CDAC
The Supercomputing People

annual report

2001
2002

Centre for Development of Advanced Computing

Annual Report

2001-2002

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*** as on 31-Mar-2002**

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> Overview

Initiated with a mission to provide indigenously developed state-of-the-art, scalable high performance computers, Centre for Development of Advanced Computing (C-DAC) in about a decade has placed India on the world map of select countries possessing the skills and technology of building high performance computers. True to its vision of emerging as the premier R&D Institution for the design, development and deployment of world class information technology (*IT*) solutions for economic and human advancement, C-DAC has relentlessly pursued its mission objectives.

After delivering two highly result oriented missions, in high performance computing, C-DAC is at the threshold of completing its Third Mission; that of developing Next Generation High Performance Computing & Communications (HPCC) technologies and applications. Teams of highly skilled technical professionals are involved in building on the cutting edge of technology to facilitate delivery of C-DAC's Terascale Supercomputing facility at its Knowledge Park in Bangalore.

Contemporary in its ingenuity, C-DAC's deliverables are designed with a foresight. This has enabled C-DAC to evolve as a trendsetter with its pioneering work in multilingual computing technologies, unmatched expertise in offering advanced computing based strategies and solutions in a number of key sectors, apart from offering advanced training in IT.

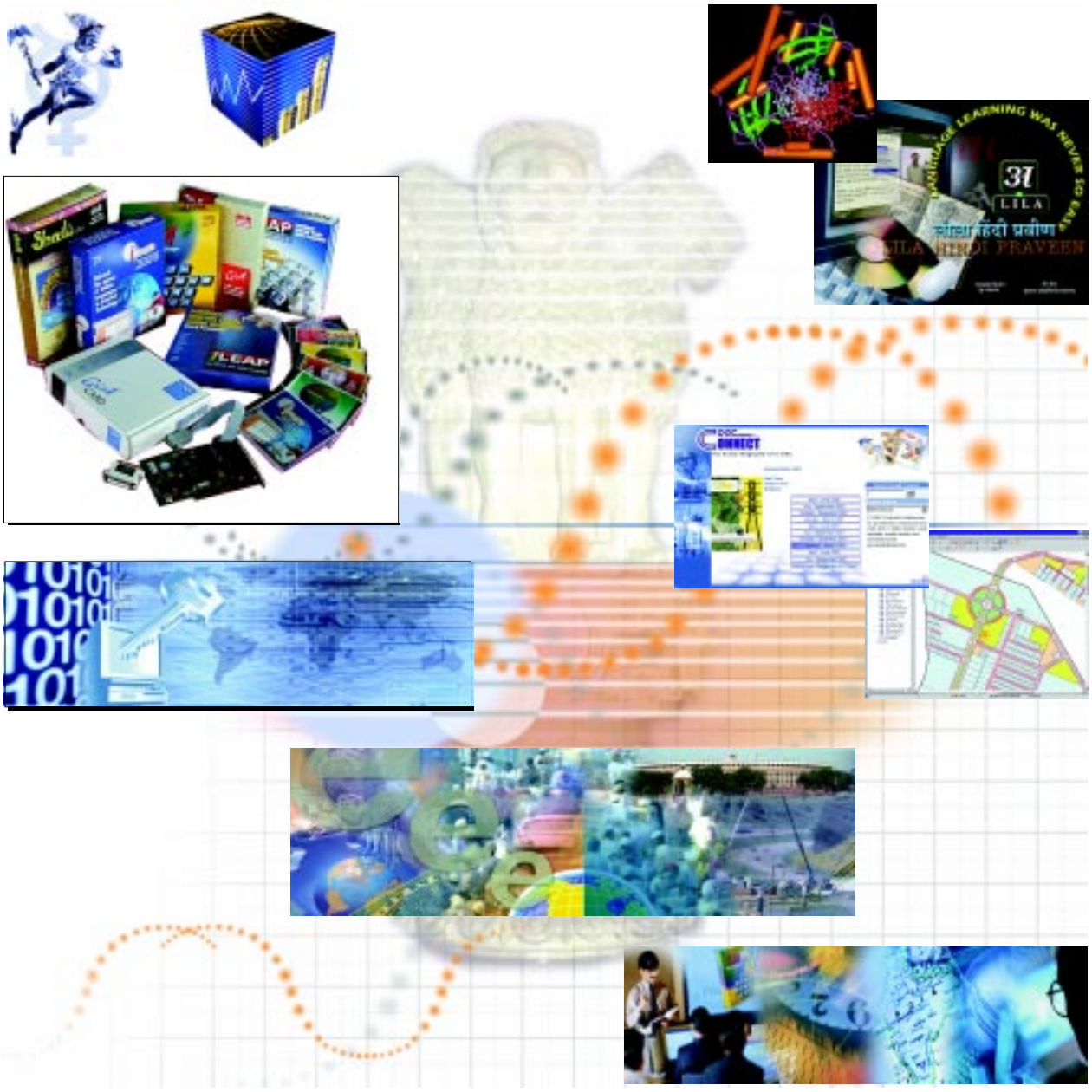
C-DAC's multilingual computing technology proficiency is ably shouldered by its Graphics and Intelligence based Script Technology (GIST). The C-DAC GIST products and solutions have been effective in overcoming the language barrier and proliferating the use of computers in Indian languages amongst the large populace.

Concentrating on its core strengths, C-DAC forged ahead in the areas of eGovernance, eCommerce, eLearning, Digital Libraries and advanced software solutions based on Data Warehousing / Data Mining, Genetic Algorithms, Network Security, Geomatics, Artificial Intelligence, Natural Language Processing and Real Time Systems. C-DAC, accordingly designed and developed advanced computing products, solutions and services applicable in several sectors including Education, Research, Power, Telecom, Health Care, Finance, Agriculture and Network Security.

C-DAC Knowledge Park, Bangalore

C-DAC continues to play a pivotal role in providing trained manpower for the IT industry through its Advanced Computing Training School (ACTS). Keeping abreast with the Industry requirements, C-DAC offers advanced computing programs, which impart comprehensive education on the latest technologies and its applications covering areas of VLSI Design, Embedded System Design, Multimedia and animation, Geoinformatics, Enterprise System Management and Bioinformatics.

Built on its R&D activities, C-DAC has addressed its business operations with equal élan. Various prestigious sponsored and contract projects have been delivered and new ones procured by C-DAC in the areas of Financial Modelling, Telemedicine, Information Retrival, Machine Translation, Network Security, e-Learning, Fault Tolerant and Industrial Computing System, Multilingual Computing, Scientific modeling and visualization, e-Governance. C-DAC has also been offering its services as a turnkey solution provider for several State and Central Government projects. C-DAC's products and services penetrated the international market with C-DAC entering in strategic alliances with renowned overseas organizations.



> Technical Activities

C-DAC's range of activities are broadly divided in the areas of

- RESEARCH & DEVELOPMENT
- SPONSORED / CONTRACT PROJECTS
- BUSINESS OPERATIONS
- EDUCATION & TRAINING

RESEARCH & DEVELOPMENT

C-DAC's R& D efforts are focused in the areas of

- High Performance Computing and Communication (HPCC) Technology and Applications
- Multilingual and Multimedia Computing Technologies
- Advanced Technologies leading to business solutions

The work undertaken in these areas during the year is presented in the succeeding sections of this chapter.

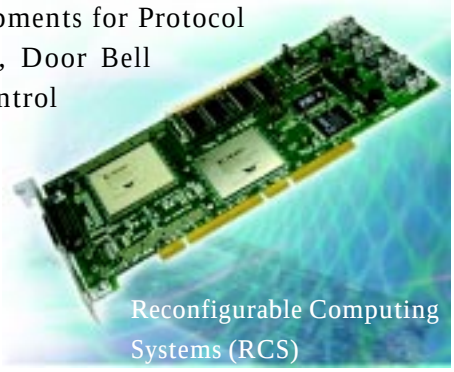
High Performance Computing and Communication (HPCC) Technology and Applications

The R & D work in this area covers hardware technologies, system software, scientific and business computing applications and supporting supercomputing facility.

Hardware Technologies :

Keeping in sync with C-DAC's Third Mission objectives in the HPCC, the Hardware Technology Development Group (HTDG) of C-DAC is developing advanced technologies in high performance computing & communications for Next Generation System Area Networks (SAN) as PARAMNet II and Reconfigurable Computing Systems (RCS).

Phase-I of this activity, involving the development of 1.25Gigabits/Sec speed using C-DAC's Communication Co-Processor (CCP-II) for SAN was completed. As regards the SAN Switch, the development of the 8 PORT Switch (two way 1.25 Gbps) of PARAMNet II was completed and the design of 16 PORT Switch (two way 2.5Gbps) is under progress. The CCP-III, a much advanced version of the CCP II processor, the range of developments for Protocol Controller, ZBT RAM Interface, Address Translation Block, Door Bell Controller, CRC32 Logic Generation & Verification, Flow Control and Transmit/Receive block, DMA and Host Interface and, PCI Interface are completed. Integration & functional simulation is underway. Development of the Virtual Interface Peripheral Library (VIPL) is also under progress.
The design and development of a prototype board for proving the technology concept for Reconfigurable Computing



Reconfigurable Computing Systems (RCS)

System (RCS) was completed and application testing is under progress. Development of the Device Driver over LINUX for the RCS card was also completed. Implementation of the Cholesky Decomposition (FEM) is currently underway.

C-DAC also completed the development of CC-EMAC CORE for UMS CHIP for Cradle Technologies, USA.

System Software :

The ISO 9001: 2000 certified System Software Development Group (SSDG), of C-DAC addresses the performance and usability challenges through HPCC Software - a high performance flexible software environment, which adheres to the established and emerging standards in parallel and distributed computing. HPCC software supports Fortran 77/90 and C languages and is available for both Solaris and Linux computing clusters with PARAMNet system area network.

HPCC - BASE Software

For parallel applications to scale on large computing clusters, the HPCC base software provides low overhead communication, optimized Message Passing Interface (MPI) and a Parallel File System (PFS). The HPCC software KSHIPRA communication substrate provides lightweight communication primitives on the PARAMNet conforming to the Active Messages II specifications of the University of California, Berkeley. KSHIPRA is being extended to include industry standard Virtual Interface Architecture (VIA) implementation and the corresponding MPI implementation for it.

