Journal URL: https://scholarsjournal.net/index.php/ijsc

DOI: https://doi.org/10.31686/ijsc.vol1.iss1.4151

Application and Exploration of FLUENT Software in the Teaching of Engineering Thermophysics

Xiaolang Feng, Yu Yan, Wenyu Zhang, Shiyu Liu, Jinsheng Li

School of Electronic and Electrical Engineering, Shanghai University of Engineering Science,333 Longteng Road, Shanghai201620, People's Republic of China

Email: wglwrc2016@126.com

Abstract

Engineering thermophysics is a basic discipline for energy majors, but this course emphasizes the theoretical level and is difficult to understand. Students' enthusiasm and participation in the learning process are low, and it is difficult to understand the course. Accordingly, the research team attempts to introduce Fluent software into the course teaching exploration. Specifically, Fluent software is adopted to provide a reliable physics teaching model, and to change the traditional teaching mode, so as to improve students' daily learning ability and practical ability, and ultimately enable students to learn and practice.

Keywords: Fluent Software, Engineering Thermophysics, Teaching

1. Introduction

Engineering thermophysics, also known as engineering thermodynamics, is a technical science with high application value. As its name suggests, it is the application of thermophysics in engineering. The main industries involved provide the basis, support and promotion for the sustainable development of the national economy and engineering and technological innovation and progress, and play an irreplaceable role in the engineering department. Based on the first and second laws of thermodynamics, it seeks to solve the problem of extremely low heat engine utilization of fossil energy, and involves courses such as theoretical mechanics, engineering mechanics and combustion. They permeate each other and are inseparable, which enables engineering thermophysics to become a discipline with high cross-discipline, rich content and wide application. In the teaching process of engineering thermophysics, students are prone to low enthusiasm and participation in the learning process, and can not fully understand the course content because it is difficult to combine theoretical teaching with practice. Therefore, this paper will discuss the application of Fluent software in the teaching of engineering thermophysics in order to enhance the teaching effect and improve the enthusiasm of students.

2. Problems in traditional teaching

2.1 It is difficult to be concrete

Engineering thermophysics is different from other conceptual disciplines, it is an applied discipline, involving many experimental links. However, in the face of this highly theoretical and difficult subject, it is difficult for students to understand part of the content, let alone put it into practical application. To make matters worse, students are unable to mobilize their enthusiasm for learning because they are unable to connect engineering with practice, and it is difficult to establish their own creative thinking. In the traditional classroom, the model drawings in textbooks are 2D and planar, and most students can not understand the 3D physical model with complex structure in engineering thermophysics relatively thoroughly. For example, the internal systems of some device components can not be observed intuitively, and their internal structure is very abstract, which can not be explained clearly in traditional teaching. As a result, some students who are more difficult in the course seem to understand it after learning, and they still stay in the formulation stage and are difficult to materialize.

2.2 Teaching and practice cannot be combined

In the traditional engineering classroom teaching in the past, the combination of teaching and practice has always been one of the problems to be solved urgently. In class, the teacher's simple theoretical explanation can not be well combined with the actual experiment. In the process of learning, students often know how to learn and don't know how to do it. Now, the country requires to train international-oriented applied talents, that is, students should not only have solid basic theoretical knowledge, but also use what they have learned to solve practical engineering problems and apply them in work and life. Engineering thermophysics is a subject with a strong combination of teaching and practice, so it is difficult to mobilize students' initiative in pure theory teaching. [1] this is obviously not in line with the original intention of the establishment of this discipline.

3. Fluent meets teaching trends

3.1 Overview of Fluent

Fluent is a commercial CFD software package with rich physical models, advanced numerical methods and powerful pre-and post-processing functions to simulate complex flows from incompressible to highly compressible. It can be used in any industry related to fluid, heat transfer and chemical reaction. Fluent contains a variety of heat transfer combustion models and multiphase flow models, which can be used in almost all fluid-related fields, from compressible to incompressible, from low speed to hypersonic, from single-phase flow to multiphase flow, chemical reaction, combustion, gas-solid mixing and so on. This suggests that it is sufficient to apply Fluent to the teaching of engineering thermophysics.

