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Application of Virtual Reality Teaching Method in Combination with Practical Teaching Method in the Undergraduate Teaching of Colleges

-Taking the Course of Rolling Technology as an Example

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***Abstract*—This paper has introduced the application of virtual reality teaching method in combination with the practical teaching method in the theoretical teaching of application-oriented undergraduate colleges. Virtual simulation system is used to build the training platform consistent with the actual production environment for students to ensure students in an authentic simulated rolling production environment. Students can independently complete a dozen practical training tasks close to production practice or complete it in groups, and meanwhile, use the hot rolling mill of the rolling laboratory to complete the rolling experiment. Students can not only get familiar with the typical production workshop equipment of steel plate and strip, but also master the production procedures of steel plate and strip, and ensure the teaching effect while cultivating their independent working capacity and coordination capacity, improving students' post practice skills, and possessing the capacity to take the post directly. All of this has met the requirements of the society and enterprises for the theoretical knowledge and strong practical capacity of application-oriented talents.**

Keywords—Virtual reality; Practice teaching; Rolling technology

I. INTRODUCTION

Rolling Technology II (Plate and Strip Production) is one of the compulsory professional courses for students majoring in material modeling and control engineering, and occupies an important position in professional cultivation. The teaching objective is to make students more systematically mater the basic knowledge, principle and methods about the production of steel plate and strip, initially possess the capacity for analyzing and solving problems, and lay a foundation for being engaged in the production, management, design and scientific research of steel plate and strip[1]. The traditional teaching about the production of plate and strip is to adopt "blackboard steel rolling" mode, and the theoretical contents are abstract, making it hard for students to contact it with actual production. Now, we adopt the combination of virtual reality and practical teaching method, make abstract knowledge vivid, so that students can easily understand them, and then in combination with professional knowledge, students can use simulated practical training system for design and operation exercise, and then realize design scheme in the rolling laboratory, and then after practice, students can fully master the theoretical knowledge [2]. This paper takes the core knowledge module of the course--the rolling reduction schedule design and strip shape control as an example to elaborate the practice of virtual reality teaching method and practical teaching method in the course.

II. APPLICATION OF VIRTUAL REALITY IN THE ROLLING REDUCTION SCHEDULE DESIGN AND PRACTICE

The rolling reduction schedule design is one of the core knowledge modules for the rolling technology course, and a reasonable rolling reduction schedule is the basis for producing qualified plate and strip products, and the precondition for ensuring the quality of plate and strip products. The basic contents of the design include: The verification about the biting capacity of rolling mill, the design of rolling pass, the design of reduction rate for each pass, the design of export thickness for each pass of rolling piece.

A. Teaching design

In traditional teaching, this part of contents will be mainly taught via blackboard and PPT, the derivation and application of the teachers' teaching experience formula, and students will design as per the products set by teachers. Traditional teaching lacks in the inspection of design result, and students cannot judge the difference between different design schemes, so it is impossible to find out the optimal scheme via comparison [3-5]. Use the hot continuous rolling steel strip simulated practical training software to simulate the rolling operation training; students can use the interface data feedback and rolling statement to directly see the practical training result of the design scheme and then guide students to discuss spontaneously and amend the design scheme. Use the 300 Two-high Rolling Mill of the rolling laboratory to respectively complete the rolling experiment as per the pass and the amended design scheme, and reach to the designed target product size. The mode of combining virtual reality and practical teaching can largely improve students' learning initiative, and then apply it in practice, with good teaching effect.

B. Simulated application

As per the calculation formula, students can calculate the reduction schedule, and then input the rolling parameters in the hot continuous rolling simulated practical training system, observe the data in real time, query the rolling statement, and then complete the rolling reduction schedule design as per the statement optimization design scheme.

