Computational Modelling Division

An Overview

Informatics Department

Introduction

Much of modern computer aided engineering is concerned with design. A major part of the design process is concerned with setting up models of real world objects and simulating how they behave. This ensures, for example, that structures can be designed to withstand earthquakes or high winds, or that fuel is burned more efficiently in a car engine.

Much design work relies on the exploration by trial and error of alternatives by using existing knowledge and past experience to home in on acceptable solutions. In Computational Modelling Division (CMD) the emphasis is on the development of new techniques for modelling of engineering systems, the production of libraries of useful software, the implementation of software on parallel processing computers and the presentation of multi-dimensional results. Specific application areas are particularly addressed: process and device modelling of semi-conductor devices ('silicon chips'), computational fluid dynamics and electromagnetics.

The Work of CMD

The CMD consists of five groups:-

Mathematical Software Group

This Group is primarily concerned with the development of new computational techniques and the implementation of these into software packages and libraries. A library of software using the Finite Element method was started in 1978 and is now distributed by the Numerical Algorithms Group (NAG) in Oxford. Over the years, new releases of the library have been produced which broaden its applicability.

The Group has a special interest in device and process modelling of semiconductor devices. The work has been largely collaborative with industry and university departments, both in Britain and the rest of Europe. The funding came from both the Department of Trade and Industry's (DTI's) Alvey Programme and the Commission of the European Community's ESPRIT Programme. A 2-dimensional device simulator was started many years ago and has been through a number of changes. A software package, TAPDANCE, contains the current state of these activities. A more demanding 3D simulator called ESCAPADE is being developed as part of the ESPRIT-funded EVEREST project.

Engineering Applications Group

The Rutherford Appleton Laboratory (RAL) has a long interest in the development of computational methods and software relevant to magnet design and similar activities. A range of application software packages has been developed and these are now marketed by a software house, Vector Fields, based in Oxford.

The major thrust of this Group's activities now is the development of these programs for new computing systems, in particular parallel and vector processors. The existing software, with suitable development and tuning, has been mounted on a wide range of computers from the CRAY X-MP to more dedicated systems such as the Stellar, the IBM 6150/transputer system and the Ardent TITAN. The emphasis is on

the development of efficient new methods and software for well defined existing problems.

Parallel Processing Group

To achieve realistic simulations in real time and at economic cost means that large problems will need to be tackled using parallel processing systems. The Group has concentrated on the use of computers with up to 32 transputers to achieve this, backed up by the IBM 6150 workstation. Some electromagnetic software has been tried out, achieving a speed up of about 25 times that on a single transputer. The Group provides technical support to the local London and South East Regional Transputer Support Centre.

Visualisation Group

The need to provide better ways of transforming computational results into images that can be observed is becoming more apparent as the advances in high speed computation allow larger and more complex problems to be tackled.

The Group evaluates the usefulness of super-workstations such as the Stellar in this area and works closely with the applications of interest to the Division in devising new ways of visualising complex data.

The Group has a research interest in interpretation of images and is producing an image processing library with NAG.

Computational Fluid Dynamics Group

Computational Fluid Dynamics is an area of interest to all the Committees of the Engineering Board of Science and Engineering Research Council (SERC). The Group has set up a Community Club to provide a forum for researchers to share common experience, to exchange software and test data, and to propose new activities. Initially the focus will be on better methods for visualisation of results.

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