3.2 Exploration of Fluent in the teaching of other subjects

At present, many teachers begin to explore the combination of Fluent and university curriculum. For example, Luan Yigang et al. [2] combined the Fluent software with the teaching of engineering fluid

mechanics, and applied the finite element software to show the Newtonian plate flow phenomenon. Similarly, Yu Ping et al. [3] integrated Fluent software and engineering fluid mechanics teaching to help students understand and master abstract concepts in engineering fluid mechanics. Yang Xiaoping et al. [4] cited the Fluent software and the course of computational fluid dynamics at the same time, and incorporated the finite element software into the finite element software to clearly show the heat transfer phenomenon of the heat absorption tube of the tower solar heat absorber. Liu Jingzhi [5] also used Fluent software and water conservancy machinery courses, which enabled students to see the internal workings of water conservancy machinery. Chen Shanqun et al. [6] combined Fluent software with civil engineering fluid mechanics courses, and adopted the software's ability to solve fluid problems to simulate numerical values. In addition, in civil engineering, Hu Peng et al. [7] simultaneously applied Fluent software and civil engineering professional engineering structure wind resistance experiments, and used finite element software to demonstrate the wind resistance effect of wind farms. Huang Qian et al. [8] explored the combination of Fluent software and the professional course teaching of oil and gas storage and transportation engineering. This graphic display enabled students to see the flow in the equipment. Yang Xiuping et al. [9] combined Fluent software with hydraulic transmission teaching, allowing students to see the flow of fluid inside the component.

4. Fluent is used in engineering thermophysics teaching

4.1 Provide a reliable physical model

In the study of engineering, students often pay most attention to the formula. They often can only rely on rote memorization to remember the formula itself, unable to form a complete understanding memory, resulting in the formula is very easy to forget, and the specific meaning behind the formula is often unknown. Fluent enables students to build a physical model on the basis of the formula, so that students can understand the meaning behind the formula through images, and can learn from examples and memorize the formula deeply. For example, in engineering thermophysics, the law of heat and mass transfer is a common and difficult concept, then the establishment of a dynamic model can show the abstract knowledge through images, and students can directly combine theory with practice.

4.2 Change the traditional teaching model

In the traditional teaching of engineering thermophysics, teachers aim to teach knowledge in class, while students only learn theoretical knowledge, but lack of practice. As a result, the enthusiasm of the students is very low. On the contrary, by using fluent software simulation, students are allowed to practice on their own software, which greatly and significantly arouses students' passion. The use of fluent software to simulate the teaching experiment can greatly improve students' cognition of knowledge and operation, so as to achieve the unity of knowledge and practice. The use of fluent software to simulate the teaching model simplifies the complex model structure and makes it perspective. Teachers don’t need to be constrained to ask questions about knowledge points when taking sample questions. Instead, they can look at pictures and talk, so that interactions with students will be more frequent.

Conclusion

In the teaching of engineering thermophysics, professional knowledge teaching is the foundation and the guarantee that students have basic knowledge, and software-assisted teaching is the most effective supplement. The engineering thermophysics course is difficult and theoretical. If Fluent software is introduced into this course, it will enable students to visualize learning content and connect professional knowledge together, which will help students better understand, analyze and apply the knowledge they have learned, and provide new ideas and new ideas for university teaching reform in the new era.

References

[1] Zhang Kun. The Innovative Design of Physics Teaching in Colleges and Universities under the New Media Environment——Comment on "Modern Curriculum Design Teaching Based on New Media Technology"[J].Chinese Science and Technology Papers,2021,16(09):1040.

[2] Luan Yigang, Wan Lei, Sun Tao, Sun Haiou. Application of Fluent software in the visualization of Newtonian plate flow phenomenon[J]. Heilongjiang Science, 2019, 10(4): 22-23.

[3] Yu Ping, Guo Huafeng. Application of FLUENT software in the teaching of engineering fluid mechanics[J]. Education Teaching Forum, 2018(16):271-272.

[4] Yang Xiaoping, Cai Zhuodi. Application case of numerical simulation in heat transfer flow teaching [J]. Guangdong Chemical Industry, 2018,15(45):232-233.

[5] Liu Jingzhi. The application of Fluent software in the teaching of hydraulic machinery[J].Technology Wind, 2019(33):60+64.

[6] Chen Shanqun, Liao Bin, Sun Junwei. The application of FLUENT software in the civil engineering undergraduate course "Fluid Mechanics"[J].Journal of Mudanjiang University, 2017,26(07):164-166.

[7] Hu Peng, Han Yan. Application of Fluent in the wind resistance experiment teaching of engineering structures [J]. Experimental Technology and Management, 2017, 4(34):138-142.

[8] Huang Qian, Long Xueyuan, Meng Jiang. Application of Fluent software in the teaching practice of oil and gas storage and transportation engineering[J]. Modernization of Education, 2018,5(14):175-176.

[9] Yang Xiuping, Chen Wei, Guo Jinjin, Yang Minghao. Application of Fluent software in hydraulic transmission teaching[J]. China Modern Educational Equipment, 2013(15):4-5.