C-DAC's ongoing collaboration with the Indian Institute of Science (IISc) Bangalore, led to the development of the initial version of the PFS. Successive optimizations during the year have enabled to improve the PFS performance up to 40% with the benchmarks in the application areas of Bioinformatics and Computational Fluid Dynamics.

HPCC- Program Development

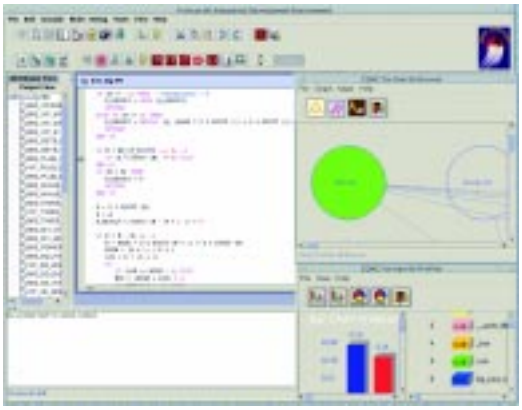
C-DAC has successfully enhanced the analysis phase of the Fortran 90 compiler. These enhancements allow the compiler to generate a highly optimized code. The enhanced compiler is now available for Solaris 2.6, 2.8 and Linux environment.

C-DAC is developing a Symmetric Multi Processing (SMP) based parallelzing compiler in collaboration with the Institute of Systems Programming (ISP), Moscow, of the Russian Academy of Sciences. This compiler takes sequential FORTRAN programs as input and generates OpenMP program that can be run on a SMP compute node. C-DAC is presently working on extending the parallelizing compiler to a computing cluster of SMP nodes.

For correctness and performance debugging of parallel applications, the HPCC software provides DIViA debugging environment that debugs MPI programs written in C and Fortran languages. The latest addition to this environment is the Message Debugger that intercepts messages and allows the user to view and modify the message data. The Message Debugger is available on Solaris 2.6, 2.8 environments. The Linux version is under progress.

DIViA – An Integrated Parallel Program Debugging Environment

HPCC - System Management

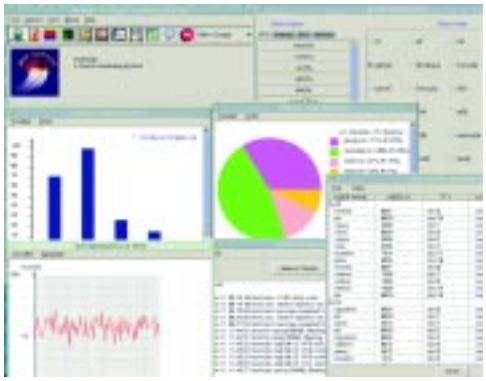


F90IDE – F90 Integrated Development Environment

HPCC software also provides programmers with software engineering tools for producing and maintaining quality code.

A large computing cluster requires tools to manage the system effectively. The system management tool PARMON allows the cluster user or administrator to monitor activities and resource utilization of various components of the cluster. PARMON monitors system activities like process activities, system log activities, kernel activities; controls devices and generates and analyses events. It also provides physical and logical views of the system. PARMON has been enhanced to include web-based monitoring. WebPARMON allows cluster monitoring from any remote node with Java Virtual Machine (JVM) enabled Internet browser.

C-DAC has also developed the Resource Management Software (RMS) for clusters. This software, schedules and load balances jobs across the nodes of the cluster. Support for MPI parallel programs is being provided. RMS is available on Solaris 2.6, 2.8 and Linux environments.



PARMON – An Unified Cluster Monitoring System

Real-time CORBA

In continuation with the development of Real Time CORBA, to provide middleware level scheduling service, a tool for schedulability analysis has been developed. The tool addresses schedulability analysis of both distributed and non-distributed real-time applications.

C-DAC initiated an independent project under the mission to develop a Fault Tolerant Message Passive Interface (FTMPI) to address the growing needs of high availability applications on PARAM. Check-pointing and process migration functionalities are being added to the MPICH architecture under this project. A check point server has been designed and being tested for tolerating the node failures.

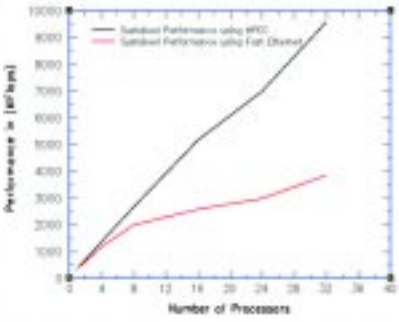
The Fault-tolerant CORBA implementation has also been tested on PARAM Linux clusters using PARAMNET and MYRINET switches. This would enable PARAM clusters to be used for distributed object oriented applications requiring fault-tolerance.

System and Application Benchmark on PARAM 10000

The work on benchmarking of the existing PARAM 10000 system was pursued to optimize on the achievable performance.

The LINPACK is a collection of Fortran subroutines that analyze and solve linear systems of matrix equations by LU factorization. It is simple and easy to use, yet a good indicator of the numerical computing capability of a Parallel system. Using this, one processor of PARAM10000

achieved 390 Mflop/s performance and 9.6 Gflop/s achieved on 32 processors of PARAM 10000 using HPCC software, with a peak performance of the system being 19.2 Gflop/s on 32 processors. The graph alongside compares performance obtained using PARAMNet and Fast Ethernet Switches.



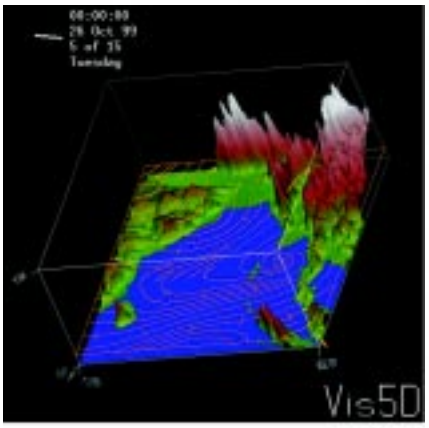
NAS benchmark suites are simulated application benchmarks that combine several computations in a manner that resemble the actual order of execution in certain important Computational Fluid Dynamics (CFD) application codes. Under this, the LU benchmark for class A achieved 2.6 Gflop/s sustained performance on 32 processors using HPCC software.

Scientific and Engineering Computing Applications on PARAM 10000

C-DAC's application development program continued to develop and offer contemporary solutions and applications encompassing areas of science, engineering and business computing. The work carried out in this area during the year is presented.

Computational Atmospheric Science

C-DAC was involved in porting and optimizing the Climate System Model (CSM) on PARAM 10000. The software which is based on a framework that divides the complete climate system into *component models* connected by a *coupler*, was demonstrated on PARAM 10000.



Simulation of 1999 Cyclone with MM5

In collaboration with the Centre for Environmental Science and Engineering at IIT, Mumbai, a detailed regional climate study to examine the aerosol forcing to simulate aerosol chemistry and dynamics is being carried out on C-DAC's PARAM 10000.

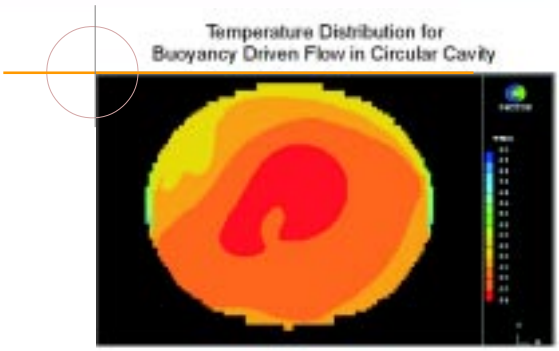
As a collaborative research, the Department of Environmental Science, University of Pune and C-DAC are studying on developing a system that will enable environmental researchers, atmospheric scientists, and town planners to offer an effective environment pollution control strategy.

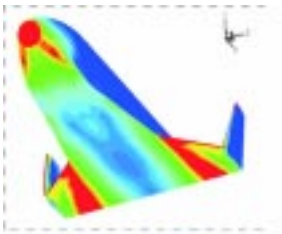
C-DAC also interacted with scientists for developing a pre-processor to predict weather in defined regional locations to serve their operational needs.

As a part of the complete weather forecast cycle requirement, the spectral statistical interpolation code SSI80 and the weather forecasting code were parallelised on an 8 node PARAM 10000 for the National Centre for Medium Range Weather Forecasting (NCMRRWF).

Computational Fluid Dynamics

Simulation of the hypersonic flow for the re-entry class of vehicles under the Integrated Long-Term Programme (ILTP) of collaboration in science and technology between India and Russia





Pressure Contour over Reentry Vehicle

nodalised by the Department of Science and Technology, Govt. of India was undertaken in collaboration with Vikram Sarabhai Space Centre (VSSC), Thiruvananthapuram. The simulation was carried out simultaneously at the Russian-Indian Centre for Advanced Computing Research (RICCR), Moscow and the National PARAM Supercomputing Facility (NPSF), Pune of C-DAC. For this, PARAM 10000 resources were deployed to solve the three-dimensional Navier-Stokes equations. The computational domain was adequately discretised to capture boundary layer, shock waves and the fluid mechanic characteristics to assess the aerodynamics of re-entry vehicle geometry.

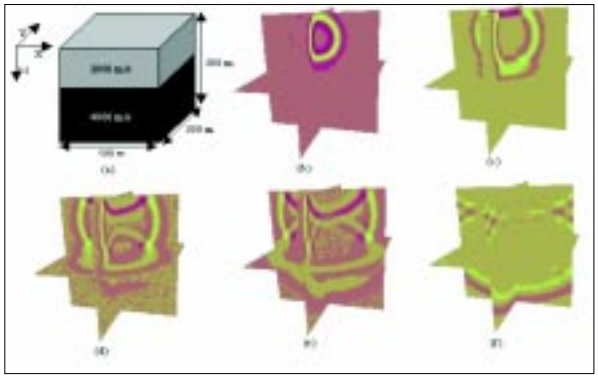
Calendria is an integral unit of the various nuclear power plants designed and managed by the Nuclear Power Corporation, and consists of a cylindrical cavity with a bundle of tubes in which the heat is generated. Its prime objective is to avoid heat spots which, if unchecked, lead to reduced effective operational life. In order to study temperature distribution inside the calendria and maintain its uniformity, the numerical simulation using the PHOENICS, software package, was carried out on PARAM 10000.

