The 6600 showed some slight deterioration of performance towards the end of
the month of April with weekly down time figures running at a few per cent.
One as yet unexplained phenomenon which has been observed is fluctuations in the power
supply. At least a few of these fluctuations have been correlated with machine hang-ups.
The cause of the fluctuations is being investigated.

The 3800 has continued to behave well, but hardware parity errors still occur
occasionally.

---

**CDC 3800 MEMORY CHANGE**

The 3800 at present installed at CERN has a 3503 memory, the same as on
3600 computers, with a memory cycle time of 1.4 μsec compared with 900 nsec for the
3803 memory module. The new module has been installed in some 3800 machines now for
some months and appears to be as reliable as the 3603 memory. CERN has therefore
exercised its option on the new memory and it will probably be installed towards the
middle of June. Users will be informed later of the precise data, for the installation
will require that the 3800 is down for up to 2 days.

The cycle time speed ratio of the new to the present memory is 1.55, but this
should not be taken to be the speed-up factor for execution of programs. Memory
references are of course interspersed with arithmetic operations, and waits for
input/output. The average speed-up factor for the whole work spectrum will probably be
less than 20%.

---

**VIM 6**

The latest meeting of the Control Data 6000 series users was held in
San Francisco in April. There are now forty members of VIM denoting that there are
over forty installations with 6000 series machines on order or already installed. The
tenor of the meeting with regard to hardware was one of calm as all the machines now
appear to be working well and in fact there are many installations with more than one
machine on order.

On the software progress, the issue of the next version of SCOPE, version 3.0
is delayed about one month. Most other items appear to be on schedule. The loader in
SCOPE 2.0 has been found to be extremely slow and a small committee has been formed to
work with CDC on a new design. A committee was also formed on the software aspects of
the ECS (extended core storage) and also one on computer management. The latter
committee attracted a considerable amount of interest, in particular on the subjects of
accounting, system efficiency and operating procedures.
Two topics which generated a considerable amount of discussions were on the subject of payments for manuals, and on a new requirement by CDC that customers must purchase the media on which systems are sent from the distribution centre, i.e. magnetic tapes, or disk packs. As the latter cost approximately 2,500.-- per each, it becomes quite an expensive item. The manuals policy of CDC is now to issue a limited number free to each installation depending on the number of full time systems programmers and then to charge quite highly for any additional copies. The users felt that whereas the intention of the policy may be reasonable, the definition of it was ambiguous and unclear and that the prices were excessive. Motions were passed requesting CDC to delay or reverse the introduction of these new policies and to re-think and rephrase their implementation.

Future meetings have been arranged to be in Pittsburgh, Albuquerque, and then in late summer of 1968 there will be a meeting in Europe to coincide with the IFIPS meeting in Edinburgh. A small meeting of the European users decided on setting up some small working groups in Europe and there will be a meeting at CERN to initiate these groups.

**TWO ON-LINE VISUAL DISPLAY SYSTEMS**

This article attempts to describe the mode of operation and applications which are being found for two different on-line CRT display systems in use within different parts of the Lawrence Radiation Laboratory. Both systems can be used in a "conventional" - if that is the right term - manner whereby the computer executes a program, and at the end the result is displayed to the programmer in the same manner as if he had asked for printed or plotted output. These devices are capable of more sophisticated use however whereby the programmer can really interact with the machine via the display system and exploit this interactive ability to solve problems which would be orders of magnitude more difficult or time-consuming if only batch processing facilities were available.

At the Livermore Laboratory a console is available communicating with a small computer 600 Km away in Santa Barbara using a system known after its designers G.J. Culler and B.D. Fried. This is a remarkably powerful and ingenious facility considering the hardware being used. The computer is an old and slow TRW 400 which has only 1000 words of central memory and uses a drum and disk as backing store. Communication is over normal telephone links and at the moment this one system is being used from consoles at Harvard, Florida and Kansas as well as Livermore, and in Los Angeles. The consoles themselves have a small diameter (~15 cm) storage tube display (considered sufficiently large by its users) and a keyboard with 90 keys. Such a console may be used as a sophisticated desk calculating machine, but its real strength lies in solving classical mathematical analysis problems, for which it was designed. It is unsuited to handling problems involving large amounts of data, or (with the current computer) massive amounts of computation.

