Web Simulation Service Improvement on EDISON_CFD

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Abstract. EDISON (EDucation-research Integration through Simulation On the Net) project is supporting web simulation service for CFD and Chemistry. To support CFD simulation service, EDISON employs e-AIRS (e-Science Aerospace Integrated Research System). In this paper, we present the service improvement of e-AIRS such as stable system, faster data response time, and waiting time. We also describe the change of user's feedback between first and second semester in 2011.

Keywords: EDISON_CFD, Simulation service, Service improvement.

1 Introduction

EDISON (EDucation-research Integration through Simulation On the Net)[1] project supports for researchers and industrial workers to register, use, and share their simulation software and contents (advanced research achievements) based on the cyber infrastructure of supercomputer. To support CFD web simulation service for the lectures in 2011, EDISON employs e-AIRS (e-Science Aerospace Integrated Research System)[2].

In this paper, we present the service improvement of e-AIRS such as system reorganization, job assignment control, faster response time, and waiting time by analyzing user requirements, which are extracted from survey of user satisfaction of 2011-1(the first semester in 2011). After providing the improved service at 2011-2(the second semester in 2011), we also describe the change of users' feedback.

2 Present Condition of Web Simulation Service

There are various kinds of web simulation services such as Nanohub[3], ICEAGE[4], CLEERhub.org[5], Manufacturing Hub[6], C3Bio[7], NEES[8], and hpc2[9]. Nanohub[3], which was based on PUNCH (Purdue University Network

Computing Hubs) project in 1995, is developed by NCN (Network for Computational Nanotechnology) project. Nanohub provides abundant simulation tools and contents for more than 175,000 users in the world. More than 350,000 simulations ran on Nanohub by using a user friendly interface, which is based on HUBZero. Besides, Users can utilize Rappture interface, on-line meeting, sharing simulation, and content convertor service. EU leads ICEAGE (International Collaboration to Extend and Advance Grid Education) project [4], which is based on EGEE (Enabling Grids for E-science). ICEAGE provides education resource and education program development environment by using a large scale cyber infrastructure. CLEERhub.org is developed to support engineering education as a digital habitat by collecting education resources such as qualitative research, RREE, Wind power, and cooperative learning [5].

These previous research and education service is very useful for students and researchers to study various kinds of application areas such as Physics, Chemistry, and Engineering.

3 Web Simulation Service for CFD

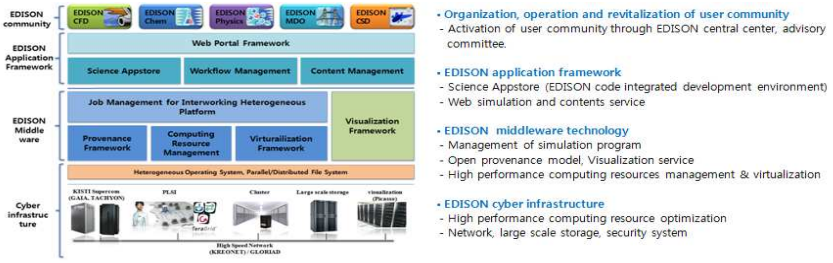

Fig. 1. Progress of web simulation service

EDISON is new project for web simulation service to support advanced web simulation service such as Science appstore, simulation based content, advanced simulation service, and personalized page on the extended area such as CFD, Chemistry, Physics, Structural dynamics, and Computational design. In order to support CFD simulation service for lectures in 2011, EDISON center employs e-AIRS that is a cyber infrastructure to support CFD simulation service with eMesh(mesh generator) and eDAVA(visualization tool).

Fig. 2. e-AIRS

e-AIRS supports 12 CFD Simulation solvers such as 2D Comp and 2D Incomp. Besides, CFD introduction, which includes text, pictures, and movies, is also provided for users to understand the phenomenon of CFD. e-AIRS provides the e-AIRS mesh generator for users to make a mesh file and the eDAVA (visualization tool) to show simulation results such as mesh, contour map, vector, and stream line animation.

4 Service Improvement

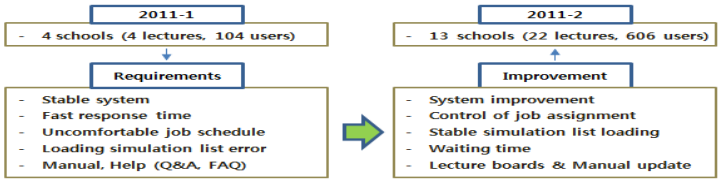

Fig. 3. e-AIRS

e-AIRS has some problems such as stable system, waiting time, and control of job assignment. We analyzed current condition of system and improved the services.

4.1 Reorganization

To improve server environment, we reorganizes web server, database server, and file download service with database tuning. In e-AIRS, a physical server has several services such as database and web server (user interface, file download). It's not bad in general lecture, but there are some overloads during term projects, especially, a report deadline. Sometimes, these overloads make web server down or data loading problem. Database (Mysql) has different table types, which have different table locking policies such as Innodb and MyISAM. We checked a record update processing in e-AIRS and adjusted table types and Mysql environment variables to support an effective data processing such as thread_cache_size, read_buffer_size, connect_timeout, join_buffer_size, and sort_buffer_size.

4.2 Control of personalized job assignment

Some students made more simulation cases such as 400 and 500 cases, because e-AIRS had no limit for to submit simulation jobs. This policy had serious problems for most users to wait to finish many simulation jobs for a long time, because of the limitation of calculation resources.

