

Application of Numerical Simulation in Engineering

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Abstract

Under the background of rapid popularization and vigorous development of Internet technology, the deep integration of various scientific research fields and Internet technology has become a new engine of scientific development. Engineering science research, which covers all fields of social life, must also take advantage of the opportunity of Internet development to become the core driving force of engineering science research so as to meet the development requirements of new engineering in the new era. How to grasp the computer technology to promote new engineering science research and construction engineering power is a topic concerned by scientific research institutions, institutes and engineering science scholars. This paper systematically analyzes the new scientific research method of computer numerical test combined with computer technology formed in the new era of engineering science in China. The application of computer numerical simulation in engineering research is reviewed and summarized.

Keywords

Engineering science, Numerical simulation, Computer technology, Finite element method.

1. Introduction

Held since the eighteenth congress, the party central committee pointed out many times, in the future decades, will be a new round of technological revolution and industrial revolution in our country with historical intersection period of accelerating economic development in our country. The role of social engineering in China are also profound changes have taken place, engineering science and technology progress and innovation is the important engine to promote the development of human society, for the engineering science, which is both opportunity and challenge ^[1]. To meet the requirements of development in the new era, the state has put forward a series of major strategies for engineering science to actively serve the country, including innovation-driven development, "made in China" and "Internet+". In 2016, the ministry of education organized universities to conduct in-depth discussion and research, put forward the construction concept of "new engineering", and formed the "Fudan-consensus" and "Tianjin-University action". New engineering construction concept is the important strategic decision of engineering science education in our country, in the face of increasingly fierce international competition, world multi-polarization and economic globalization. A new round of technological revolution and industrial revolution gaining momentum, the traditional engineering science must comply with the new era, new background, new ideas, the ministry of education Zhong and others believe that the future engineering talents cultivation standard should emphasize the core elements: innovative pioneering, interdisciplinary intersection, critical thinking, global view, sustainable development and digital literacy.

In recent years, China's higher engineering science research and education has implemented a series of major measures, such as "excellent engineer education and training plan", "2011 plan", innovation and entrepreneurship reform, and achieved remarkable results. But scholars pointed out that the ministry of education, scientific research and education of engineering in China's big and not strong problem still exists, the multidisciplinary cross fusion concept remains to be further strengthened, and the world's leading talent is not enough, big craftsman is relatively scarce, high-end field of

engineering science and technology talent shortage, cause the transformation and upgrading of manufacturing engineering and technical personnel to support ability to the situation of inadequate. The current mode of engineering science research and training does not adapt to it. The development of a series of subversive technologies represented by globalization and network has greatly changed the way of education, scientific research and information sharing, and brought profound changes to the environment and conditions for accepting new knowledge. In addition, since the development of computer technology, new knowledge has developed exponentially. The interdisciplinary integration of various engineering disciplines is emerging, especially the deep integration of each discipline with computer and Internet technology. Therefore, how to base on the needs of China's development strategy, the huge trend of international competition to seek new ideas of engineering science research in the new era has been put on the agenda.

In the face of industrial transformation and upgrading in China, especially the subversive influence of the Internet on traditional industries and the transformation of traditional industries [2], the transformation and upgrading course transformation of existing disciplines is carried out. In the new era, we should not only retain the unique essence and status of traditional engineering science, but also complete the upgrading and transformation in accordance with the requirements of the development of The Times. Of different engineering disciplines including cross composite intersection, engineering and other disciplines, such as civil, mechanical and computer and Internet is the development trend of modern industry, is also the needs of the development of modern engineering science, it strengthened the connotation of the engineering science, gives its new development space and potential [3]. Basically had a few characteristics that lead to blend innovation to cross boundary and development. Based on the background of computer technology, this paper discusses the powerful vitality of deep integration of computer numerical simulation technology and modern engineering science, which accords with the strategy of innovation-driven development in China. Therefore, the deep integration of engineering science research and computer technology has gradually become the powerful vitality of engineering science research institute in the new era [4,5].

