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Cultivation and Practice of College Students' Mechanical Innovative Ability by Combining Virtuality with Reality

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Abstract: *Cultivating college students' mechanical innovation ability is urgent requirements for mechanical engineering education in today's society. In this paper, we put forward improving the students' ability of knowledge application and mechanical innovation design through virtual assembly technology based on institutional innovation in the comprehensive practice teaching. The practice results of teaching reform show that the teaching based on virtual simulation and assembly technology of engineering helps students apply what they have learned, stimulate their interest in learning, and cultivate their mechanical innovation design ability, which verifies the validity of the teaching reform..*

Keywords: *Virtual assembly, mechanical innovation, knowledge application, teaching reform*

I. Introduction

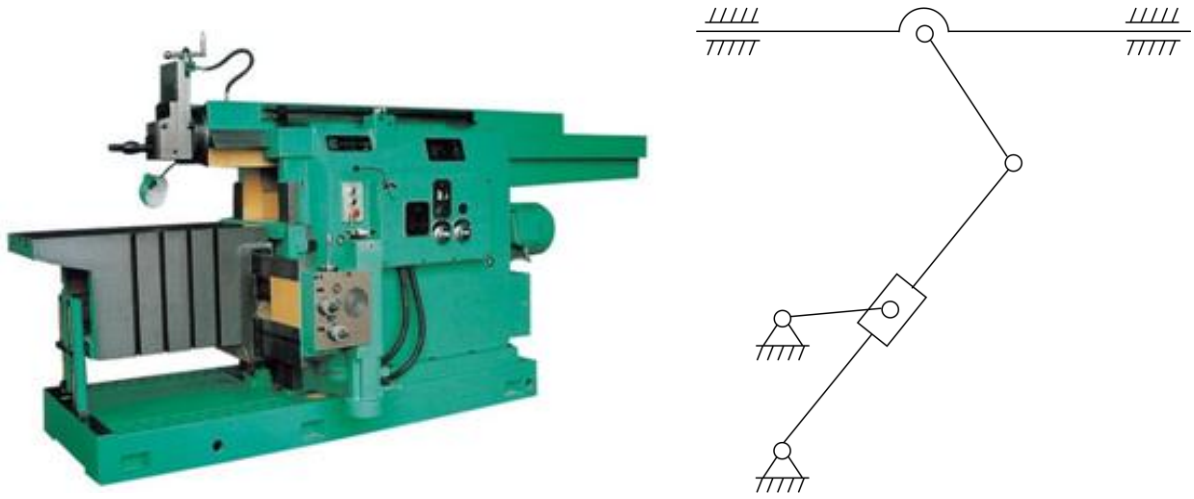
President Jiang Zemin said that [1], "The Innovation is the spirit of nation's progress and the invariable force of a country's prosperity. If the independent innovation ability is weak and blindly rely on technology import, it will always be difficult to get rid of the outdated technology. It will be hard for a nation without innovation ability to stand among advanced nations of the world." With the development of the computer technology, the virtual technology has also been developing rapidly. As a new teaching media, virtual reality technology has been widely applied in college teaching [2]. Aiming at the teaching reform of chemical reaction engineering, Chen *et al*. [3] discussed that how to integrate the virtual simulation technology with the teaching philosophy of chemical reaction, and how to use the existing various virtual simulation technique form to enrich the course content and teaching methods. From the practical teaching plan in the practical teaching of Virtual Reality and System Simulation, Yang *et al*. [4] introduced the teaching practice and the extracurricular research work. Han *et al*. [5] introduced the main viewpoints of constructivist theory, and Virtual Reality technology features, analysed the advantage of Virtual Reality technology and discussed the application in automobile specialty teaching.

