

Analysis of the practical reform of engineering thermal physics teaching based on FLUENT

Yimin Zhao, Yancheng Xia

(Shanghai University of Engineering and Technology, Songjiang District, Shanghai, 201600)

Abstract

Engineering thermophysics is a technical science which studies the law of energy transformation in the form of heat and its application. It studies the internal laws of various thermal phenomena and thermal processes, and can be used to guide engineering practice. FLUENT is a tool course that plays a great role in assisting with the simulation of some devices in engineering thermophysics and fluids. However, in the process of learning simulation, students have had difficulty in mastering the FLUENT software and this paper proposes some constructive suggestions for measures to increase students' mastery of this software.

Keywords: engineering thermophysics; FLUENT; microchannel heat sink; practice

1 Introduction

[1] FLUENT can be used for anything related to fluids, heat transfer and chemical reactions, etc. FLUENT software is very powerful and has a wide range of applications in aerospace, automotive design, oil and gas and turbine design with its rich physical models, advanced numerical methods and powerful pre-processing and post-processing capabilities. Proficient use of FLUENT allows researchers to reduce the repetitive and inefficient effort invested in computational methods, programming, pre-processing and post-processing, and to devote their main effort and intelligence to the exploration of the physics problem itself. However, problems with FLUENT's own operating language and method of application, coupled with a single PowerPoint teaching, make it difficult for students to become proficient in this vital software. Therefore FLUENT needs to be taught in conjunction with practice and theory for better teaching results. In this paper, we will discuss the teaching model of FLUENT and make suggestions to improve the current situation of FLUENT teaching.

2 Example of a microchannel radiator

As described above, FLUENT can be used for anything related to fluids, heat transfer and chemical reactions, etc. In this paper, we will take The microchannel heat sink as the entry point to explain the importance of FLUENT. There are various categories of microchannel heat sinks and since Tuckerman's introduction of the microchannel heat sink, many research institutes have developed various heat transfer techniques to further improve the heat transfer performance of microchannels. The main heat transfer techniques currently available are: nanofluid, porous material filling, addition of ribbed/notched

microstructures, etc. [4] Xia et al. from Beijing University of Technology proposed the use of Al₂O₃ and TiO₂ nanoparticles with high thermal conductivity to improve thermal conductivity of cooling medium, reduce the conduction thermal resistance and enhance the heat dissipation effect of the microchannel. [2] Deng et al. from Xiamen University and [5] Shen et al. from Northwestern Polytechnical University filled the microchannels with porous metal materials of different shapes, not only to improve the convective heat transfer area, but also to promote fluid mixing and enhance the heat dissipation effect. [3] Liu et al. of Huazhong University of Science and Technology proposed a microchannel heat sink radiator. In terms of microchannel heat sink, it is impossible to use macroscopic theory to measure it, and it involves fluid mechanics, so the skillful use of FLUENT is an effective method to simulate this kind of heat sink efficiently, which makes the research in microchannel heat sink fast and convenient. Thus, when it comes to simulation of fluids, heat transfer and chemical reactions, we can use FLUENT to carry out simulations to get twice the result with half the effort. This is why FLUENT is a core tool for engineering students. The main focus of this paper is on how to get students up to speed with the software and how to become proficient in its application.

3 Common problems in teaching

3.1 Shallow and boring teaching methods

In normal teaching activities, the teaching of FLUENT is only superficial, lacking the corresponding theoretical knowledge teaching, students' repeatedly boring practice of a single case caused a fatal problem: in the case of theoretical knowledge is not solid enough, they can not really understand the operation of the FLUENT software. In that case, it caused the students only proficient in the simulation of what they always practice, and can not simulate other module, which is turning students into kind of bookworm, and make them not being able to do other example, resulting in a fake mastery of the FLUENT software.

3.2 The FLUENT software system language is English

FLUENT is currently a popular international software, so the language of the system itself is English, and for most students, the vocabulary of professional system terms in the FLUENT system is not built up enough to understand the entire operating interface, which leads to a half-understanding of the system and makes it difficult to even maintain normal operation on a regular basis, which causes them great difficulties in mastering FLUENT.

4 Proposed solutions

4.1 Enrichment of teaching methods

In the usual teaching activities, students always operate FLUENT directly, without the corresponding theoretical support, which makes it difficult for them to master the FLUENT system systematically. So, in that case Fluent teaching should set up corresponding theoretical courses in advance. Teachers should teach some relevant knowledge of engineering thermophysics and fluidology, and then carry out actual computer operation simulation, so that students can apply the theory to practice. This will enable them to understand the specific meaning behind each step of the operation, so that they can master FLUENT systematically

and get rid of the simulation of a single model, and then they can really do whatever they want by FLUENT.

4.2 Supplementary teaching of professional English words

During the course of their studies, students are rarely exposed to the unusual words that will make them difficult to understand the whole FLUENT system. Therefore, during lessons, teachers should explain the terminology, not only its meaning, but also the knowledge behind it, so that students can really understand the FLUENT system and master its operation.

Conclusion

In the field of fluids, heat transfer and chemical reactions, etc., FLUENT is a very important simulation tool that allows efficient simulation. There are currently problems with the teaching of FLUENT, such as the shallow and boring teaching methods and the large number of hard English words in the operating system. In order to solve these problems, this paper proposes a series of specific measures to ensure that students are proficient in FLUENT system and to strengthen their ability to do by themselves.

References

- [1] Wang Ruijin, Zhang Kai, Wang Gang. *Fluent Technology Fundamentals and Application Examples* [M]. Beijing: Tsinghua University Press, 2007
- [2] Deng Daxiang, Tang Yong, Fabrication and performance study of micro-scale thermal mass transport enhanced channel porous structures, *Metal Processing (Cold Processing)*, (10) (2015) 82-82.
- [3] Liu Youlu, Liu Wei, Design of an efficient tiny channel heat sink heat dissipation system and its experimental study, *Huazhong University of Science and Technology*, 2010
- [4] G. Xia, R. Liu, J. Wang, M. Du, The characteristics of convective heat transfer in microchannel heat sinks using Al₂O₃ and TiO₂ nanofluids, *International Communications in Heat and Mass Transfer*, 76 (2016) 256-264.
- [5] B. Shen, H. Yan, B. Sunden, H. Xue, G. Xie, Forced convection and heat transfer of water-cooled microchannel heat sinks with various structured metal foams, *International Journal of Heat and Mass Transfer*, 113 (2017) 1043-1053.