Contribution of SSC Supercomputing to Korean Science and Technology

Joon-Whoon Choi, Don-Woo Cho, Si-Heung Lee, Hee-Il Lee, Joong-Kwon Kim, Chung-Il Park, and *Year-Back Yoo*, Super Computer Center, Systems Engineering Research Institute /Korea Institute of Science and Technology, Taejon, Korea

ABSTRACT: *SSC(SERI Supercomputer Center) installed CRAY supercomputer system first in Korea with CRAY-2S system in 1988. At present, CRAY C916/16512 is operated in SSC. There has been a remarkable increase in the number of users, CPU time usage, and application fields using application softwares installed on the CRAY systems.*

1 Introduction

SSC was established in 1988 as a branch of SERI by Korean government for the purpose of operating a CRAY supercomputer system. SSC is the only supercomputer center in Korea open to general scientists and researchers through networks. It is equipped with a CRAY C916/16512, two main frames(NAS AS/XL V50, CYBER 960-31), about a hundred workstations, and hundreds of personal computers. All the computers are connected to a high speed network. The configuration of the SSC hardware system is shown in Fig-l, and application softwares are shown in Tab-l.
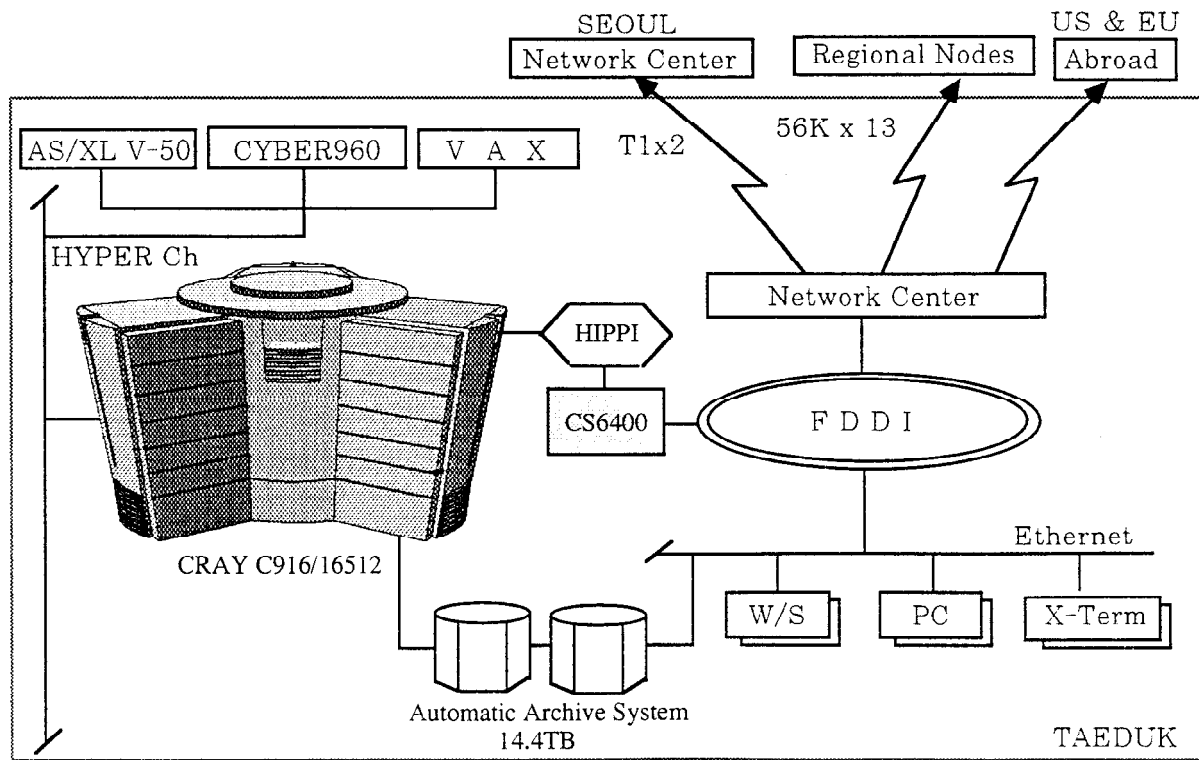

Figure 1: The hardware configuration of the SSC.

Table 1: The Application Software of the SSC.