In another project jointly carried out with IIT, Kharagpur, using PHOENICS, C-DAC solved the Navier-Stokes equations and the Species Continuity equations in the boundary fitted coordinate system comprising of a large-scale industrial size tundish. The fluid flow properties with the different turbulence models were analysed in the project.

Seismic Data Processing

Seismic data processing, which enables the gathering of useful information of underground geological structures and their physical properties, is becoming very computationally demanding in terms of memory, I/O and speed. To meet these demands, parallel supercomputers like PARAM are preferred platforms for cost effective computations.

C-DAC developed WAVES, which included several wave equation based parallel migration and modeling routines. This facilitated the completion of a development project sponsored by the Department of Science and Technology, Government of India. WAVES is extensively used by several research centers including National Geophysical Research Institute (NGRI) to study deep crustal data sets.



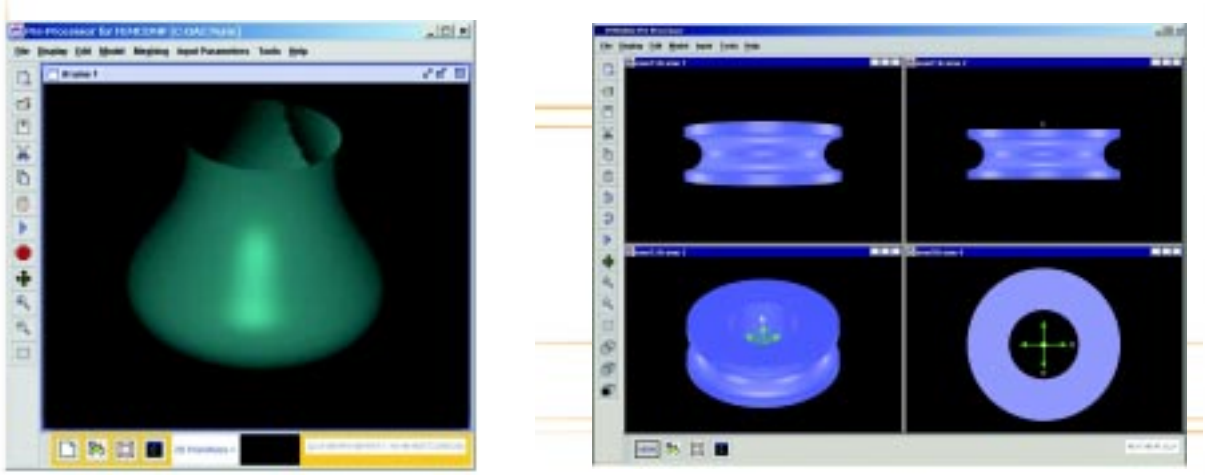
(a) 3D flat layer velocity model snapshots of acoustic wave propagation at (b) 0.008 sec, (c) 0.01 sec, (d) 0.012 sec, (e) 0.014 sec and (f) 0.026 sec

The interactions with the Institute for Computer Aided Design (ICAD), Moscow and the Russian Indian Centre for Advanced Computing Research (RICCR), yielded highly accurate and higher order seismic model algorithms. These were implemented in both the elastic and acoustic equations. The usefulness of such software capabilities on PARAM 10000 was demonstrated, and a project "Development and Parallelisation of 2D model-based Seismic Waveform Inversion Algorithm and software for estimating Elastic Properties of the Earth" has been proposed with Oil and Natural Gas Corporation (ONGC).

C-DAC continued its efforts to develop solutions to mitigate the I/O bottlenecks using ROMIO, an MPI-IO implementation over Parallel Virtual System(PVS) on Linux clusters.

Computational Structural Mechanics

C-DAC completed the installation of the FEMCOMP software at the 12 premier academic institutes in India under a project. To enhance FEMCOMP capabilities, interactive sessions were held with IIT-Mumbai and Shri G.S. Institute of Technology & Science (SGSITS), Indore. A development project for this activity has been proposed to the Aeronautics Research and Development Board, Govt. of India.



Surface of revolution option provided to
sweep 2D geometries to form 3D entity

As a part of a joint project with IISc-Bangalore, 2-D Fracture Mechanics algorithms were ported on PARAM 10000.

A non-linear stability analysis in thin walled structures on PARAM 10000 was carried out under the Integrated Long-Term Programme (ILTP). C-DAC continued collaboration with the Engineering System International (ESI) group, FRANCE, promoting the use of PAM-CRASH and PAM-SHOCK packages with the Industry. C-DAC is working on project INTEGRA in which a solid modeler and visualization tool is being developed in Object Oriented Design. The first phase of the project was completed and the 2-D modeler is at the testing stage.

A multidisciplinary project on Performance Optimization of IC Engines was formulated for an automobile engine. It involved geometric modeling, combustion model development and parallelization activities.

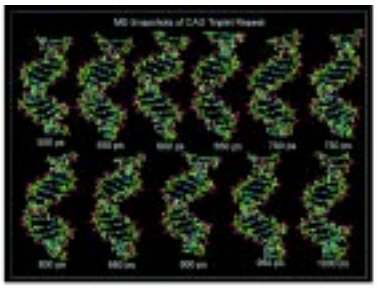
As a part of the project, at the premier academic institutes in India, C-DAC provided technical

assistance and guidance on parallel processing related issues and interacted with experts in specific areas. At IIT-Delhi, parallel implementation of wavelet and finite element methods for 2nd order elliptic Partial Differential Equations (PDEs) is in progess. At IIT-Guwahati, work on delamination of Fibre Reinforced Plastic (FRP) composites under low velocity impact is underway. At IIT-Mumbai the project work involves use of parallel computing in finite element methods, and at IISc-Bangalore the project on implementation of geometric and material nonlinear analysis of structures is being carried out.

Bioinformatics

C-DAC's Bioinformatics team worked towards implementing and optimizing the molecular modeling and sequence analysis codes on PARAM 10000, as well as developing problem solving environments (PSE) for these codes, apart from undertaking research in the domain areas.

To enable biologists the use of parallel Bioinformatics codes on PARAM 10000, C-DAC developed problem-solving environments to use parallel AMBER on PARAM. Parallel AMBER was used to perform one nanosecond (ns) Molecular Dynamics simulations on certain DNA involved in neurodegenerative disorders that revealed the flexible nature of such DNA.



Snapshots of DNA during the one nanosecond molecular dynamics simulation

Significant motifs present in the 500 bp upstream regions of yeast ORFs were detected using parallel Multiple Expectation maximization for Motif Elicitation (MEME), a motif detection program ported on PARAM 10000.

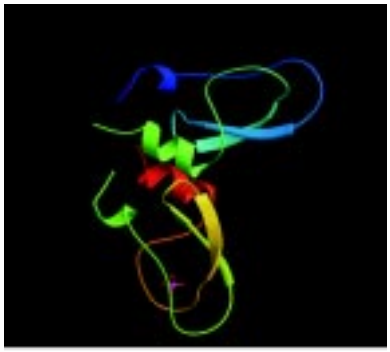
10 ns simulations were also carried out to study the effect of chemical modification, viz. methylation on DNA recognized by PvuII restriction endonuclease enzyme. Analysis of the data generated from these long simulations is currently underway.

Basic Computational Sciences

Under this area, several activities were undertaken dealing with Parallel genetic algorithm, specifically for Bioinformatics, Internal Combustion (IC) engine optimization and Financial modeling, High throughput scanning and feature selection, and Computational Chemistry.

As part of there activities , C-DAC initiated development of a Parallel Genetic Algorithm Library (PGALIB) for a portable and re–useable object–oriented parallel library on PARAM 10000.

C-DAC has also developed Genetic Algorithms to address two important issues in Bioinformatics; multiple sequence alignment and protein structure prediction. The programs are developed in-house and implemented on PARAM10000.



Protein Structure Prediction

C-DAC also developed a method based on Genetic algorithm to minimize the energy of a polypeptide and proteins in torsion angle space. Sequential, data parallel and island models have been implemented on PARAM 10000.

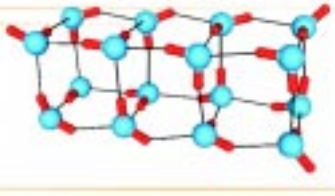
Interaction with the University of Pune continued in the research area of Computational Chemistry. The sequential package for the property calculation, INDPROP was developed on PARAM 10000 and the various modules of INDPROP were parallelised. .

GAMESS was ported and compiled on PARAM 10000. The present version of GAMESS is extremely useful in studying medium and large molecular systems at HF and MP2 levels of theory.

The packages developed by C-DAC for Molecular Systems Study have been employed extensively to study the various issues of chemical interest.

Extensive *ab initio* calculations were performed for several possible structures of medium and large sized water clusters.

RHF/6-31(d,p) optimized geometry of $(H_2O)_{10}$
(Interaction Energy - 96. 75 kcal/mol)



RHF/6-31(d,p) optimized geometry of $(H_2O)_{16}$
(Interaction Energy - 169.33 kcal/mol)

PARAM TF

As an important deliverable of its third HPCC Mission, C-DAC is building a High Performance Computing Cluster with a peak computing power of One Teraflop (TF)with several terabytes of storage by December 2002. For strategic reasons, C-DAC has decided to create this "TeraScale Supercomputing Facility" (CTCF) at its premises in C-DAC Knowledge Park, Bangalore.
The hardware and software being developed in the Mission would be deployed in this facility.

Multilingual and Multimedia Computing and Communications

C-DAC continued to pursue its multilingual computing mission to develop technologies and solutions in Indian Languages. C-DAC's GIST (Graphics and Intelligence based Script Technology) promulgated its developments and creations in myriad domains of IT.

C-DAC released its new "Plug & Play" PCI Bus Based GIST Card. Based on the latest GIST ASIC Chip 9002, this advanced GIST Card has several features as against the earlier GIST ASIC 9001.

ISM 2000, targeted at the desktop and publishing sector to support applications such as Office Suite, desktop mailing systems and desktop publishing applications, was launched. Keyboard drivers, fonts and utilities were developed for it to support multiple applications such as MS Office, Star Office, Lotus Smart Suite, Outlook Express, Page Maker and Corel Draw. Online language tools in the form of macros were also developed for the MS Office and Lotus Smart Suite, with a view to facilitate a seamless use of these tools. Support for

ISM 2000 in all these applications was made available for the Windows 95, 98, NT, 2000, XP platforms and Millennium Edition (ME).