2. Background and current situation of numerical simulation technology

Along with the social and the rapid development of modern industry engineering technology, the practical engineering project is increasingly complicated, in a wide range of industries using traditional calculation and design methods are often difficult to meet the needs of actual engineering design, in the design and research of engineering science, scientific experiment is scientific research workers are vital to design and research, and the traditional scientific test method in accuracy and recognition has its unique position and advantage, but with the actual engineering has become increasingly complex and huge number of traditional test will be harder, The traditional test will be more difficult, and the test equipment is limited and expensive, which consumes a lot of manpower, material resources and time cost. So it is very embarrassed to design practical engineering problems by using test method. However, the rapid development of computer technology and the emergence of numerical simulation and analysis technology have changed this dilemma. Since the 1980s, various commercial-numerical simulation-software have gradually come into people's eyes. In practical projects, scientific research and design personnel widely use computers for numerical simulation analysis [6, 7].

3. Development of numerical technology

In a typical professional civil engineering disciplines, mechanical materials and other specialty as an example, the analytical solutions to solve the structure of the stress or strain is often based on a one-dimensional or multidimensional space model based on elastic-plastic mechanics, and the most practical structure is relatively complex, based on the material constitutive relation contains linear and nonlinear partial differential equation, differential equation and integral equation and other equations, according to the different initial conditions and boundary conditions to solve. To get its analytical solution must be really very simplified conditions, but too much hypothesis and simplified

and the actual situation in and out of larger, science and technology personnel gradually moving target to widely absorb the theory of modern mathematics, numerical analysis and the numerical solution of strong theory, perfectly fit the super important achievements of the development of computer technology, computer numerical analysis ability and can meet the engineering requirements [7]. As a product of computer science and technology, numerical simulation technology has become an important means of modern engineering science research. The rapid development of computer technology makes the numerical simulation technology in engineering has been widely used in scientific research and development of numerical simulation methods including finite element method, finite difference method, finite volume method, the finite element method (FEM) is most widely used analytical tools in the engineering science, its application and implementation includes three aspects: the calculation principle, calculation software, computing hardware. According to relevant information, 90% of the mechanical products in the world are analyzed by using the finite element method, so as to improve and optimize the design, greatly reducing the R&D cost and R&D cycle. In fact, the finite element numerical simulation has become a numerical "virtual test" corresponding to the traditional test. In the author's opinion, it is worth mentioning that this kind of "virtual trial" combines a lot of calculation and analysis with typical sub-validation test to achieve high efficiency and low cost. The technical route of computer numerical simulation technology is shown in Fig. 1.