	CRAY C916/16512	Workstation
Structure Analysis	ABAQUS	MSC/XL
	MSC/NASTRAN	MSC/PATRAN
	CAMRAD/JA	
	PAM-CRASH	
	PAM-STAMP	
CFD	PHOENICS	PHOENICS
	CRI/TurboKiva	CRI/TurboKiva
	RAMPANT	OMNI3D
	VSAERO	H/FLOW3D
	H/FLOW3D	
Graphics	AVS, CVT	NCAR-GKS
	CA-DISSPLA	Ensight, ape III
	Ensight	TDV, TAV, TAP
	NCAR-GKS	IMSL-IDL
		HI-VIEW, PCI
Chemical & Bionics	GAUSSIAN92	Insight II
	X-PLOR	Quanta
	DISCOVER	
	CHARMm	
	Unichem	
Mathematics	IMSL	
Industrial Eng.	SLAM II	TEMPAS
		TEAMWORK
Others	SPSS	ACCELL/SQL
	CRAYFISHPAK	so many S/W

Out of the last five years' CPU usage of SSC supercomputer, 16% was occupied by the third party application softwares and 84% by other in-house programs. The CPU usage by the third party application softwares is shown in Fig-2.
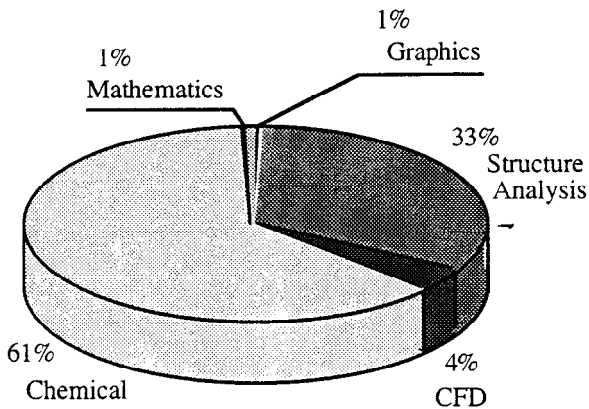
Figure 2: The Usage of Third Party Application Software.

Main users of the supercomputer are universities, research institutes, and commercial industries. The CPU usage by the users' affiliation is shown in Fig-3.
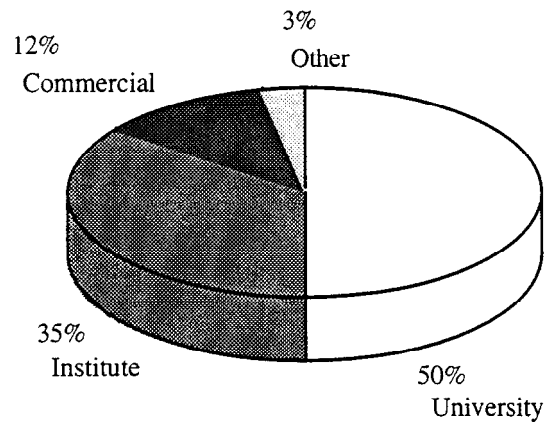
Figure 3: The Distribution of Users.

Programs are developed by the users for weather forecasting, remote sensing, nuclear safety, and social science analysis. In the weather forecasting, the computing time was reduced to one hour from 30 hours on CYBER 960-31 with the introduction of CRAY-2S. Also, the weather forecasting accuracy of the Far east Limited Area Model(F-LAM) was greatly enhanced. As an example, routes of the typhoons in 1990 and 1991 were successfully predicted. In the remote sensing, the three-dimensional visualization using CRAY systems contributed to formulating army strategy, constructing huge-dams, and making a Korean peninsular map. In social sciences, a warning system for stock investment securities was developed by analyzing the database of the Korean stock market during the past 15 years. It also contributed to the development of an analysis model of the Korean economy. As academic results, more than 600 technical papers were published using the supercomputer.

2 Research Products

Following are some examples of research works by SSC users; universities, research institutes, and industries.

Title: Climate Change Impact Assessment and Development of Visualization Technique for Climate Information
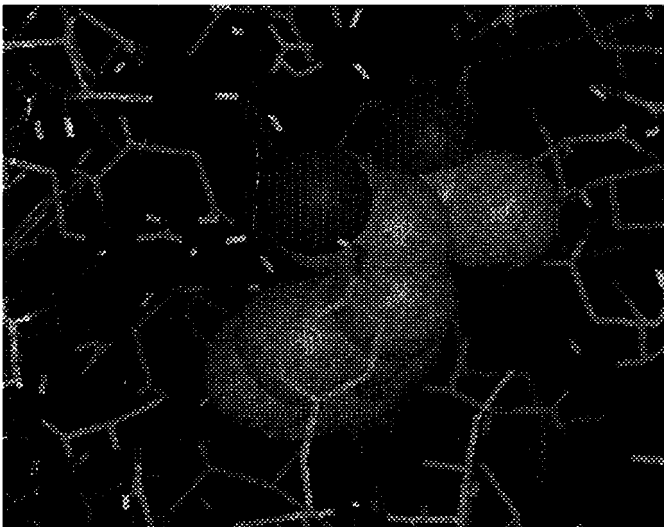Principal Investigator: Sung-Nam OH (SERI)
Research Period : OCT, 1992 ~ OCT, 1995
Contents & Result:

- the impact assessment of climate change on the water resources and rice yields; the climate change is predicted by General Circulation Model (GCM) using supercomputer CRAY C916/16512

- the development of visualization technique for interpreting and understanding of the massive and the complex climate data which are provided from observations or numerical models like GCM

- the climate data (temperature, sea level pressure, precipitation, cloudiness, outgoing longwave radiation, absorbed solar radiation, etc.) simulated by YONU GCM are visualized and animated by scientific visualization techniques.