C-DAC's multilingual applications, tools and products were enhanced to provide support for the Internet based applications. ISM 2000 fonts and components were fine tuned for web-based applications such as browsers and web development tools such as Front Page and Dream Viewer. The fine-tuning of ISM 2000 with Database and database developer tools was also undertaken. Server side components for Apache, Tomcat, JWS, and iPlanet were developed to enable development of applications using iPlugin for web-based applications.

The ISCII Type Manager project of GIST aims at the standardization and compatibility of font codes, enabling the exchange of documents / data from various vendors. The first phase of the project, which is essentially a feasibility study sponsored by the Manufacturer Association for Information Technology (MAIT), was conducted with three other developers in the field of language technology.

Continuing its contribution in the standardization of fonts, C-DAC hosted font standardization meetings as a part of the MAIT language technology consortium with support from the Ministry of Communications and Information Technology. Standardization of four scripts viz. Devnagari, Gujarati , Punjabi & Bengali were undertaken.

C-DAC also participated in several standardization activities such as UNICODE, Vedic font, organized by MAIT and Ministry of Communications and Information Technology.

Work on the development of Open Type (OT) for Devanagari, Bengali, Telugu and Kannada was also carried out. A new suite of 8 bit and 16 bit fonts was developed for enhancement of C-DAC GIST products.

C-DAC made its debut on the Linux platform in the form of LISM, which is a keyboard driver application, providing support for multilingual usage in Linux GUI applications. C-DAC also developed language tools for the Linux platform to enhance applications based on Linux.

The PHONIX tool, which provides unique codes for similar sounding strings was developed. This provides a facility to search for strings that have multiple spelling variations but similar pronunciation. PHONIX was effectively applied in the Election Commission of India project for developing a voter query system. It included development of Indian language components and several customized tools for electoral roll data validation. An application for a patent was filed for the PHONIX tool.

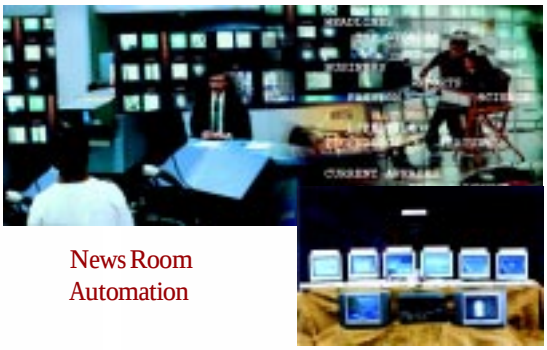
Indian language support for Oracle in the form of a component developing in PL/SQL and C Bridge was achieved.

A project was completed in collaboration with LIPI Data Systems for development of device driver support for Hindi and Tamil for the LIPI range of Dot Matrix printers.

A windows based Multiprompter application was developed and released to assist anchors, newsreaders and comperes to host television programs in Indian Languages.

Multiprompter

C-DAC launched its Multilingual Advanced News Automation System (MANAS) a completely automated and indigenously developed system. MANAS supports the diverse activities required for efficient news production, and facilitates news collection, news story preparation, news sequencing, teleprompting, character generation and news archiving. The entire MANAS comprises of the Multilingual News Editor, News Wire, News Controller, Multilingual Teleprompter, News Character Generator MOVECG 2001, News Betacam Controller, News Admin, News Archival & Search, and Video Browser, as an optional feature.



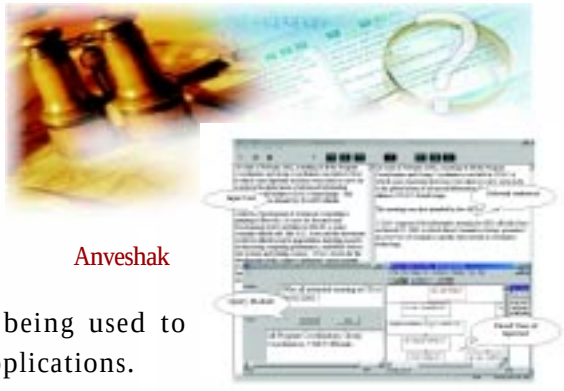
News Room Automation

C-DAC undertook a new Windows based subtitling application with support for DVD subtitle generation. It is in the final stages of development and will be productised in the near future.

As a part of the Asia Information Technology & Communication Programme (Asia IT & C) initiative of the European Commission (EC), C-DAC, in association with Maison des Sciences de l'Homme France and Asociación de Industrias de las Tecnologías Electrónicas y de la Información del País Vasco, (GAIA), Spain, is jointly working on a project titled "Indian Language Communication Tools". The objective of the "Get in Touch – Keep in Touch" phase of the project is to explore the latest advancements in the emerging field of Multilingual Technologies and its potential future directions. The key focus areas of this project are Optical Character Recognition, Speech Technologies & Internet Tools for content creation & its retrieval, in South Asian & European languages.

C-DAC has been engaged in developing an effective user friendly Optical Character Recognition (OCR) for Indian Languages. As part of this effort, OCR for Devnagari is being productised first.

C-DAC has also been carrying out the development of platform independent components based on Java. The productisation process of these components is underway and applications based on these are being developed. JAVA native interface components were also developed as part of this.



Anveshak

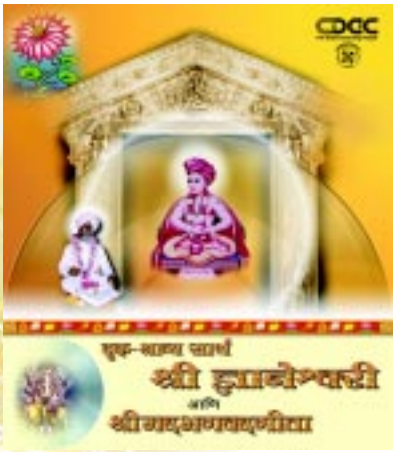
ANVESHAK, a Natural language processing based information retrieval system, with a Summarizer is being developed. ANVESHAK is capable of efficiently and accurately answering queries in the natural language. In this knowledge based Information Retrieval/Information Extraction (IR/IE) system, a knowledge engineering approach is being used to develop an effective system for use in identified applications.

Multimedia

C-DAC's National Multimedia Resource Centre (NMRC) focused on activities of product development, training and multimedia content development with a view to further proliferate the benefits and use of multimedia.

An interactive multimedia demonstration CD, designed to serve as a promotional tool, which provides information about the BourseAnalyzer - an Internet- based scalable platform that offers a suite of analytiques/solvers for applications problems in Capital Markets area, was developed.

A client-server framework to host the Dnyaneshwari and Bhagavad-Gita contents on the Internet which were developed, was evolved. As part of this, an Auto-installer is offered for auto-installation of Devnagari fonts on the client PC.



There are more than 3000 text pages in the Dnyaneshwari and the Bhagavad-Gita to be formatted using the HTML tags and then integrated using the *Content Integration Tool*. In order to speed up the formatting of the text pages, C-DAC designed a tool, which comprises of only the required HTML tags to be assigned.

C-DAC also developed SliceIT with an objective to create multiple segments of a WAV file and slice them into individual files. Using SliceIT the task of editing the recitation of 240 hours and 10700 verses of Dnyaneshwari and Bhagavad-Gita was successfully completed.

The NMRC team is presently engaged in designing decorative and ornamental design sets of characters in various Indian Scripts for composing logos.Two types of Devnagari character sets and the prototype of the editor has already been designed.

Under a project for the National Museum, New Delhi, C-DAC is developing an interactive multimedia application, which will impart information about the artifacts exhibited in the Harappan Gallery of the Museum. The multimedia application will be accessible through touch screen Kiosks designed by C-DAC. As part of the project, NMRC executed the on-site photography of more than 500 objects. Still photography of the Harappan jewelry was conducted in the safe vault of the National Museum, and digital photography using a special revolving platform was done for producing 53 Quick Time Virtual Reality (QTVR) objects. The software for integrating the information about museum objects is being developed.

Under another project, design and development of a multimedia title on the Life and Works of mathematician Ramanujan has commenced in collaboration with the Institute of Mathematical Sciences, Chennal, sponsored by the Department of Science and Technology, Govt. of India.

Advanced Technologies leading to Business Solutions

C-DAC has developed skills and dealt with a number of other advanced information technologies to develop specific solutions and offer them to its customers. These cover Natural Language Processing, Artificial Intelligence, Geomatics, Network Security, Real time systems, Data Warehousing/ mining, Modelling and Visualisation in Bioinformatics and other scientific computations. Details of these activities and the solutions developed can be found in subsequent chapters.

SPONSORED/ CONTRACT PROJECTS

C-DAC has taken up a number of projects concerning its diverse areas of expertise, sponsored by the various Ministries and Departments of the Government of India such as the Department of Information Technology of the Ministry of Communications and Information technology, Department of Official Language (DOL), Department of Science and technology (DST), Department of Culture (DOC) and the Department of Biotechnology (DBT). The progress on some important projects progressing is briefly described below.

Telemedicine

Sponsored by the Department of Information Technology, a Telemedicine System has been developed and is now being taken up for evaluation and deployment. The deliverable of the project has been productised and launched as *Mercury, an Integrated Telemedicine Solution*.

Under the project, C-DAC has also developed a protocol for communication among Telemedicine Systems. To promote interoperability with various Telemedicine Systems with minimal effort, C-DAC has also developed an ActiveX Software Development Kit (SDK), called the ActiveX for Communication in Telemedicine Systems (ACTS). The SDK facilitates easy integration of any Telemedicine System with Mercury.

The system is being installed for field trials at All India Institute of Medical Sciences (AIIMS), New Delhi, Sanjay Gandhi Post Graduate Institute (SGPGI), Lucknow and Post Graduate Institute of Medical Education & Research (PGIMER), Chandigarh.

Financial Modeling

C-DAC launched the BourseAnalyzer, a web-based suite of solutions based on technical/fundamental/ quantitative analysis for global capital markets. It has been put to use as an effective vehicle to implement and deliver the Fundamental Analysis-based Capital Enhancement Tool (FACET) under a project undertaken by C-DAC for the Department of Information Technology.

A Web-based Technical Analysis in Equities, Debt Instruments and Derivatives Trading project was also undertaken as the next stage of this development. The focus of this project is on performing technical analysis on price and volume data of stocks, bonds/debt instruments and derivatives contracts of leading companies. Various mathematical/statistical and Artificial Intelligence based models are employed for performing these analyses on the enormous amount of data.