To solve this problem, we developed the job assignment control function to allow the submitted jobs to be calculated within the number of personal job assignment. The e-AIRS scheduler assigns the jobs to calculation resources within the limit of job assignment. This function can prevent the prior occupation of calculation resources of some users

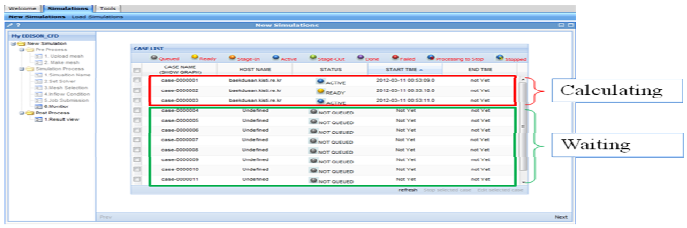

Fig. 4. Monitoring page (Limit of job assignment = 3)

Figure 4 shows the monitoring page, which illustrates the simulation processing steps (NOT QUEUED, QUEUED, READY, STAGE-IN, ACTIVE, STAGE-OUT, DONE). When the limit is defined as 3, only three cases are queued and processed in calculation resources. Other cases have to wait until the end of the calculation such as "DONE" or "FAILED". After one case is finished, another case can be calculated within the defined limit.

4.3 Stable simulation list loading

At the monitoring page, users can see the list of the simulation cases and their overall status. To show the overall status of the submitted simulation cases, web server checks all of the status of cases and assigns the overall status of them. However, this process needs more time to show the simulation list. Sometimes, users can not see the list for a long time such as one hour or two hours.

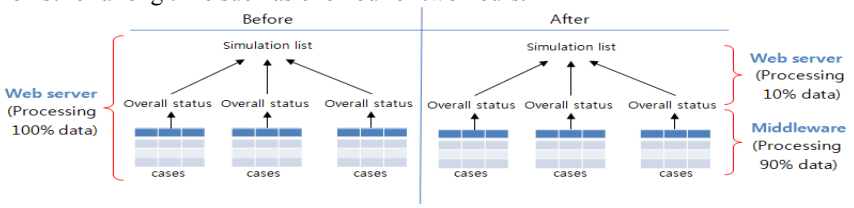

Fig. 5. Simulation job submission and job status

To solve this problem, instead of web server, a middleware defines the overall status by loading the status of cases, which belong to one simulation. This processing reduces the weight of data loading of web server, because web server only reads and shows the overall status of cases, which is defined by a middleware.

4.4 Waiting time

Users want to know when their simulation will be run, because many simulation cases are queued in calculation resources. Calculation of waiting time for simulation

case can give over data loading for every calculation time. So, we simply choose the stored average time of each solver of the queued cases and the number of queued cases as below equation.

$$waiting\,time = \sum_{n=1}^{the\,number\,of\,queued\,cases} the\,average\,processing\,time\,of\,the\,solver\,of\,n^{th}\,case$$

Besides, to reduce over data loading, this calculated waiting time is only provided for an earliest queued case for each user.

4.5. The result of service improvement

After service improvement of e-AIRS, we tested the stability of system such as the data loading time of monitoring page, data loss, and the control of the number of simulation cases for each user. To check the data loading time, we used Jennifer, which is a web monitoring tool to track every transaction of web server [10]. To test the simulation list loading time, we submitted 400 cases at the same time

Fig. 6. Before and After for simulation list loading time in monitoring page

Figure 6 shows the simulation list loading time before and after service improvement. With service improvement, the response time is reduced as low as 1/8 of the previous response time (Before : 10 ~ 800 ms. → After: 10 ~ 100 ms.).

5 Result of CFD Web Simulation Service Improvement

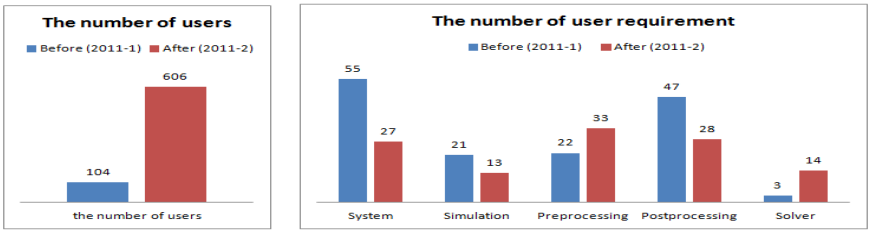

Fig. 7. The number of users' requirements

Figure 7 shows the change of the number of user's requirements between 2011-1 and 2011-2. In 2011-1, students required more stable system to support CFD simulation and more functions of post processing (eDAVA) to show the simulation results. In 2011-2, users wanted to use more useful pre/post processing functions to handle a mesh file and to load the simulation results. For them, stable system is less important than the functions of pre/post processing even though the number of users increased from 104 users to 606 users. After service improvement, Graphs shows the decreased number of user requirement for the stable system and for stable simulation processing and the increased number of user requirement for more functional pre/post processing. Our service improvement changes the priority of user requirements from stable service to useful functions of pre/post processors.

6 Conclusion

According to users' requirements for CFD simulation service, we improved the e-AIRS service by reorganizing server environment, controlling personal job assignment, reducing data loading time, and providing waiting time. This improvement changes the trend of the user's requirements. This improvement will be utilized in EDISON_CFD that is new web simulation service in Computational Fluid Dynamics.

Acknowledgements

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