

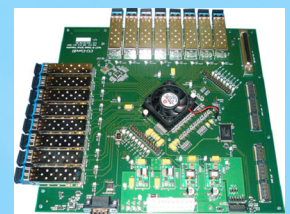
Flosolver Division

The Flosolver project was started in the year 1986 when the computational fluid dynamists at NAL were starving for computing power due to the restrictions imposed on importing powerful computers to the country. As an indigenous solution to the problem this project was started with an objective to design, fabricate and develop parallel computers, an emerging technology then, for use in fluid dynamical and aerodynamical problems and hence the generic name Flosolver. Thus the first parallel computer of India, Flosolver Mk1, was built in 1986. The charter and focus has been to use state-of-the-art processors and other hardware available to keep developmental cost low, make the best use of available sequential software to obtain quick returns on hardware investments, secure the maximum possible raw computing power for a unit investment, keep in pace with the technology development and achieve concurrent application software.

During the last two decades the unit has developed six generations of parallel computers, Flosolver Mk1 to Mk6, and customized software applications, each with a performance far surpassing that of the previous generation. On the hardware front the highlights are 1) successful usage of Multibus I & II for communication in Mk1 and Mk2, 2) execution of NAL's first project under the New Idea Fund scheme of CSIR entitled "Alternate design of high performance CPU card without secondary cache", 3) design and development of an intelligent communication device, the FloSwitch which makes the architecture scalable for tightly coupled problems such as global climate models, DNS and panel codes, and 4) design and development of the FloOptiLink, a versatile communication device for large-scale integration. On the software side, a variety of codes from different fields within the country and abroad were parallelized. Mention may be made of 1) PABAS (parallel *ab initio* atomic base simulator) and PACAL (parallel circuit simulator) of Hitachi, Japan, 2) optimization and parallelization of a multi-grid Navier-Stokes solver of JNCASR (Jawaharlal Nehru Centre for Advanced Scientific Research) for calculating internal flow in a pipe with a super-linear speedup of eleven on an eight-processor system, and 3) development of VARSHA GCM, a hydrostatic, spectral weather prediction code which incorporates features of tropical physics, flexibility of scales, higher precision and software engineering.

Under the NMITLI ((New Millennium Indian Technology Leadership Initiative) scheme, Flosolver led a national team "to design and develop a 128 processor parallel supercomputer incorporating the new high speed switch and optimized to run the new monsoon prediction software and other popular mesoscale codes" and completed it successfully. This resulted in the award of the second phase of the above program jointly supported by Ministry of Earth Sciences. The objectives are to develop a ten Teraflop parallel computing hardware customized for meteorological applications and an enhanced version of the Varsha GCM for better forecasts of the Indian monsoon, which is important to the country.

The Flosolver Unit will continue its work in the field of integrated development of hardware and software for meteorological computing. Studies in many exciting new directions such as multi-precision computing, coupled models, innovative inter-connect strategies, high performance visualization are being planned. It is evident that the hardware and software developed will find direct use in "flow solvers" used for aerospace applications.



The new FloOptiLink communication device with 16 channels.



Flosolver Mk1. India's first parallel computer developed in 1986.



The 128 processor Flosolver Mk 6 and the results of computations made using the Varsha GCM.