Lila Projects

C-DAC developed LILA HINDI PRAVEEN (Windows Version), the second in the series of a multimedia based intelligent self-tutoring software package for learning Hindi as a second language. Sponsored by the Department of Official Language (DOL), Ministry of Home Affairs, LILA HINDI PRAVEEN was launched on September 14, 2001 at the hands of the Union Home Minister. Development of the third and final software in the series, LILA HINDI PRAGYA, is under progress.

Development of Web-based LILA Hindi Tutor, aimed at non- Hindi speakers in India and abroad including NRIs, was also taken up by C-DAC for Internet based learning.

Additionally,projects on learning Prabodh, Praveen and Pragya for South Indian Languages and Computer Assisted Translation based on server have been initiated.

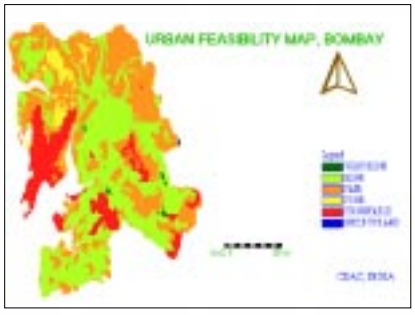
LILA Range of Products

Mantra

C-DAC undertook the design and development of MANTRA, a MAchiNe TRAnslation system under a project sponsored by the Rajya Sabha, based on the architecture and technology of the MANTRA Translation system of C-DAC. It is intended to help in automating the complete process of English-Hindi translation of the official bulletins and proceedings. Initial work on the corpus analysis, grammar creation, tools development and translation modeling is completed.

Geomatics

In association with Maharashtra Industrial Development Corporation (MIDC), C-DAC has implemented GIS Enabled Land Management System (GELMS). Under this, mapping of industrial sites including Ranjangaon, Hinjewadi and Taloja is carried out using IRS 1C remote sensing data and field surveys. A Decision Support System (DSS) for infrastructure planning and management of industrial sites has also been developed. Users of GELMS include Planning, Land and Engineering divisions of MIDC. A subset of GELMS has been hosted on the MIDC site for dissemination of information regarding availability of vacant industrial plots and submission of applications on the Web using Geomatica Web Server.



C-DAC has been awarded a pilot project to develop GIS based Electricity Distribution Management System by the UP Power Corporation Ltd. (UPPCL). Mapping of part of the Lucknow city is being carried out using high-resolution remote sensing data (IKONOS) and field surveys.

The Department of Biotechnology and Department of Space, Government of India, have awarded C-DAC a project on 'Biodiversity characterisation at Landscape level using Satellite Remote Sensing in the Western Ghats of Maharashtra'. The project is intended to assess vegetation biodiversity of Western Ghats (hot-spots) using principles of landscape ecology and geomatics tools.

In association with Wadia Institute of Himalayan Geology (WIHG), Dehradun, C-DAC has initiated a project on 'Microzonation and risk assessment of the landslide affected areas between Banderdewa – Gohpur in Itanagar Capital Complex and Arunachal Pradesh, using GIS and Remote Sensing Techniques'. Department of Science and Technology, Government of India under its Jai Vigyan Programme has sponsored this project.

Development of Compact-PCI bus based Industrial Computer Systems

Sponsored by the Department of Information Technology, C-DAC is developing the Compact-PCI Bus based industrial computer systems to meet the growing needs of the industry for such systems.

A series of modules including Compact-PCI backplane, processor, analog & digital interfaces, field bus (CAN), GPS module, communication controllers, digital signal processor are being developed, leading to rugged industrial computer systems targeting industrial control applications. Embedded software for hot-swap infrastructure, data acquisition and web connectivity using CORBA have been already developed under the project.

Digital Library

The Digital Library project pursues the development of technology, tools and contents to uphold and propagate the rich Indian heritage through the use of state-of-the-art digital technology.

As part of the project, work continued on the authoring of Indian epics such as Bhagavad-Gita, Vishnusahasranama and Rig Veda to provide content for the Digital Library with several features like indexing, search and analysis of the contents. The work on Dnyaneshwari, which is a commentary on Gita, is also under completion.

Under the project, the Digital Library Application Suite (DLAS) has been developed. The DLAS conceives digital data in the form of text, images, audio and video and nurtures it as a consortium with the option of retrieving the stored digital data. The suit also comprises of Dynamic Data Entry Wizard (DDEW), a tool to preserve the contents by digitization, enter meta data to the contents and store it in the database.

A web site for the Saraswati Mahal Library, Thanjavur has been developed and hosted by C-DAC featuring multimedia based information on the rich collection of ancient paintings, writings on palm leaves and other objects.

As part of the task of rendering four Vedas, the Indian Heritage Research Group completed as a first step towards this, Rgveda Ratnakar, an easily searchable database of RgVeda mantras (with user friendly options). It was recently supplemented with the Krama Deepika, a treatise on a combinatorial pattern of recitation in the manuscript form. A Yajurveda reader was also developed

to assist the user to browse the Samhita, Padapatha, Brahmanam, Kathaka, Ekagni-Kanda and Aranyakam. Rendering of the Sam Veda was made possible by the development of Grantha script component.

Sansk-net

Sansk-net, an abbreviation for the Sanskrit Network, was launched with the objective of bringing the Sanskrit institutes/universities under one roof to enable synergised research in Sanskrit. In the first phase, six institutes: RSVP (Rastriya Sanskrit Vidya Peetha, Tirupati), IHRG (Indian Heritage Research Group, C-DAC, Bangalore), AMSC (Ahobila Mutt Sanskrit College, Maduranthakam, Tamil Nadu), ASRM (Academy of Sanskrit Research, Melkote), CIF (Chinmaya International Foundation, Veliyanadu, Kerala), PPSM (PoornaPrajna Samshodana Mandiram, Bangalore) have been identified for this purpose.

Sanskrit Authoring System

The project on Sanskrit Authoring System was completed by C-DAC. Under the project, a product C-VYASA was provided with necessary computational tools for Sanskrit research. It has a multilingual editing facility to create Sanskrit articles, books, technical papers etc. To limit the search to only selected texts, *Tools* for user configurable searching have been added to the system. A Format converter and a Generic converter have also been provided to the system.

MAHABHARATA Database Project

The Mahabharata database project sponsored by the Central Secretariat Library, Department of Culture is underway and the creation of a database of verses of Mahabharata in ISCII format and storing it in the CD-ROM for the same is in progress. A retrieval scheme and a search index are also being developed under the project.

Sanskrit Dictionary

A project for undertaking on a pilot basis, the computerization of Deccan College, Pune, encyclopedic Sanskrit dictionary has been studied and the proposal made.

Network Security

Under this project, core technology of network security covering cryptographic keys and virtual private network is in progress. The secure crypto-keys have been developed based on duly optimized standard algorithms and the design of VPN was completed and its implementation is in progress.

Component based eLearning Functionality Tools

A project, with an objective of developing component-based functionality to eLearning tools with an Indian Language interface and developing a pilot for proving the framework has been initiated. Under the project, courseware would also be designed for specific topics and training will be offered on web learning tools.

Resource Centre for Persio-Arabic Script

As part of the initiative of setting up resource centres for developing tools in various Indian languages, the Department of Information Technology has created a Resource Centre at C-DAC for the Persio-Arabic Script. Under the project, standards for the script have been evolved and a Beta version of an Urdu word processor has been developed. Also, a transliteration software has been used for translating text from Hindi to Urdu, and web hosting of the urdu text undertaken.

Projects on Scientific Modeling and Visualization

The Department of Science & Technology, has supported projects in the areas of computational atmospheric science, seismic data processing, computational fluid dynamics, climate modeling and parallelising compilers for development of specific applications using the PARAM 10000 platform. The Department of Biotechnology has supported a project on creating molecular modeling infrastructure. Under this project, large molecular dynamics simulation has been carried out.

BUSINESS OPERATIONS

The Business Division of C-DAC is its commercial arm, which extends the technologies and products developed by C-DAC commercially to the academic, scientific and other business and economic sectors. The range of activities cover requirements study, software design, consultancy, turnkey assignment, specialized training, product supply, customer support and so on. C-DAC's business activities also embrace a range of areas such as e-Governance, Healthcare solutions including Hospital Information System, Enterprise Network, Data Warehousing and Database Management, Geographic Information System based solutions, Real time system and solutions, Multilingual and Multimedia Computing Products and Solutions and HPC based systems and solutions.

C-DAC's business activities have sustained a steady growth in its clientele, scope and in the revenue earned. During the year, C-DAC achieved a turnover of Rs. 68.27 crores with a surplus of Rs. 13.03 crores.

Central Government Projects

C-DAC undertook the campus wide networking of the Police Head Quarters (PHQ- Madhya Pradesh), Bhopal. The current phase covers a campus wide networking in the PHQ campus of 250 nodes and will connect various sites over leased line of 2 Mbps. This ambitious project of the Government of Madhya Pradesh is designed to expand to 1100 Police Stations spread across the State. The Campus wide network has a Gigabit Ethernet on Fiber Optic Cable as a Backbone and Fast Ethernet in the client side. The network has provisions for incorporating concepts like Security, Video Conferencing and IP Telephony.

A contract from OIL India Ltd., Duliajan (ASSAM) includes in its scope of work, campus wide networking of 500 nodes to connect all the departments spread in the total area of 10 Sq. Kms. This ambitious project will use 8.5 Kms of Fiber Optic Cable and 14.5 Kms of UTP cable spread across the campus. The Campus wide network which has an ATM Backbone and Fast Ethernet in the client side, has provisions for incorporating Security, Video Conferencing, connectivity to RAS and IP Telephony.

DOEACC, has awarded an order for a turnkey solution including supply of Hardware, Application Software, Networking, Security, and VPN for their set up in Delhi. The Application Software includes On-Line registration, accreditation, porting of existing data and evaluation, and is PKI enabled and payment gateway inbuilt.

An order received from the Indian Patent Office (IPO), involves providing a turnkey solution including supply of hardware, third party software, networking, Security and VPN at their major sites in Delhi, Mumbai, Chennai and Kolkata.

Department of Information Technology, has awarded a project for making a documentary on the successful e-Governance applications all over the country for public awareness. Another project, the country Gateway Portal, which is a World Bank funded project, will showcase the information on the various sectors like Agriculture, Power etc. of the country to attract foreign investors in India, and act as a catlyst to the introduction of best practices towards e-Development, e-Governance, and e-Empowerment through collaboration among various stake holders.

