

An e-learning system for CAE

A. Kuwata¹, H. Noguchi² and H. Kawai³

Summary

In this research, we constructed an e-learning system of the CAE (FEM) education. We analyzed about the usefulness of e-learning from each viewpoint of a software developer of the e-learning system, a system administrator of the system, and a user. In addition, we considered about the necessary technology in Web application.

Introduction

Shift from physical labor society to knowledge society has raised the demand for higher education rapidly. In the knowledge society, knowledge required for a worker changes at an extremely fast speed in every industrial field. Therefore, the necessity of lifelong education has been increasing.

The new educational methods such as e-learning are proposed because of the recent development of information technology.

To educate a learner along a learning target, e-learning is the education method to use Web technology. Conventional classroom-based education has problem of the time and spatial restrictions. e-learning is expected as means to solve such a problem.

Recently, the performance and the usability of Web application software are improving rapidly. It is so called, "Rich-client", or "Rich Internet Application (RIA)"[1]. The quality of educational contents of e-learning is improved. It is now used in a variety of fields.

The development period of a new product has been shortened in manufacturing company, and quick response to the market is demanded. A numerical simulation (CAE) is often used in such a factory. Training of a CAE engineer is an important issue in the whole industry. However, it is difficult to acquire such kinds of knowledge only by the classroom-based education because the specialty of CAE is high. Therefore, self-learning environment is needed.

From the background above, we constructed the e-learning system of CAE (FEM) education. And we analyzed about the usefulness of e-learning from each viewpoint of a software developer of the e-learning system, a system administrator

¹School of Science for Open and Environmental Systems, Keio University, Hiyoshi 3-14-1, Kohoku-ku, Yokohama, Kanagawa, Japan

²Department of Systems Design Engineering, Keio University, Hiyoshi 3-14-1, Kohoku-ku, Yokohama, Kanagawa, Japan

³Department of Systems Design Engineering, Keio University, Hiyoshi 3-14-1, Kohoku-ku, Yokohama, Kanagawa, Japan

of the system (company/school), and a user (CAE engineer/student). In addition, we considered about the necessary technology in Web application.

e-learning

The reasons for the spread use of e-learning are shown as follows.

- Difficulty of the uniform study method to provide suitable educational contents according to the level of each learner
- Development of remote learning intended for a person who cannot commute to an educational institution by various circumstances
- Development of Web technology.

From the above-mentioned reasons, the effects requested to e-learning are as follows.

- Educational service can be provided anytime and anywhere.
- Educational opportunity can be equally given to everyone.
- Decrease of user support cost by use of Web technology

Current state that surrounds Web application

Many corporate systems begin to shift from the Client/Server system to the Web application as the Internet is widely recognized and used. However, a lot of problems are pointed out about the user interface of Web browser. "Rich client" is expected now as a solution to this problem.

A Web browser has attracted a great deal of attention as a client because of the Internet spreads all over the world. Web browser-based client is called a thin client from the lightness, and the client running directly on the PC as a native binary executable is called a fat client.

In the fat client, there was a big problem called distribution of the client-side binary executable.

In the fat client, an administrator needs to install a client program on each of hundreds, thousands of the corporate PCs. And whenever the program has any change, the system administrator has to redo installation. The maintenance cost was enormous.

This problem was solved by re-building C/S system as a Web application. All the functionalities in the Web application are placed on a server. There is no need to install the client program.

However, there was a problem also in a Web browser. Originally HTML and Web browser were tools to read information. An HTML-based Web application has only the poor user interface. For example, it cannot provide high-end user support functionalities such as keyboard short-cut, drag and drop, and function

keys. Those are popular in "fat client" age. Usability as business application is extremely low. Moreover, the server generates HTML data every time the screen needs to be updated. Because the HTML data is sent to the Web browser, the response is also slow.

The merit of the fat client was considered again, as these problems were recognized. Rich client, which has advantages of both of the fat client and the thin client, appeared. The main features of the "Rich client" are as follows.

- The same level of usability with the C/S system is achieved.
- Since functionalities other than application logic are placed on a client side, the amount of communications with a server is reduced. So response speed is improved.
- Since installation is unnecessary, maintenance cost is reduced.

There are many "Rich client" technologies, such as Java, .NET, Ajax and Flash. In this research, we used Flash to construct our e-learning system.

CAE (FEM)

In this e-learning system, we used FEM (Finite Element Method) which is the typical simulation technique of CAE.

Typical analysis procedures using FEM are as follows.

- (1) Mesh generation
Divide the entire analysis domain into multiple elements. Numerical accuracy improves when the number of elements increases, but the computation time increases also. The important thing is to achieve accuracy good enough at allowable computation time.
- (2) Setting of boundary condition
Specify load and constraint to the analysis domain.
- (3) Setting of material property
Specify material property parameters over the analysis domain.
- (4) Analysis
Compute using a FEM code.
The FEM code is written also in ActionScript3.0.
- (5) Post processing
The result of the analysis is examined by visualizing the stress distribution and the deformation plot.