As for the first pass of the reduction quantity design for rough rolling in the rolling reduction schedule, the experience range for the reduction rate is 30%-40%, the diameter of the rolling mill and roller is 700mm, and the size of raw materials is 135mm×1250mm×13500mm; students can design the first pass of reduction quantity as 54mm according to 40% reduction rate, and then respectively design the second pass and the third pass of reduction quantity. Students used their own student number as the user name to log in the hot rolling simulated practical training system, as shown in Figure 1, to select the steel type, the size and specification of raw materials, the size and specification of finished products, and complete the preparation work before rough rolling, and then input the calculation parameters of rolling reduction schedule in the rolling control interface, and after clicking rolling start, it was found that the system prompted rolling bite failure, and it was impossible to complete the rolling process, and realize the big rough rolling reduction and the longitudinal extension of products. After problems occur, students actively looked up textbooks and references, and then found out that no verification was made for the biting conditions of the rolling mill, and after calculation, the maximum reduction quantity shall not exceed 42.4mm. In order to realize biting and sufficiently exert the capacity of the rolling mill, the first pass of reduction quantity shall be amended as 40.9mm, and the amended scheme is as shown in Table 1, and the control interface input parameters are as shown in Figure 2. Students can observe the appearance of steel plate via the virtual interface in real time during the rolling process, and can also observe longitudinal direction is the main extension direction of the plate and strip, the length will be increased, but the thickness will become thinner, as shown in Figure 3.

TABLE I. ROLLING REDUCTION SCHEDULE

	B (mm)	H (mm)	L (mm)	ΔH (mm)	ε (%)
FCE	1250	135	13500		
R-1	1250	94.1	19367	**40.9**	30.2
R-2	1250	57.7	31585	36.4	38.7
R-3	1250	32.0	56953	25.7	44.5
F1	1250	16.58	109922	15.42	48.1
F2	1250	9.81	185726	6.77	40
F3	1250	6.47	281899	3.35	34.1
F4	1250	4.44	410497	2.03	31.3
F5	1250	3.58	508378	0.85	19.1
F6	1250	3	600119	0.55	15.3

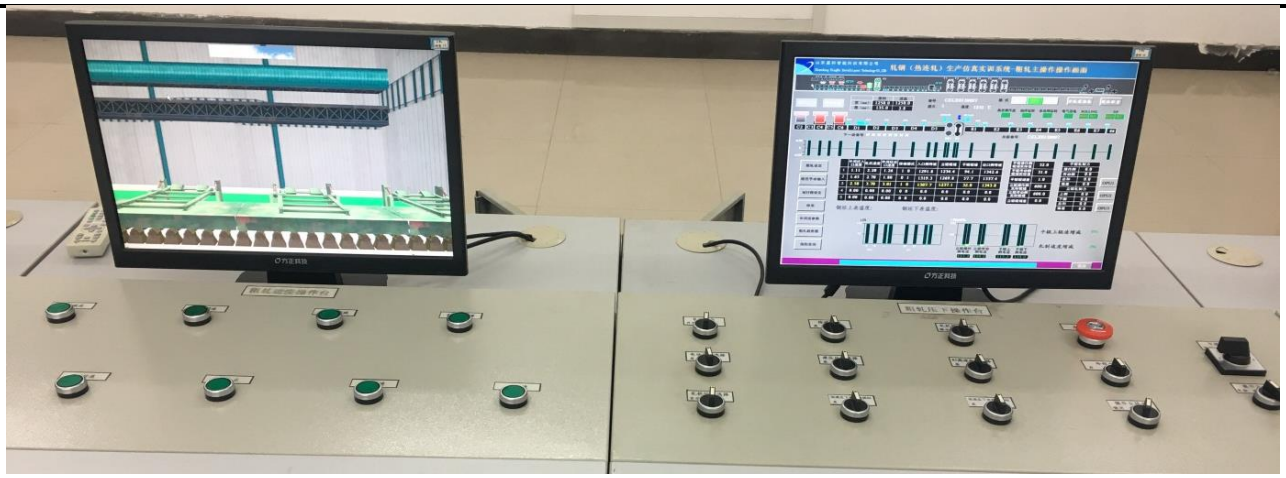

Fig. 1. Rough rolling operation station of the hot continuous rolling practical training system