Development of a Web based Multilingual Electoral Roll Query system for the Election commissioner of India New Delhi, was undertaken and is nearing completion.

C-DAC undertook a turnkey project for development and deployment of an On-line Management and Monitoring System (OMMS) for Pradhan Mantri Gram Sadak Yojana (PMGSY) sponsored by the Ministry of Rural Development, Government of India. The development of seven different modules for various functionalities and the website is under completion and training to the officials from various states is being provided. A proposal for creating a Data Centre and nationwide connectivity of information on road development is under consideration. The project development is expected to be completed by November 2002.

Geomatics

Geomatics (Geographic Informatics) encompasses all aspects of geo-referenced data, viz. data acquisition, data integration, decision support and information dissemination. C-DAC has carried out a number of development and business projects in this area.

Disaster Management needs an interactive, intelligent, spatial information system that utilizes various aspects of advanced computational techniques including intelligent reasoning, Geomatics tools and flexible GUI to support real time communication and coordination. A Decision Support System (DSS) should comprise of the information generated as a result of data analysis and modelling combined with many other factors. On consultancy from National Disaster Management Cell (NDM), Ministry of Agriculture, Government of India, C-DAC has submitted a report on use of GIS, GPS, network and Web based technologies for Strengthening Disaster Management Capacity within the country.

C-DAC developed the GIS based Computer-aided Information System (COINS), against a Special project.

As a result of its long-term strategic alliance with PCI Geomatics, C-DAC is the first in India and amongst the first few world-wide to implement projects using Geomatica software – world's first totally integrated solution in remote sensing, GIS and cartography. C-DAC has installed over 500 licenses of geomatics software products (50 licenses of Geomatica software during its first year of release) in more than six-dozen institutions including ISRO/DOS, NIC, CWC, CWPRS, CMPDI, CMRI, WIHG, SOI, PRSC, MPCOST, RESECO, BIRSAC, ORSAC, APSRAC, IWM, HPRSAC, DMG-Bihar, IIRS, Anna University, AHEC, Roorkee University, IGIDR, TCE, DIPAC, DTRL, DEAL, NPOL and SASE.

An order received from the U.P. Power Corporation Ltd. (UPPCL), Lucknow involves development of execution level software compatible with their existing MIS and development of GIS for Distribution Network. This will also include the data collection for Warehousing to be taken up in the next phase. The Software Requirement Specification phase has been completed. The project also has a component on GIS, which will map the Distribution network in LESA – I Circle of Lucknow. This real time map based information will link the MIS of UPPCL and will help in asset management, load forecasting, optimal route planning, etc.

Real Time Systems

C-DAC Open Process Solution (COPS) based Supervisory Control and Data Acquisition (SCADA) system was implemented at National Thermal Power Corporation (NTPC), Noida and NTPC, Lucknow. The Islanding and Load Shedding model of COPS was successfully installed and commissioned at Bokaro and Rourkela, Steel plants of Steel Authority of India (SAIL)

COPS-RTU at Punjab State Electricity Board (PSEB) has been completely integrated with the unified system of Power Grid Corporation of India Ltd. (PGCIL).

The Lab Automation Software for Central Power Research Institute (CPRI) in its Phase III has been developed with a partial development workflow and Data Acquisition modules.

High Performance Computing and Communication

C-DAC undertook the up gradation and expansion of HPCC software of the existing eight node PARAM 10000 at The Russian-Indian Centre for Advanced Computing Research (RICCR), Moscow.

A proposal for jointly setting up of a 250 Giga Flop PARAM technology based Supercomputer alongwith LNCC Brazil has been made under Indo-Brazilian Cooperation in Communication and Information Technology.

As part of the supply of a configuration of PARAM 10000 for Premier Institutes under a project, C-DAC completed the Installation and Commissioning of PARAM at the twelve Premier Institutes.

Proposals to National Centre for Medium-Range Weather Forecasting (NCMRWF), New Delhi for an 8 node PARAM 10000 and a another to National Metallurgical Laboratories (NML), Jamshedpur, have been submitted under the MOU's with these organisations.

e-Governance

Under a turnkey contract awarded to C-DAC, software solution for 6 City Corporations of Karnataka covering all their functionalities like property tax, birth/death certificates, trade licenses, water billing, consumer complaints etc., was developed, installed and commissioned. The Karnataka Government has decided to roll out the software for a further 211 Municipalities in the Karnataka State based on this solution.

A web portal for the students information system was developed for the Department of Information Technology, Karnataka. Application software was also developed for the examination process of (KPSE), Government of Karnataka with local language support, which was used for the January 2002 and Departmental examinations.

C-DAC extended its services for maintenance of computerisation projects on PWD on-line, stamp Registration, Legislative Assembly / Council, Electoral Polls for Maharashtra Government, which were earlier executed by C-DAC as a turnkey solution provider.

A Memorandum of Understanding for formulating the e-Governance programme, identifying requirements, and advising on technology solutions was signed with the Government of Goa under which System Requirement Study has been successfully completed for 25 departments in Goa in the first phase.

C-DAC was appointed IT consultant to the Department of Information Technology, Government of Maharashtra for their statewide networking project. Also the Vidhan Bhavan (Secretariat) project for Networking was successfully completed.

Software for facilitating on-Line admission to the 1st year Pharmacy and Architecture Graduate course for the Directorate of Technical Education, Maharashtra was undertaken.

Phase I for the Campus Wide networking of seven colleges under the aegis of the Pravara Rural Trust in Maharashtra was completed. The campus wide networking project at college of Engineering at Shegaon was also completed successfully and certified by AMP.

A LAN alongwith a server client configuration was installed for Agharkar Research Institute.

E - security

A project in the area of e-security was undertaken by C-DAC at Hyderabad. It involved executing a feasibility study for providing secured networking. Also implementation of a security solution on a pilot basis for the client's local area network with dial-up connectivity to another office in Hyderabad is underway. The feasibility document has been prepared and the field-testing of the pilot implementation is in progress.

Using its multilingual and multimedia expertise, C-DAC created a bilingual website for National Remote Sensing Agency (NRSA), Hyderabad by using dynamic fonts, which was launched in September, 2001.

EDUCATION & TRAINING

As part of its charter of responsibility, in order to build and mobilize highly skilled human resource required for the IT industry, C-DAC's Advanced Computing Training School (ACTS) offers specially designed training courses through a network of 106 Authorized Training Centres (ATC's) in India, besides C-DAC's own centers in Pune, Delhi, Hyderabad, Bangalore and Chennai. ACTS also entered the international arena through a strategic alliance with IT Microsystems, to offer various courses of C-DAC in Auckland, New Zealand, Dubai, UAE and New York, USA.

The Courses offered by ACTS are :

Preparatory Course for Diploma in Advanced Computing (PreDAC)

This course grooms students seeking admission to C-DAC's coveted Post-Graduate Diploma in Advanced Computing (DAC) course. It is also considered an independent course incorporating Programming Fundamentals, C Programming Language and Object Oriented Programming Concepts.

Diploma in Advanced Computing (DAC)

The course trains post-graduates for the software industry and equips them with higher value skills in tools and methodologies for diverse software development projects and activities. The course contents are regularly updated to meet the industry requirements.

Diploma in Information Technology (DIT) and Advanced Diploma in Information Technology (ADIT)

These courses are designed for students, teachers, executives, government employees, businessmen, professionals, housewives, senior citizens and all those who would like to use computers intelligently and undertake software development for small and medium size business houses.

Diploma in VLSI Design (DVLSI)

ACTS, in association with C-DAC's Hardware Technology Development Group, offers the Diploma in VLSI Design Course. The course trains engineers and electronic science students in diverse areas of VLSI design.

Co curricular Diploma in Advanced Computing (CcDAC)

Students studying in their graduation courses are facilitated to take the modules of this course, which then becomes a co-curricular course. At the end of the graduation, the student passes out with enough insight in the tools and methodologies in IT. These courses are being redesigned to facilitate a flexible schedule, a credit system based on modules, modular structure across a wide variety of subjects of topical concern in the software sector.

Computer Arts Courses

ACTS, in association with C-DAC's National Multimedia Resource Centre, offers various courses in the field of Computer Arts viz. Diploma in Advanced Computer Arts, Applied Computer Arts and Low Cost Multimedia Creations.

Maharashtra State Certificate course in Information Technology (MSCIT)

This course was initiated by the Govt. of Maharashtra for the junior and senior college students as also for employees and staff of the Government of Maharashtra. C-DAC was selected to offer these courses through its existing chain of ATCs across the State.

Diploma in Embedded Systems Design (DESD)

To tap the growing potential in the area of Embedded Systems, a new professional course, DESD was launched this year, and on a pilot basis is being offered to the students in C-DAC's centres at Hyderabad and Bangalore.

Courses and Number of Students registered during the year.

Sr. No.	Course	No. of Students
01	Diploma in Advanced Computing (DAC)	3405
02	Diploma in Information Technology (DIT)	13522
03	Advanced Diploma in Information Technology (ADIT)	822
04	Co-curricular Diploma in Advanced Computing (CoDAC)	1159
05	Preparatory Course for Diploma in Advanced Computing (Pre DAC)	1391
06	Diploma in VLSI Design	195
07	MSCIT	4642

Total Number of Students : 25136

Total Number of Centres (in India) : 106

Total Number of Centres (Overseas) : 03

C-DAC Hyderabad established the e-Learning and e-Learning technologies group (ELELTECH) for developing various technologies and strategies related to e Learning supported by the Department of Information Technology, Ministry of Communications and Information Technology, Government of India. Using the expertise built up, C-DAC is designing a framework to offer some of its courses in e-Learning frame work.

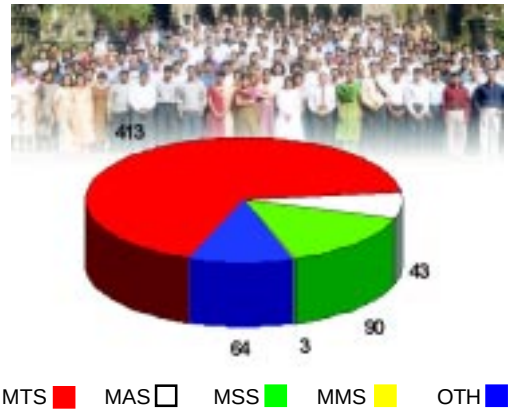
PACE (Programme for Advancing Computer Education)

This programme was designed to spread IT education to the masses across the country keeping the language sensitivity of the beneficiaries in view.