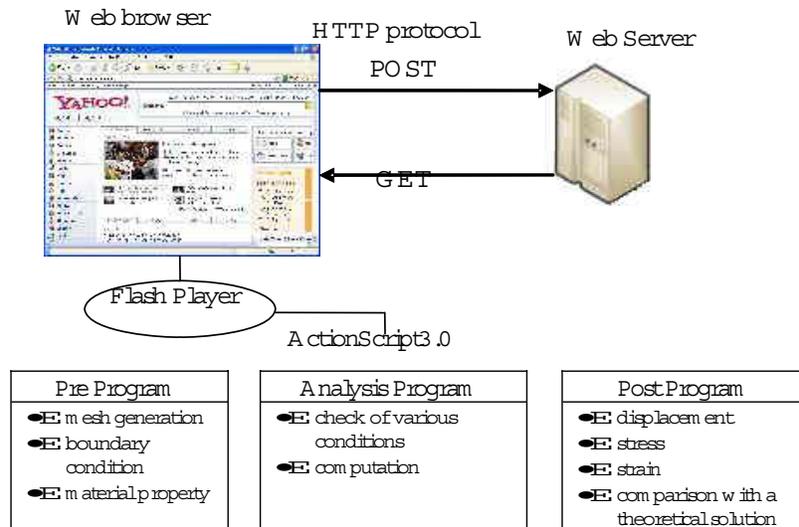


Figure 1: System configuration

Outline of e-learning system

The system configuration is as follows.

Fig 1 is a general composition of Flash application. Flash application is downloaded from web server and performed on the Web browser. ActionScript is a programming language for Flash application. It is compatible with ECMAScript (JavaScript). From ActionScript version 3.0, Flash application is compiled by JIT compiler (Just In Time), before execution.

The development environment and the user environment are as follows.

- Language: Macromedia ActionScript3.0
- Development environment: Flex ver.2 (SDK for free)
- User environment: Flash player ver.9

The screen area configuration of our e-learning system is as follows.

The screen is composed of four areas as shown in Fig.2. Areas ①-④ are as follows.

- ① Navigation Area
It shows the current location in the menu step where the user is now.
- ② Work Area
Work area where the user sets various parameters. A button named "Next" is moving to the next step, and a button named "Prev" returns to the previous step.

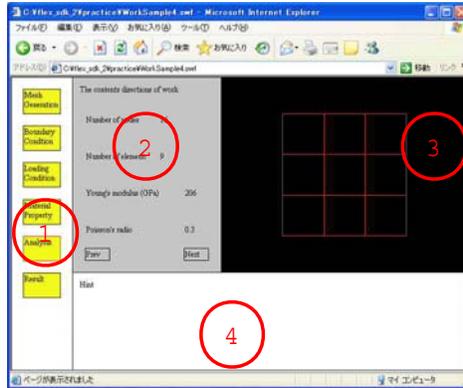


Figure 2: Screen area configuration

- ③ View Area
This area displays a mesh and its result.
- ④ Note Area
This area displays notes and advices.

The user mainly operates text boxes and buttons on each area.

The screen samples in an actual process are as follows. In the example of Fig3, a sheet metal with a hole was divided into 5×5 .

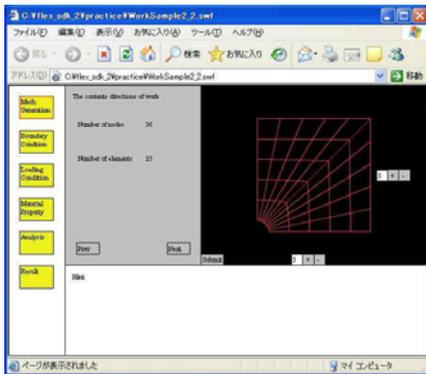


Figure 3: Mesh generation

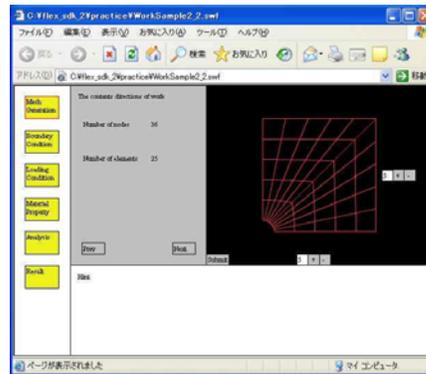


Figure 4: Setting material property

In fig5-6, only View Area is extracted and displayed. The result of the sample problem which added concentration load along edge of a beam is displayed. Thus the learner can learn CAE (FEM) through the operation of this e-learning system.

Conclusion

We constructed an e-learning system for CAE (FEM) education. And we analyzed the technical characteristics required by e-learning.

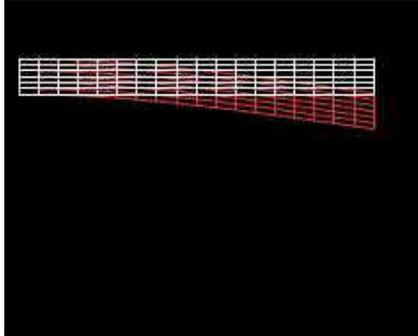


Figure 5: Deformation plot

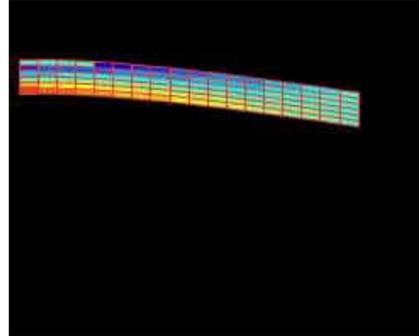


Figure 6: Stress contour plot

References

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