Applications:

- the development of scientific visualization software for understanding of climate change

- the scientific visualization can be used in estimating the performance of model-simulation

- the visualized product of climate data will be valuable in understanding and educating the climate change

Title: X-ray Crystallographic study of enzyme inhibitor complexes
Principal Investigator: Sang-Soo KIM(Lucky R&D Center
Research Period: MAR, 1991 ~ OCT, 1992
Contents & Result:

- Analysis of a complex structure of carboxypeptidase A and its inhibitor using X-ray crystallography

- Elucidation of the interaction mechanism between the enzyme and the inhibitor

Applications:

- using the inhibition mechanism of the inhibitor, similar inhibitors for related metalloproteaser are now available

- This inhibitor serves as a model compound for developing therapeutics for same serious diseases such as AIDS
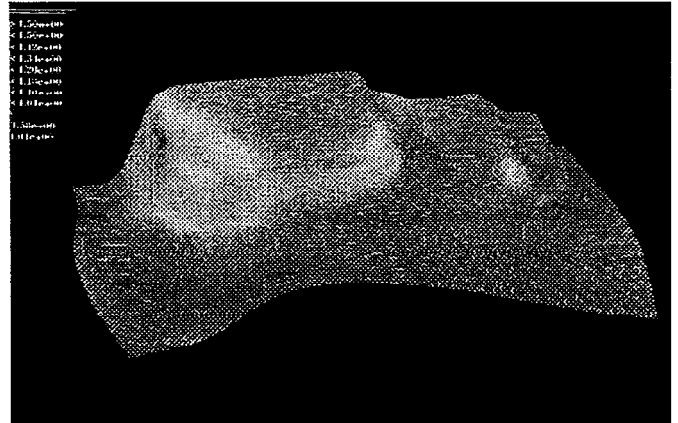
Title: Development of the 3-dimensional Sheet-forming Analysis System
Principal Investigator: Yeong-Sung SUH(SERI)
Research Period: JUN, 1994 ~ FEB, 1995
Contents & Result:

- development of SERI_SFA V 1.0, a 3-dimensional sheet-forming code(in progress)

  - adopted an implicit numerical scheme with the membrane element for accurate and relatively fast computation

  - vectorized for the supercomputer CRAY C916/16512

  - proved accuracy of the code with an automobile fender simulation

  - will be enhanced to simulate variety of sheetforming process

- Application of the computer-aided virtual manufacturing technique to the actual forming practice

  - employed ABAQUS/Explicit system on CRAY C916/16512

  - performed virtual die tryout with an automobile oil pan formed from the vibration damping steel sheet (VDSS)

  - showed the advantage of using the virtual manufacturing technique to form sound product in an efficient way

  - suggested an improved way of oil pan forming process

  - constructing a remote sheet-forming CAE system with Seohae Industry, Inc. to implement developed process

Title: Car Crashworthiness Analysis using PAM-CRASH
Principal Investigator: Yeong-Sung SUH (SERI)
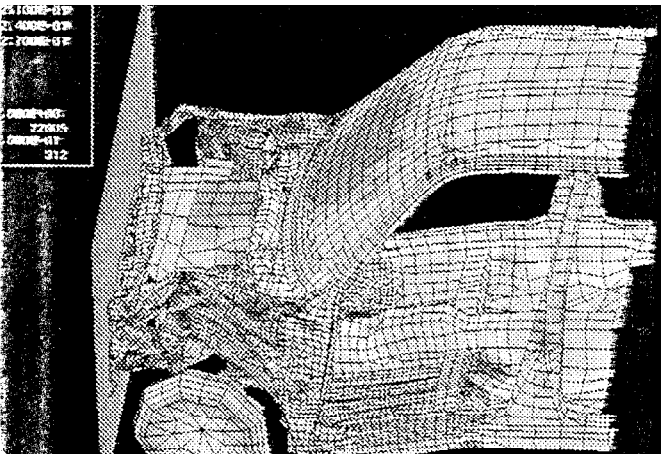
Research Period : AUG, 1994 ~ OCT, 1994