The year witnessed significant developments for PACE. It reached a network of 500 centres across the country. The centres were graded as per Government defined systems. Based on the economic and geo-political conditions prevailing in each state, different course and fee structure were designed to create a faster and deeper reach in each State, and has consequently created awareness about C-DAC's software proficiency and multilingual technology. The syllabus of PACE courses was revised with a distinct weightage towards multilingual contents. Emphasis was placed on standardization of the PACE programme, with designated infrastructure facility and course material, which were monitored through field visits to ensure quality of delivery.

> Infrastructure and Facilitating Activities

Human Resources Development



Total : 613
Staff Type Wise Distribution
as on 31.3.2002

During the year, with a continuing focus on HR interventions, steps were initiated to ensure that the focus was maintained on both the classical HR functions relating to Personnel Management as also on the development of HR. Emphasis was laid in identifying employee satisfaction levels through frequent employee surveys. C-DAC monitored and identified manpower pools based on skills and a project wise manpower deployment process got underway.

In order to maintain contemporary skill sets in C-DAC, the HR Department continued with its training programmes to enhance the skills of its employees. A total of 83 soft skills developmental programmes, technical programmes and sponsored training programmes were conducted during the year. Consequently 991 C-DACians underwent various training programmes during the year across these courses.

HR revamped the Employee Provident Fund Trust, systematized the recruitment process and revised the appraisal policy. The HaRP (Human Resources and Payroll generation system) Software comprising various HR modules was also customized for the 'Employee data and records' as also the 'Payroll software', and was completed.

As part of the Vision and Mission initiatives, a workshop for the Top Management was organized to revisit C-DAC's Vision and Mission objectives. The Management was also exposed to leadership issues and general management programmes.

An HR Meet 2002 was held during February 5-6, 2002 to reflect on the HR interactions carried out during the year and establish the HR agenda for the year 2002 – 2003.

National PARAM Supercomputing Facility (NPSF)

C-DAC's National PARAM Supercomputing Facility (NPSF) set up at the Pune University campus in the Science & Technology Park, provides supercomputing facilities to industries, research and academic institutes in India that need such a facility to process their diverse compute intensive applications. The PARAM 10000 installed at NPSF makes this facility the largest supercomputing facility in India. Remote connectivity is available at NPSF for those users who wish to work on it remotely by establishing adequate connectivity bandwidth as per their requirement.

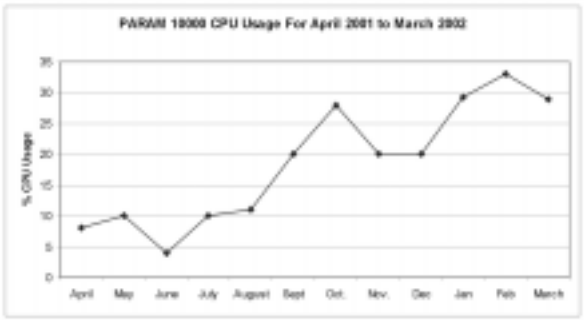
Researchers regularly use the high performance PARAM system at NPSF within C-DAC as well as external users. Some of the external user agencies who have made use of the NPSF include :

- Department of Chemistry, University of Pune, Pune
- Bioinformatics Centre, University of Pune, Pune
- Department of Computer Science, University of Pune, Pune

- Department of Scientific Computing, University of Pune, Pune
- Satyam Computer Services Ltd., Pune
- Institute of Computer Aided Design (ICAD), Moscow, Russia
- Indian Institute of Astrophysics (IIAP), Bangalore
- Indian Institute of Technology Kanpur (IITK), Kanpur
- Indian Institute of Technology Roorkee (IITR), Roorkee
- Indian Institute of Technology Madras (IITM), Chennai
- Department of Atmospheric Sciences, Indian Institute of Technology Delhi (IITD), New Delhi
- Department of Computational Fluid Dynamics, Indian Institute of Science (IISc), Bangalore
- Institute of Armament Technology (IAT), Pune
- National Centre for Medium Range Weather Forecasting (NCMRWF), New Delhi
- Indian Institute of Tropical Meteorology (IITM), Pune
- National Chemical Laboratory (NCL), Pune
- Computational Mathematics Laboratory, Tata Institute of Fundamental Research (TIFR), Pune
- Structural Engineering Research Institute (SERI), Mysore
- Department of Electronics, MIT College of Engineering, Pune
- Department. of Crystallography & Biophysics, Anna University, Chennai,
- Indira Gandhi Institute of Development & Research (IGIDR) along with National Stock Exchange (NSC), Mumbai
- Scientific Computing Group, Vikram Sarabhai Space Centre (VSSC), Thiruvanathapuram
- Indian Institute of Technology Bombay (IITB), Mumbai
- Astrazenica Ltd., Bangalore
- Pentafour, Chennai
- National Geophysical Research Institute (NGRI), Hyderabad
- Geo Processing & Interpretation Centre (GEOPIC), Oil & Natural Gas Corporation (ONGC), Dehradun

NPSF currently offers remote connectivity to the following user groups, as per their requirement.

- C-DAC, Bangalore
- C-DAC, Delhi
- C-DAC, Hyderabad
- Institute of Armament Technology (IAT), Pune
- National Chemical Laboratory (NCL), Pune
- Satyam Computer Services Ltd., Pune
- Department of Chemistry, University of Pune, Pune



The usage statistics of NPSF during the last financial year is shown in the graph alongwith.

Intellectual Property Protection

C-DAC's Knowledge Management Cell strengthened the process for filing applications for the registration of C-DAC's Patents, Copyrights, Trademark, Logos, Product names and Training courses. During the period under review, fifteen different applications were filed. In addition, eight applications for copyright of Software and a provisional Patent application was also filed.

Library and Information Centre

C-DAC has a well-resourced technical library on a range of technically relevant subjects such as Supercomputers, HPCC, Networking and Communications, Software Engineering, Hardware and Architecture and others. The library also maintains information on management techo-economics and related issues.

C-DAC's Technical Library has over 7500 Books, Reports and Conference proceedings. It subscribes to 130 different periodicals and online versions of some journals and has 2200 bound volumes of periodicals.

The library updates and maintains 37 information folders, which contain cuttings on subjects of C-DAC's interest from newspapers and journals. It also offers e-clipping service to its customers connected with media reports on information technology.

C-DAC Knowledge Park

C-DAC's Bangalore Centre is now housed at its own premise, better known as the C-DAC Knowledge Park, near NGEF. Covering an area of more than 55,000sq feet, the Centre is equipped with state-of-the-art facilities and infrastructure and is considered a landmark in this area.

Hindi Cell

In order to proliferate the use of Hindi, particularly amongst the IT populace, C-DAC has contributed immensely by developing various tools and technologies using the natural language processing. Several packages were introduced during the year to popularize Hindi, and downloads of some of them are available at the website : http://www.cdacindia.com

Vigilance, Grievances and Liaison

As per the directives of Chief Vigilance Commission, a Vigilance Officer oversees the Vigilance related issues in C-DAC. A Senior Member has also been nominated as a Grievance Officer and Liaison Officer for Reserved Category members.

Cultural and Welfare activities

C-DAC facilitates and encourages a congenial work environment amongst its members. The organizational culture is addressed to keep members happy and committed to their work with the greatest motivation. Some of the cultural and welfare activities undertaken included:

- Science Day was observed on 11th May 2001. The public at large was invited to get a glimpse into C-DAC's major activities, which were showcased.

- C-DAC took up a stall to propagate and showcase its technology at the National Children's Science Congress during December 27 – 31, 2001 organized in Pune.
- Badminton Tournaments were organized for the members of C-DAC.

- A Cultural programme was organized for members of C-DAC and their families. Members, their spouses and children got an opportunity to exhibit their talents and interact with C-DACians.

- The Executive Director was invited to Yerawada Central Jail to distribute certificates to inmates who were trained in a basic course in computers, and a promise to support the cause was extended by C-DAC.

- C-DAC actively participated in "Children's Day Celebrations" where computer literacy through Multimedia products was demonstrated in a Pune based School.

> | Workshops, Seminars and Exhibitions

C-DAC pursued its knowledge-sharing objective by organising and participating in a number of workshops, seminars, conferences and exhibitions during the year.

- In association with the local chapters of Indian Society of Remote Sensing and Indian Society of Geomatics, C-DAC organised a daylong workshop on 'Seismicity of western India with special reference to recent Kutch earthquake' in July 2001
- A one-week workshop on Geoinformatics during Aug 6- 10, 2001 aimed at providing conceptual knowledge on GIS and related fields, and hands-on training on the use of GIS software.
- C-DAC conducted a weeklong training workshop on Geoinformatics for Bharat Electronics Limited (BEL) officials during February 25 - March 02, 2002.
- C-DAC and the Department of Information Technology, Government of India jointly organized a two-day national seminar on E-Learning and E-Learning Technologies (ELELTECH India-2001) at Birla Science Centre during August 7-8, 2001. ELELTECH India –2001 focused on e-learning methodologies, convergence of Internet in e-learning and pedagogical issues in web based learning.
- A Bioinformatics Industry Meet was held on March 8, 2002. The Meet aimed at providing an insight into the potential of high performance computing in Bioinformatics and was targeted at executives and professionals from various pharmaceutical, agricultural and other industries.
- A series of one-day workshops in the areas of Computational Atmospheric Sciences, Computational Fluid Dynamics and Seismic Data Processing were held during March 5-7, 2002.
- C-DAC conducted a two-day workshop during April 6-7, 2001 on CORBA based Real-Time Fault Tolerant System for industrial Applications.
- A two-day eGovernance road show during November 26-27, 2001 was held, with the objective of showcasing its expertise and strengths in eGovernance solutions and services.
- C-DAC's National Multimedia Resource Centre (NMRC) organized an educational seminar on December 23, 2001 in the area of Animation and Modelling.
- A workshop, to review the activities of the project for the installation and usage of PARAM

10000 at twelve Premier Academic Institutions in India was organized at C-DAC, Pune, during July 5-6, 2001.