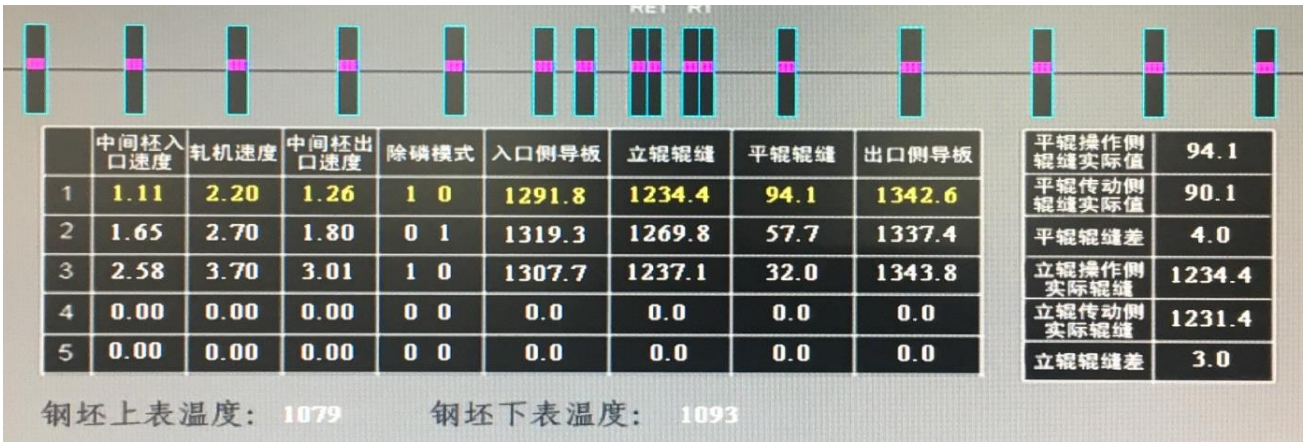

Fig. 2. Technical parameters of rough rolling

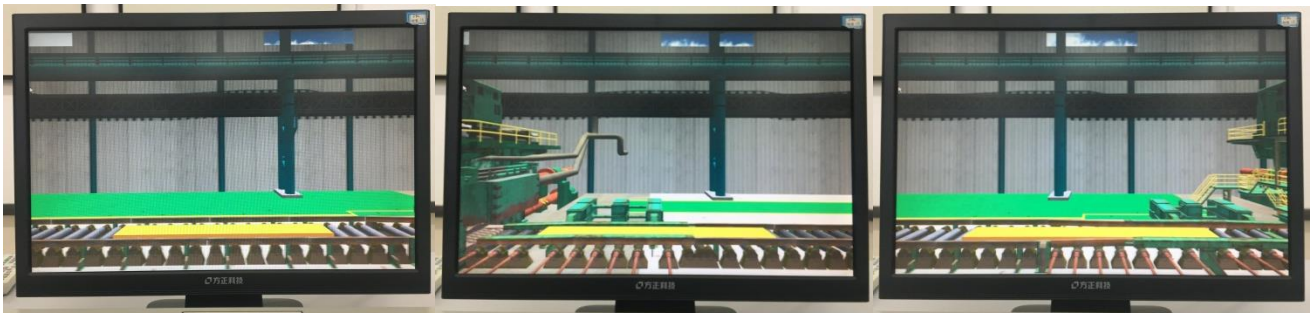

Fig. 3. Simulated interface of rough rolling process

C. *Rolling experiment*

Students can use 300 Two-high Reversible Rolling Mill of the rolling laboratory to conduct hot rolling experiment as per their designed technical procedures, as shown in Figure 4.