Contents & Result:

- studied a crash characteristics of an automobile

- developed an application technique of the crashworthiness analysis with PAM-CRASH

- utilized PAM-CRASH as a benchmarking tool for the development of SERI DYNA V 1.0 a prototype version of the crashworthiness analysis software

- showed the advantage of using the computer-aided virtual crashing technique to design a stout car in an efficient way
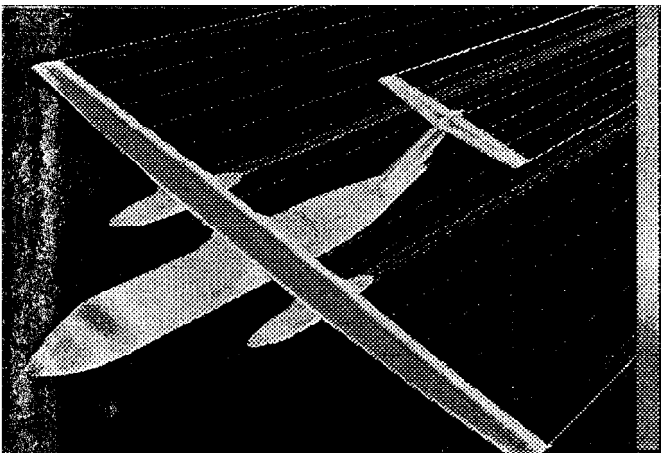
Title: Development of Commuter Aircraft Design and Analysis

Principal Investigator: Dong-Hwan CHOI (KARI)

Research Period: OCT, 1990 ~ DEC, 1992

Contents & Result:

- conceptual design technology development of Twin-engined turboprop aircraft

- basic design technology development in such fields as aerodynamics, structure, control and system integration, etc.

- research on airplane type verification procedure

- construction of computer system for airplane design technology

Applications:

- application for the design inspection and analysis of multipurpose small-type airplane(CHANG-GONG91)

- establishment of fundamental technology for the development of commuter aircraft
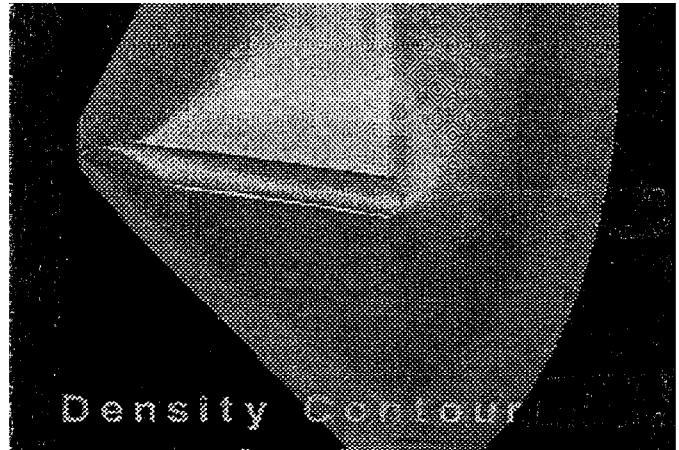
Title: Study on Aerodynamic Simulation of Scientific Rocket

Principal Investigator: O-Hyun ROH(SNU)

Research Period: NOV, 1992~ NOV, 1993

Contents & Result:

- computational code development on supersonic viscous flow around three-dimensional rocket body

- aerodynamic analysis, especially on heat transfer and vortex flow

Applications:

- produce numerical aerodynamic data for vehicle preliminary design

- apply for the aerodynamic simulation during real flight

- construct the basis for the development of domestic rocket system

3 Conclusion

For the last 5 years of supercomputing in SSC, the technology level in Korea was lifted up from the elementary application of general purpose third-party programs, to the advanced stage of modifying and optimizing application softwares. As an instance, DYNA3D. a general purpose structural analysis software, was modified for parallel processing machines, and an initial version was tested on CRAY C916/16512 with successful performance improvements. Currently, SSC is developing a MPP version. Also, CAMRAD-JA for computational fluid dynamics which had been on a VAX system was successfully modified for use on CRAY systems. This effort was made through a joint project between SERI and KAIST

(Korea Advanced Institute of Science & Technology). SSC has several R&D plans for developing a Korean language system and application softwares for CRAY systems. With the progress of these plans, supercomputing in Korea would increase significantly for the years to come.

4 Future Plan

The SSC has a goal to be a leading national super computer center in the world in 2000s. To do so we are trying to make a plan.

1. Leading role in constructing the Korea information super-highway

2. Meta computing center for solving Grand Challenge problems on a high speed network

3. Developing advanced technologies in supercomputing and networking

4. Providing high quality computing services

5. Sharing computer resources with foreign countries