- A workshop, on the usage of PHOENICS was organized by C-DAC at Pune during May 14-18, 2001 for the Premier Institutes where PARAM 10000 has been installed and the usage of PHOENICS on the parallel system has been opted for.
- The Indo-Brazilian Trade promotion meet at Brazil and the INTEX 2002, Indian Trade Exhibition in Colombo, Sri Lanka during March 21-24, 2002 witnessed the presentations from C-DAC.
- C-DAC also participated in the Broadcast India 2001 Exhibition, held from Nov 1-3, 2001 and in Broadcast Engineering Society (BES) Expo 2002', held at New Delhi during February 14-16, 2002.
- C-DAC participated in the Bangalore IT.Com 2001 during Nov 1-5, 2001 and displayed its expertise in eGovernance and Multilingual Applications.
- C-DAC, participated in the High Performance Computing Conference: HPC Asia/Pacific 2001, held at Gold Coast, Australia, during September 24-28, 2001. As many as 16 Asian countries, experts from Europe and USA, in addition to many private industries who deal in high performance computing hardware and software, attended the conference.
- C-DAC participated in ELITEX 2001, a conference and Exhibition organized by the Department of Information Technology, Govt. of India.

> | Awards

C-DAC got recognition and won accolades and acclaim for its products and services during the year.

- C-DAC was adjudged the Best Reseller by PCI Geomatics for the second year consecutively in 2001 and was awarded a Golden Plaque.
- C-DAC bagged the Second Prize for Best utilization of the given space and good color combination at Bangalore IT.com 2001.
- ILeap, the Intelligent, Internet-ready, Indian language Word Processor from C-DAC was awarded the PC Quest Users' Choice Award 2001 for the best Indian language software for the fifth successive year.
- C-DAC' s LILA HINDI PRABODH bagged the Computer Society of India's (CSI), CSI - INFOSYS award for the best shrink wrapped software Product for the Year 2000.
- C-DAC's MOVE CG 2001 bagged the First runners-up CSI - Wipro Award-2001 for the Best Packaged Application.
- C-DAC ISM 2000 bagged the Second runners-up CSI - Infosys Award-2001 for the Best Shrink Wrapped Product.

> Technical Publications

The following Technical papers of C-DAC members were published during April2001 to March 2002.

1. Anbarasu, L. A. :
Parallel genetic algorithm for multiple sequence alignment problem: 'Graduate student workshop' at Genetic and Evolutionary Computation Conference on July 7-11,2001 at San Francisco, CA, USA.

2. Anbarasu, L. A., Sundararajan, V. and Narayanaswamy, P. :
Parallel genetic algorithm for performance-driven sequence alignment; "Late-Breaking Paper" at Genetic and Evolutionary Computation Conference on July 7-11, 2001 at San Francisco, CA, USA; Submitted to special issue on Evolutionary Computation, Information Sciences (Elsevier).

3. Anbarasu, L. A., Narayanasamy P. and Sundararajan, V. :
Parallel adaptive genetic algorithm; 2001; submitted to Applied Intelligence.

4. Anbarasu, L. A. and Sundararajan, V. :
Multiple Sequence Alignment Using Parallel Adaptive Genetic Algorithm; InCOB 2002, The International Conference on bioinformatics 2002. Bangkok, Thailand, 2002

5. Dhurandhar, Medha :
Data Mining for optimal trading strategies in financial markets using parallel genetic algorithm; The 2001 International Conference on Parallel and Distributed Processing Techniques and Applications (PDPTA '2001); June 25-28,2001, Las Vegas, USA

6. Katre, Dinesh S. :
"Template based Authoring for Cost Effective Multimedia Production", IEEE Multimedia Technology and Applications Conference Proceedings, pp. 133-142, University of California, Irvine, USA (Nov. 2001)

7. Katre, Dinesh :
Unconventional inspirations for creating software interface metaphors; Proceedings of International Conference on Media and Design (ICMD 2002), Volume I, pp. 1-15, Mumbai, India

8. Kiwelekar, A. W. and Sinha, Pradeep K. :
Evaluating CORBA as a cluster middleware for heterogeneous cluster, Proceedings of the 9th International Conference on Advanced Computing, Bhubaneshwar, India, p. 113-116, December 16-19, 2001

9. Kumar, V., Sundararajan, V., Belosludov, R., Mizuseki, H., Kawazoe, Y. and Kasuya, A.
ab initio study on magic behaviour of CdSe clusters; Proceedings of the International Conference on and Materials Science and Nanotechnolgy (June 2001) Nagoya, Japan

10. Phadke, S., Rastogi, R., Yerneni, S. and Chakraborty S. :
Parallel Distributed Seismic Imaging Algorithms On Param 10000, Fourth International Conference and Exposition of the Society of Petroleum Geophysicists (SPG'2002), January 7-9, 2002, Mumbai, India

11. Rastogi, R.and Phadke, S. :
Optimal aperture width selection and parallel implementation of Kirchhoff migration algorithm; Fourth International Conference and Exposition of the Society of Petroleum Geophysicists (SPG'2002), January 7-9, Mumbai, India.

12. Sinha, Pradeep K. :
Multipurpose, multilingual, multimedia scaleable information warehouse for state level governance, IETE Technical Review, Vol. 18, No. 6, p. 443-447, Nov.-Dec. 2001

13. Sinha, Pradeep K. :
Building a large data warehouse for citizen facilitation, Proceedings of the 9th International Conference on Advanced Computing, Bhubaneshwar, India, p. 279, December 16-19, 2001

14. Sinha, Pradeep K. :
C-DAC's current and future initiatives in High Performance Computing, Proceedings of the 1st National Conference on Advancements in IT and management, Dehradun, Feb. 8-9, 2002

15. Yerneni, S, Rastogi, R. and Phadke, S. :
On selection of aperture width in Kirchhoff migration: EAGE 63rd Conference & Technical Exhibition -Amsterdam, The Netherlands, June 11-15,2001

> | Web Presence

The various activities of C-DAC can be accessed at the URL - http://www.cdacindia.com. Efforts have been made to make the site aesthetically appealing. The site being Streaming-Media and Webcast-enabled, audio-visual presentations of key events such as the Annual Foundation Day, product releases, and snippets of media interviews can now be viewed online. The Audio-Visual Gallery section contains streaming media files that provide information on the activities, achievements, and developments at C-DAC as covered by the media. Strategically positioned multiple interactive feedback-forms help the user understand various products and services, research and development activities and the like. Exhaustive details about various conferences, training programs and workshops are regularly hosted and conference proceedings meticulously archived for future reference. The popular in-house quarterly, 'C-DAC Connect' is accessible online in an interactive web form with content specifically catering to accomplished web standards. Also, past issues (of the magazine) are carefully archived. Printable animated location maps from the railway station and the airport to various C-DAC centres provide easy accessibility. A customized search engine, developed in-house by the Web Team, helps satisfy online user queries. Also in keeping with user demands, the website has integrated with a leading payment gateway to facilitate E-Commerce; thereby enabling clients to effect secure international credit card transactions. The C-DAC website serves as a launch pad for various portals such as the Multimedia Portal, the Heritage Portal, and the ACTS Education portal. The Citizen/Client Charter, provides a convenient means of grievance redressal in accordance with Government directives. C-DAC's R & D efforts in multilingual technology are brought to the forefront with the hosting of a Hindi version of the website using Multilingual Dynamic Font technology developed by C-DAC. http://www.cdacindia.com presently hosts more than 250MB of content and records an average hit-rate of more than 200,000 hits per day, with over 30,000 downloads recorded in the calendar year.

> | Foundation Day

C-DAC celebrated its Fifteenth Foundation Day on April 13, 2002. The Chief Guest for the Foundation Day, was Shri Shyamal Ghosh, Secretary, Dept. of Telecommunications, Government of India. Professor U.R. Rao, Chairman, Prasar Bharati Board and Member, Space Commission delivered the Foundation day address. Professor P.V. Indiresan, Former Director, Indian Institute of Technology, Chennai presided over the function.

C-DAC highlighted the new areas of advanced Information Technology it has ventured into. The technologies showcased on the occasion included Security over Public Networks, Natural Language Processing based Information Retrieval, Decision Support System using Geomatics Technologies and Bioinformatics: Towards safer drugs & designer medicines.

Shri. R.K. Arora, Executive Director, C-DAC, presented an overview of the activities and accomplishments of C-DAC during the year and the approach adopted by C-DAC in delivering a synergetic technological evolution.

C-DAC felicitated the Padma Awardees, Prof. N. Balakrishnan, Dr. Kota Harinarayan, Dr. Ashok Jhunjunwala, Dr. F.C. Kohli, Dr. R.V. Perumal and Dr. B.N. Suresh for their outstanding contribution to the field of Information, Science and Engineering.

C-DAC also presented Awards of Excellence and honored its members for completing a decade of service. On the eve of C-DAC's Fifteenth Foundation day, a Haasya Kavi Sammelan was organized for C-DACians and their family members.

> | Acknowledgements

C-DAC would like to acknowledge and thank Shri Pramod Mahajan, Hon'ble Minister of Parliamentary Affairs and Communications & Information Technology and Chairman of the C-DAC Governing Council for his all time support in C-DAC's endeavors. C-DAC would also like to thank Shri Rajeeva Ratna Shah, Secretary, Department of Information Technology and Chairman of the Steering Committee for his continuous support, and encouragement. C-DAC thanks Shri S. Lakshminarayanan, Additional Secretary, Department of Information Technology, Dr. A. K. Chakravarti, Advisor, Shri Y.S. Bhave, Joint Secretary & Financial Advisor, Dr. Om Vikas, Sr. Director and other officials of the Department of Information Technology, Government of India, for their cooperation and support. C-DAC would also like to place on record its appreciation to the officials of Department of Official Language, Department of Science & Technology, Department of Scientific and Industrial Research, Department of Biotechnology and University of Pune for their understanding and support. C-DAC would also like to take the opportunity to express its appreciation to all its valued clients and associates for their understanding.

(From R to L) Prof. P.V. Indiresan, Former Director IIT, Chennai, Shri. R. K. Arora, Executive Director, C-DAC, Prof. U. R. Rao, Chairman PRL Council, ISRO-Dept. of Space , Govt of India, Shri Shyamal Ghosh, Secretary, Dept. of Telecommunications, Govt. of India, Dr. S.C. Purohit, Director, C-DAC light the lamp on the occasion of C-DAC's 15th Foundation Day.

Shri Shyamal Ghosh, Secretary, Dept. of Telecommunications, Govt. of India felicitates Dr. F. C. Kohli on C-DAC's 15th Foundation Day.

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