Our university is an applied-oriented institution of higher learning and cultivating and improving the students' innovation ability is an important task. Our university should keep cultivating students' ability of innovation design, innovation thinking and operational ability at the forefront especially for Mechanical Engineering students because engineering products' functions, property and quality mainly depend on the design of the products. Innovation design is one of the most important things which make the engineering products become the goods with high quality, high efficiency and strong competitive power. Mechanical innovation design which applies innovation thinking and innovation theories to mechanical design gives full apply to designers' imagination and creativity during mechanical design. Mechanical innovation design develops a lot for many reasons especially the use of computer in the fields of mechanical design with the development of information technology. Efficiency of mechanical design improves a lot when using the strong functions of calculation, logic and storage of big design applications such as Pro/E, UG and SolidWorks. These applications could also be used for 3D design, virtual assembling on the computer and minimize a problem in the design, which will reduce the period and cost of products' design. Therefore, building virtual mechanical structure design based on apps such as Pro/E and assembled scene teaching environment during the link of practice are put forward in this article. Under the circumstance of making up students' lack of engineering application, we will reach the goal of combining practice teaching with engineering practice to help our students understand and grasp knowledge points by integrating the knowledge points in class and engineering practice with the use of cartoons of virtual mechanism kinematics and component assembly .On the other hand, with the corporation of the college's newly-built mechanical innovation design laboratory and the realization of modern

innovation practice teaching under the combine of virtual assembly with real assembly, we will enhance the students' practicing ability and cultivate their skills of mechanism innovation design in order to improve the teaching effect.

II. Simplification Of Mechanism

The shaping machine's main use is to cut and form flat surfaces, molding surfaces and grooves of small and medium-sized workpieces for single-production in the factory. Planer's main parameter is the maximum cutting length, and the rams' speed is different because small and middle-sized shapers' main motion mostly take the way of crank and rocker mechanism. If machining with single-point tools and there's no cut during return stroke of the rams, the shaper's production efficiency will be very low. Big-sized shapers mainly use the way of hydraulic transmission and the rams work with the same speed so that the rams' return speed will be higher than working speed. In recent years, for the new products of mechanically operated shapers which were jointly designed and made in our country, not only their outlook and rigidity have been improved but they were easily operated and made great progress in some ways. Shapers also have high efficiency especially when meeting narrow and long surface because their planer tools have simple structure and could be easily sharpened. Therefore, this kind of machine tools could be used in a lot of aspects especially for industries related to instrument, machine maintenance and some military-industrial sectors when doing single-production. Fig. 1(a) is the shaper's stereogram. Fig. 1(b) is the shaper's simplified diagram. In the simplified graph, bar 2 can be compared to electric motor. When the bar 2 contrarotates, the sliding block which connected to bar2 by rotation pair will do plane motion with the guide-bar 3.Finally, the slide bar will realize the rolling motion in line, which also means realizing the shaper's function of planing.



(a) Stereogram (b) Simplified diagram

Fig.1 A case for heuristic teaching

III. Do modeling and virtual assembly with innovated experimental facilities

Students use the machine part on the experiment table to prove the efficiency of simplified mechanism. Firstly, they use the Pro/E to do 3D modeling of the machine parts and do virtual assembly according to the experiment table and simplified diagram to achieve the results of Fig. 2 [6]. Virtual assembly is very important and we can use it to know whether this kind of design is right. If we can find the existed trouble on time, we could deal with it. In recent years, virtual assembly technique has attracted the extensive attention of academic and industrial community, which also has deep effects on advanced manufacturing modes such as agile manufacturing, virtual manufacturing and so on. Virtual assembly technique can build virtual environment like the real on the computer by establishing the data model of assembly. We could replace the traditional designed prototype with virtual products, which will be easy to make simulation and analysis and predict the products' assembly performance in order to find the potential conflicts and defect of virtual products and feedback the assembly information to the designers. It will be beneficial to the start of the cocurrrent engineering after the

application of the technology. The technology can also greatly shorten production cycle, reduce the cost and improve the market competitiveness.

