3 professional courses and is encouraged to participate in practical design work. The teachers who lack of practical experience are arranged to institute or processing unit to exercise engineering technical ability, to help them obtain engineering practice and relevant information of curriculum design from machinery industry production field. To ensure the smooth implementation of curriculum design guidance work, teachers' vision of mechanical discipline field is widen, teachers' ability of engineering practice and the quality of practice teaching is improved. In the guidance of the curriculum design, teachers will ask students to have a whole grasp the content of the design work for the actual mechanics involved, and combined with scientific research task or social hot issues, as much as possible to carry out the realistic study. In addition, students are required to collect the similar specification and design data manual, and to study its content analysis, pay attention to training students to solve practical engineering problems and the ability of independent analysis problems. The evaluation system is reformed and the evaluation method is diversified, innovation and distinctive design is encouraged by adding cents, so as to mobilize students' subjective initiative and raises student's innovation ability.

### **Virtual Prototype Technology is Applied in the Curriculum Design**

In view of the complex engineering problem, considering the role of computer in mechanical industry is more and more important, so good computer application ability has become an indispensable basic quality for senior engineering technical personnel. Let students try using virtual prototype technology in the curriculum design (AutoCAD, CAXA, Pro/E, MasterCAM, CATIA and ADAMS, ANSYS, etc.), so that the design conforms with the requirements of modern enterprise, and require students to learn to apply the latest drawing and calculation tools to solve practical engineering problems, so as to train the students with the characteristics and features.

### **The Integrated Implementation**

#### **Expand the Teaching Links of Curriculum Design and Carry Out the Multidisciplinary Integrated Curriculum Design Based on Virtual Prototype Technology**

Curriculum design is an important practice activity to cultivate students to solve practical engineering problem. The professional original design involves course including mechanical drawing, mechanical principles, mechanical design, mechanical manufacturing technology base and mechanical manufacturing equipment design, etc. To the need of professional certification, the original

architecture of curriculum design is redesigned, the content of these curriculum designs are optimized and integrated, and each link of the whole process of multidisciplinary integrated curriculum design is implemented continuously. Through the above measures, in order to solve complex engineering problems as the goal, in phases to complete the design task, promote the knowledge fusion of various curriculums, cultivate students the comprehensive application of knowledge ability and practice ability.

The curriculum design of mechanical drawing is designed to complete the engineering mechanical system structure analysis and mechanical parts of surveying and mapping work. In this process, the virtual prototype technology is used to train students' basic ability of structure analysis, surveying and mapping, map reading and drawing.

Based on virtual prototype technology, reform the original curriculum design content of mechanical principle and mechanical design. For a given process parameters, the following work for an engineering machinery and equipment will be carried out including the scheme of mechanical movement, kinematics and dynamics analysis, the dimension synthesis, strength and stiffness checking, the writing of design specification of assembly drawing and part drawing, etc.

Based on virtual prototype technology, complete the processing technic and assembly plan of mechanical system components for the course such as mechanical manufacturing technology base and mechanical manufacturing equipment design, and design and manufacture fixture, etc, ultimately achieve the goal of grasping all kinds of processing methods and processing technology and writing the processing technology of main parts.

In the practice of curriculum course design, the work route of production and processing is followed, as shown in Figure 1. Let the students have to study the related software of virtual prototype technology successively and finally design a comprehensive training link, so a coherent line, CAD-CAE-CAPP-CAM-actual processing, is to be built for a mechanical part. As long as finished the above learning process, students will be adept and have a good job for the whole process of mechanical processing in the future.

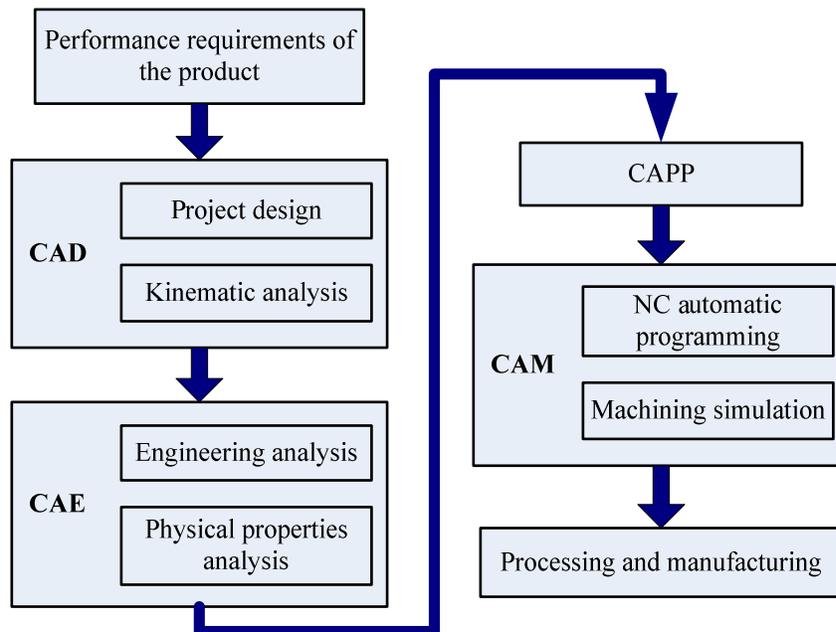


Figure 1. The implementation of virtual prototype technology roadmap of mechanical product.