In the experiment process, students can more systematically master the basic principles and methods about metal rolling and deepen the understanding about theoretical knowledge.

Fig. 4. Laboratory rolling process

D. *Teaching effect analysis*

Introduce the simulated training and rolling experiment of the rolling simulated practical training system into the teaching, and make the abstract theoretical knowledge vivid, and easy to master. Students can apply theoretical knowledge in practice, and complete the closed-loop learning from the learning of theoretical knowledge to the exercise of practical capacity. The three links of design, practical training and practice can cultivate the students' capacity to formulate the technical procedures for rolling production, and technical parameters layer by layer; Possess the capacity to operate rolling production equipment; possess the capacity to analyze and solve problems

III. THE APPLICATION OF VIRTUAL REALITY IN STRIP SHAPE CONTROL TEACHING.

Strip shape control is the key technology for realizing the accurate size of strip shape products, with good surface quality and high performance. The teaching objective is to make students master the strip shape control principle and basic means.

A. Teaching design

This part of teaching contents are relatively abstract, and teachers will explain the main indexes about the strip shape, analyze factors influencing the rolled strip plate, to let students master the strip shape control methods through the adjustment of roller slot and roller speed Due to insufficient practical experience, students cannot fully control the adjustment quantity, and through simulated practical training and rolling experiment, students can intuitively see the changes incurred by the adjustment of roller slot and roller speed to the plate and strip shape, which can be good for students to link theories with practice.

B. Simulated application

The hot rolling simulated practical training system contains the strip shape defects incurred by the abnormal working conditions of raw materials. When the upper surface temperature of the raw material is lower than the lower surface temperature, and the metal deformation quantity of the upper surface is lower than that of the lower surface, the steel plate will be subject to the strip shape defect of toe spring, so it is requested to adjust the upper roller speed of the rolling mill to improve defects; students can use the system to constantly adjust the upper roller speed, until the strip shape is adjusted to straight state. Through constant training, students can personally summarize that the upper roller speed shall be changed as per 1% for each 10℃ difference in the upper and lower surface of raw materials. When the lower surface temperature is 20℃ higher than the surface temperature, it is requested to increase the upper roller speed by 2%, to improve the defects of toe spring, as shown in Figure 5.

Fig. 5. Simulated process of strip shape control

C. Rolling experiment

In the actual hot rolling experiment, there will also be defects of toe spring; through applying theoretical knowledge in combination with the experience obtained in simulated training, it is applicable to roll qualified steel plate and strip. In the experiment process, there will also be the defects of bended camber; in the rolling process, students can improve the defects of strip shape through changing the roller slot value of the operation side or the transmission side

D. Teaching effect analysis

Through combining simulated training and rolling experiment, the operational training and production, students can actively study, actively analyze problems and find out the methods to solve problems, and actually apply their knowledge, and students' recognition degree of professional knowledge is very high. Meanwhile, the one-time pass rate for students' professional courses has also been largely improved.

IV. CONCLUSION

This paper takes the application of the combination of virtual reality teaching method and practical teaching method in the core knowledge module of the rolling reduction schedule design and strip shape control as an example, and elaborates the big changes incurred by advanced teaching methods to the teaching mode and teaching effect. On the basis of the industrial demand for the knowledge and capacity of application-oriented talents, I have used advanced teaching methods to improve students' learning interests, reinforced the students' practical capacity, cultivated students' capacity to solve problems, ensured the teaching quality, and improved the teaching effect, which can be good or developing students into application-oriented talents.

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Project name: Emphasize on innovation and entrepreneurship education, build the innovative research and practice about the cultivation mode of application-oriented talents majoring in metallurgical engineering that realizes industry-education integration and cooperative education (LJF [2016] No. 23)

(3)Transformation Development Education and Teaching Reform Projects of Liaoning Institute of Science and Technology

Project name: Professional Suggestions for Metallurgical Engineering Based on Excellent Engineer Cultivation Plan

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