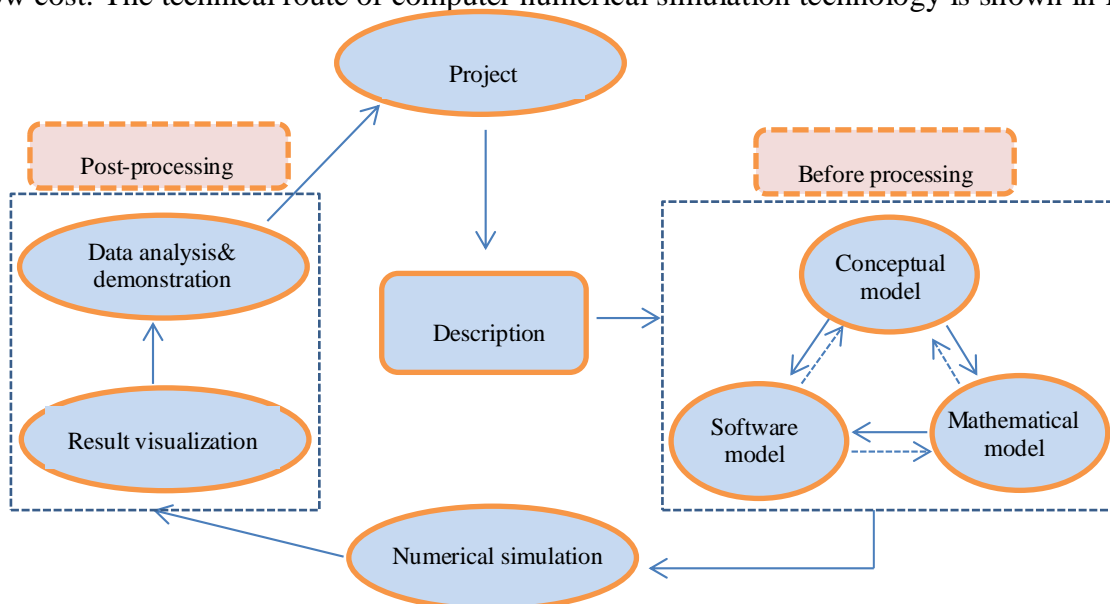


Fig. 1 Computer numerical simulation technology roadmap

4. Trend and prospect of numerical simulation technology

After theoretical analysis and experiments, the finite element numerical simulation technology to become one of the important technical means for the development of science and technology, has been widely applied in engineering research and design, become the core of the computer aided analysis, at the same time, the large-scale finite element analysis software of complete function gradually maturing, ABAQUS, ANSYS, etc. is the most advanced analysis software, the study of the engineering science in ABAQUS software, for example, a combination of structure, thermodynamics, fluid acoustic and electromagnetic blasting analysis and integration with powerful before and after treatment and analysis ability, especially in the field of nonlinear analysis, It can simultaneously simulate the coupling effect of structural thermal fluid electromagnetic field and other physical fields, and has the ability to solve complex engineering problems, and can be connected with CAD software. Realize data import sharing and exchange. The software is mainly divided into three parts: pre-processing module, computational analysis module, post-processing module. It is worth mentioning that the calculated results in the post-processing module can realize the visualization processing of the 3D model and intuitively display the physical quantities required by users.

From the perspective of the development trend of the international development trend of numerical simulation software presents the following: first in the development of computer technology in the limitation of popularity, the numerical simulation software for 2 d plane model, and to solve the single quantity, with the rapid development of computer and Internet technology, the simulation software function is perfect, in recent years, numerical simulation has been handled by two-dimensional extended to three-dimensional space, from the perspective of model have been developed to multiple physical field at the same time solving the analysis of the technical level, can simulate development to include the content of the fluid mechanics, temperature field, magnetic field, seepage, etc. Professor Lu-Xinzheng of Tsinghua university has made remarkable achievements in GPU-based collaborative calculation of earthquake damage simulation of urban buildings^[8]. In addition, the range of numerical simulation software is extended from linear problems to nonlinear problems involving many professional mathematical problems and operational skills. For example, some foreign companies spend a lot of manpower and resources to develop ANSYS, ABAQUS and other software with efficient nonlinear solver and nonlinear material database.

Although most of the numerical simulation software can solve the problem of most of the conventional, practical problems in engineering science, after all, appear very complex numerical simulation software can't solve all problems, is currently represented by ABAQUS simulation software also realized the function of the user calls a subroutine, covers the numerical simulation analysis of various modules, secondary development user class write or call program independently, solve the problem also has a lot of flexibility. It is helpful to solve the increasingly complex practical engineering science problems, which also urgently needs the computer using ability of Chinese scientific research workers. Interdisciplinary knowledge and ability is an important ability of engineering science research, which is the inevitable trend of the development of numerical simulation technology in the Internet era. In addition, the application of BP neural network algorithm to predict engineering results has become a trend of the application of computer technology in engineering science^[9,10].

5. Conclusion

Engineering science and computer technology gives the depth of the fusion of traditional engineering science new vitality, the use of the Internet technology ultra-strong permeation and the crossover of interdisciplinary engineering the combination of each part of the scientific research formed on the basis of the theory of engineering support, numerical simulation technology and real structure testing to confirm each other, with the national foster interdisciplinary high-end engineering under the age of the Internet technology talent strategic goals. Numerical simulation technology in the areas of engineering in recent years has achieved vigorous development, has become a project an important part of scientific research and even had a tendency to replace the test, but with the growing sophistication of modern engineering and scientific accuracy has increased, the numerical simulation software of the use of secondary or independent development more frequently, which requires researchers to solid basic computer. The future computer numerical simulation technology will also be an indispensable part of engineering science research.

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