**On the Basis of Training Students to Solve Practical Engineering Problems, Inspire the Students' Innovation Consciousness**

In terms of structure design, a new pattern is established from 2D design to 3D design. Through the expansion of curriculum content and the integrated design of actual project with a comprehensive production background, it not only help students to establish a complete understanding of mechanical systems, but more importantly through the cultivation of students' comprehensive ability, gives the creative potential for students and improve the ability of design, computer skills and thinking in images.

**The Virtual Prototyping Relevant Softwares Have a Combined Application in the Scheme Design of Mechanical System**

For complex engineering problems, combined with ADAMS and Pro/E and ANSYS to establish the virtual prototype model of combining rigid body and flexible body, on this basis, movement and dynamics simulation was carried out. The process is shown in Figure 2.

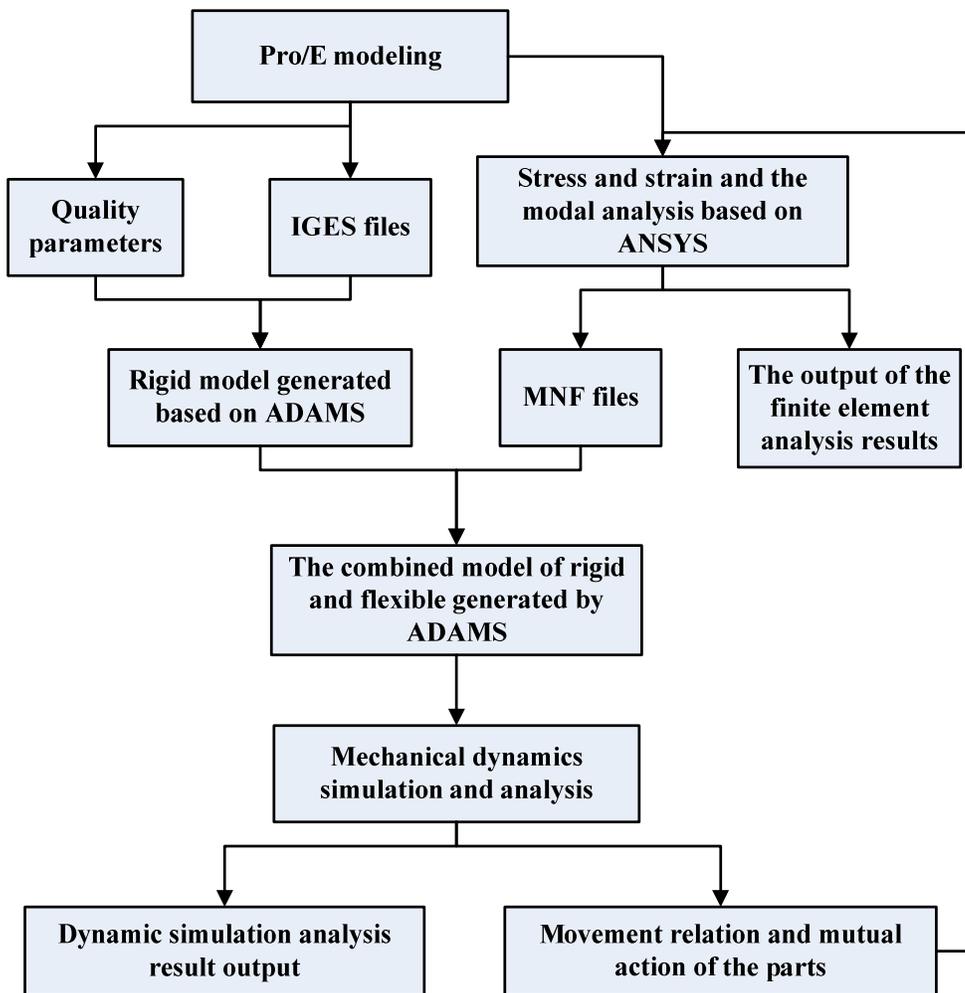


Figure 2. The process flow chart of curriculum design based on virtual prototype technology.

**Summary**

The integrated implement of these core curriculum designs of mechanical major can make various curriculum organically unifies in together. Through the reformed curriculum design, the relevant content will have a comprehensive use and the system scheme design and concrete design of

mechanical parts will link up better. Such a design can not only strengthen the training of mechanical system design, pay attention to the students' ability to solve complex engineering problems and the cultivation of innovative thinking, but also can stimulate the students' learning enthusiasm and initiative, improve the level of the design of the students and cultivate their innovation consciousness and practical ability. The teaching reform of curriculum design will lay a foundation for further satisfying the requirement of mechanical professional certification and training students' ability of solving complex engineering problems and innovative design.

For complex engineering problems, the use of virtual prototype technology can liberate the students from the cumbersome manual drawing and calculation, and make them put more energy in the structure innovation, visual simulation and precise checking, etc. Because the whole design process of virtual prototype technology is in 3D space, and the space of virtual prototype technology is quite coincident with real life space, so using virtual prototype technology for the mechanical structure design and mechanism motion simulation can provide a broad space for students' creative potential. Based on the joint application of modeling software, finite element analysis software and dynamics simulation software, it can set up the simulation model of combining rigid body and flexible body and carries on the dynamic simulation analysis, can more truly simulate the working state of the physical prototype, make the results of simulation analysis conforms to the actual situation. So this is new development of virtual prototype technology in mechanical professional education.

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