

Construction of Numerical Wind Tunnel on the e-Science Infrastructure

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ABSTRACT

Drawbacks of the existing aerospace engineering research system are as follows. As for numerical simulation, the scale of aerospace engineering objects basically requires vast amount of high-performance computing resources. With regard to experiments, scarcity of large-scale wind tunnel causes researches to spend much time on obtaining equipments and performing experiments. And, geographical dispersion of research institutes and inadequacy of collaboration infrastructure occasionally brings about repeated investment on the same equipments.

Thus, construction of the collaborative research system is inevitable where large-scale computations are conducted automatically, numerical and experimental data are shared and remote monitoring/discussion are supported. That system should provide the integrated research platform of multiple disciplines in aerospace field.

The present research developed an integrated research system of numerical and experimental scientists by adopting the next-generation computing technologies like Grid & e-Science. Grid[1][2] technology enables services for sharing the resources of an interconnected worldwide network of tens of thousands of computers and storage devices. e-Science[3][4][5] is an extended concept of the Grid. e-Science refers to the large-scale science that will increasingly be carried out through distributed global collaborations enabled by the Internet. With these technologies, scientists can generate, analyse, share and discuss their insight, experiments and computation results in an effective manner.

The product of current research is named e-AIRS and e-AIRS system is provided in the form of a portal service(Figure 1). e-AIRS portal supports both CFD simulation service and remote wind tunnel experiment service. Portal frames are developed by using GridSphere[6] and basic ideas of service architecture in Ref. 7 are referenced.

CFD simulation service offers pre-processor(e-AIRSmesh, Figure 2) and post-processor(e-AIRSview, Figure 4) along with optimized flow solver. Moreover, users can check intermediate result of their own applications by monitoring service(Figure 3). In that e-AIRSmesh and e-

AIRView are developed in java applet form, those services automatically operate in any computers only if internet is accessible. Currently, multi-block meshes with 2- or 3-D features can be generated through e-AIRSmesh. Resultant data of multi-block problems can be visualized through e-AIRView, while, at present, flow features at surfaces can be viewed.

Remote wind tunnel experiment service is composed of session request service, session managing service and session information service. In session request service, users input the information of experimental model and flow conditions and ask for experiment. In session managing service, the experimental operator confirms new session requests and uploads finished experimental data. The second service is only accessible to the operator. Finally, in session information service, users can check the status of their requests and download finished data.

Simulation of Smart UAV(Unmanned Aerial Vehicle), a Korean UAV under development by KARI(Korea Aerospace Research Institute), is selected as the numerical and experimental test problem. CFD simulation and remote experimentation of smart UAV are conducted through e-AIRS portal.

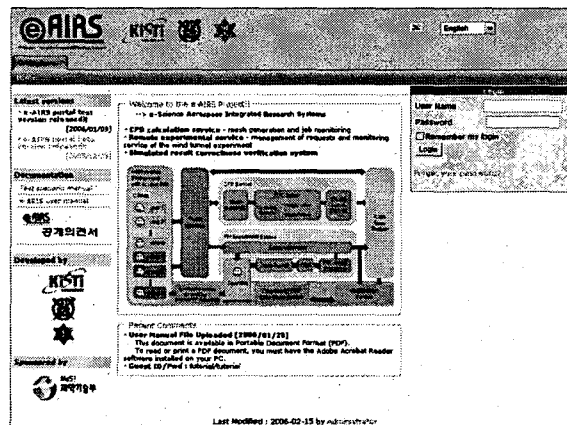


Figure 1. e-AIRS portal interface

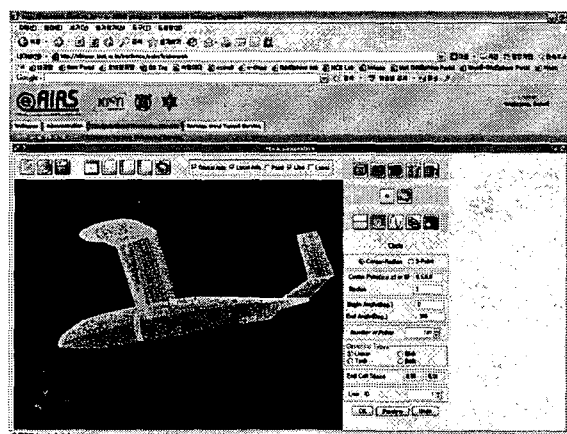


Figure 2. Mesh generation service (e-AIRSmesh)

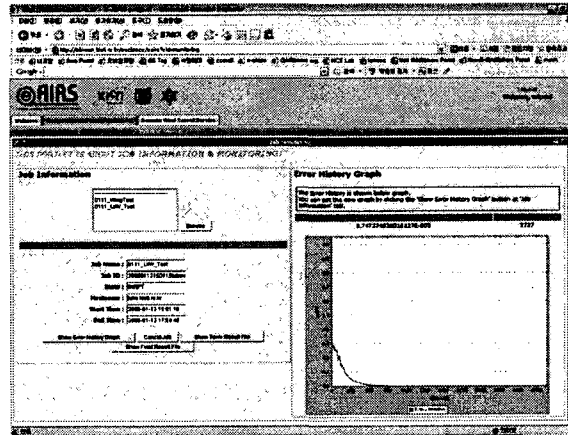


Figure 3. Monitoring service

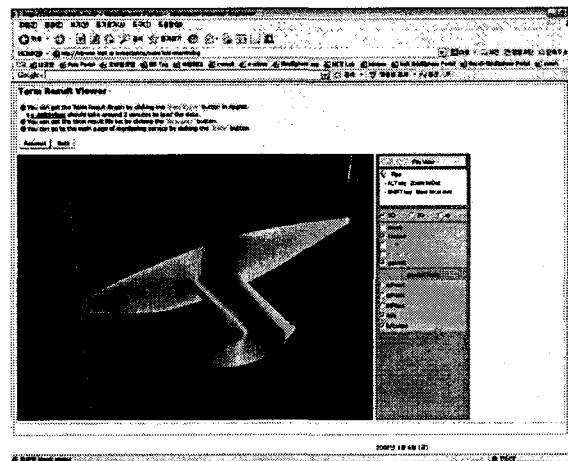


Figure 4. Visualization service(e-AIRView)

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