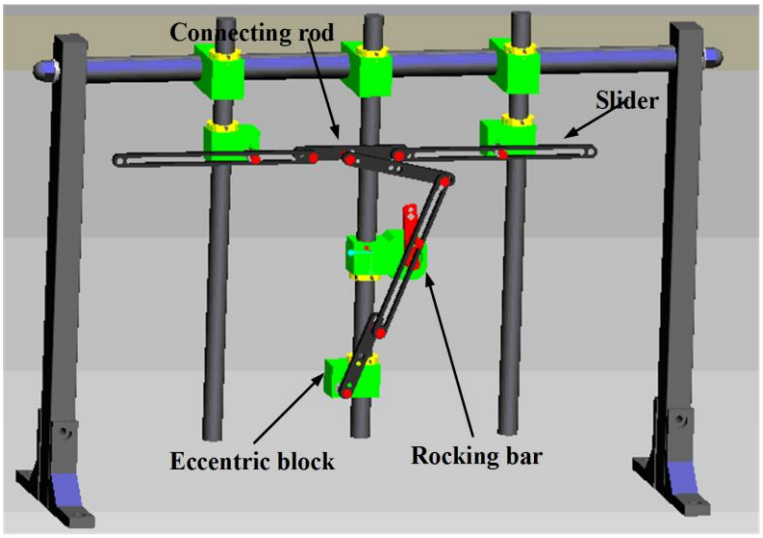


Fig.2 Virtual assembly drawing of shaper

IV. Physical structure and test on the facility in the laboratory

Let students do the physical structure on the 3DMC experiment table. In the first place, they should modify the pole spacing. Then, they need to measure the size of the experiment table and the parts they need in order to fit the table. They ought to decide where to start afterwards.

To prevent the parts from dropping because of rotation, we need to use gaskets to increase the friction between parts. We should also be careful of the distance between parts when building this in case of collision of parts which will lead to the experiment's failure and damage the machine. Therefore, we still need to check it before build up the real model and then we could apply power. Fig. 3 is physical structure graph of shaper. Students could begin each structural member's measurement and measure the angular velocity and angular acceleration if the shaper has no problems of interference and movement.

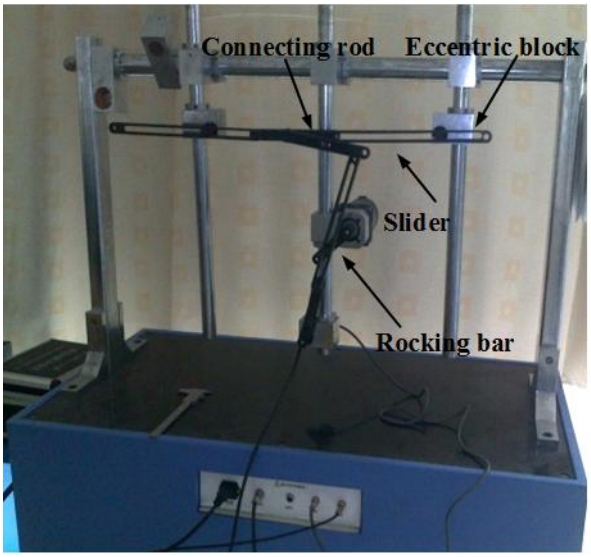


Fig.3 Physical structure of shaper

Fig. 4 is the student's measurement of the key crank members' angular, angular velocity and angular acceleration. From the figure, we can see that there is not much change of the angular velocity, which indicates that the change is smooth.

Fig.4 Experiment test results of cranks on the shaper

What we can see from the angular acceleration curve is that the angular acceleration changes all the time and it changes fast, too.

V. Conclusion

Students' mechanical innovation ability will directly decide students' specialty diathesis that will affect their competitiveness. To improve our academy's students' mechanical innovation ability, the research group will reform practice teaching via increase the application of virtual simulation and assembly in the teaching project based on the firm connect between practical teaching and project cases. The project group have succeed in helping students vote for nearly ten undergraduate mechanical innovation projects after starting practice teaching reform and one of which is national level while two projects are Jiangsu province college students practice innovation training program. In the programs, projects of ' Quadrocopter' and' Service robot in smart home' took part in the innovation competition of Jiangsu province in year 2010 and year 2012 and got the second award. In recent years, we took part in the national machinery innovation fischer group game and achieved seven second awards and two third awards. Students' graduation projects achieved three excellent team graduation projects of Jiangsu province and one individual excellent graduation projects of second award. These achievements show that students' mechanical innovation ability has got great improvement and prove the efficiency of the research group's behavior of starting practice teaching reform.

Acknowledgements

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