Data input arrays and programs, in a very simple language, are defined from the console. Depending on the nature of the problem, any of ten "levels" of calculation are available, although only five levels have so far been established, namely 1) real number arithmetic, 2) simple vector analysis, 3) analysis in the complex plane, 4) "statistical" analysis - in which a random variable is available, and 5) a level for alphanumeric character manipulation. Roughly half of the keys are associated with mathematical operators whose precise action depends on the level in which the program is defined. For example, depression of the "add" key will result in either the scalar sum, the vector sum, or the complex sum depending on whether the program is in level I, II or III respectively. These operators include the basic arithmetic and trigonometric operators, together with modulus, exponential, logarithm, forward and backward differences, Kronecker delta, summation and many others. Other keys are used to define operands. The remaining keys are used for control of the display system, e.g. scaling, for certain program instructions, e.g. STORE, LOAD, and for access to the various levels. Finally by means of additional "user levels", the programmer has available virtually the whole keyboard again, so that he can build up a library of programs, e.g. home-built functions and operators, each associated with one key. In execution, depression of that key will cause the associated stored program to operate on presently defined data. With these facilities it is possible to build up complicated
functions displaying at each stage the present curve, or its projections so that the progress of the calculation may be checked.

The Culler-Fried console is being used at Livermore with great enthusiasm by members of Project Sherwood (fusion research) to solve magnetic field equations, and for instance examining instabilities as a function of time. Electrical engineers are also using the console for circuit design problems. It takes 2-3 hours of instruction and reading of the manual for a newcomer to be able to use the console, but progress then depends on his ability to solve the problem more so than his experience with the console. An instance is quoted where in a full working day an experienced theoretician had examined several ways of solving a certain problem using the console, chosen the best method, and found the solution. The same problem given to a Fortran programmer had required 2-3 weeks working in a normal batch processing computer workshop to write and debug the program for one method of solution. Currently the system is being rewritten by Culler for an IBM 360/50 and later a 360/75. With this machine it will be possible to devote one of the vacant levels to matrix operations, and to obtain hard copy output.

The CDC VISTA system attached to the 6600 at Berkeley is a much more recently developed system and is somewhat different in conception from the Culler-Fried system. (The VISTA consoles at Berkeley have serial number one, and after a year of use are still not entirely free of hardware problems, whereas the Culler-Fried system seems to be interrupted only by telephone line communication problems.)

Normal Fortran programs are entered into the 6600 and an operator assigns a console to a programmer once the program is in central memory at a control point. Included in the Fortran program must be various subroutines with pre-selected argument options which the programmer can use for communication with the program via the console, and also which he may need to have executed during a particular run depending on the outcome of part of his calculation. Communication with the machine is accomplished at present principally via a light pen. (A small keyboard is available, but characters can be entered only in octal and hence the keyboard is seldom used.) To enter a control statement or data word it is necessary to display a matrix of characters (alphabetic, numerical, punctuation, etc) and point in turn with the light pen to the characters and hence build up the required message. This method has an annoyingly slow response however and in the future a teletype keyboard will be made available with each display. It is not possible at present to change the program in central memory via the console, because once the program has started execution it is not possible at present to recall the compiler or change field length.

Two major lines of use of the system are being developed at Berkeley which illustrate well the potential of the system. The CRT displays themselves provide a picture approximately 40 cm square and hence quite detailed pictures can be obtained. One group is using the consoles as a powerful tool in magnet design and also for beam transport calculations. In the magnet design, the program generates by standard methods a field pattern for an initial set of design parameters and displays the field. Depending on the result the programmer may then from the console modify his design parameters, or change the mesh of his model of the magnet and demand the program to be executed again, and so on until the desired field is obtained. In beam transport problems the position or strength of the components of the transport system can similarly be redefined from the console. With these techniques a programmer may pass through several iterations of the design in one run which with conventional facilities would have required some days for the same number of individual runs. Furthermore if at some stage in a calculation the problem fails to converge satisfactorily, the calculation may be re-started and the results of individual iterations may be displayed so that the appropriateness of the mathematical techniques themselves may be investigated.

A second line of development being pursued is to obtain a form of "instant SUMX" which is being found useful in debugging the control cards for a production SUMX run. A program and control cards are set up normally and execution proceeds using an data a tape with a suitable sample of the events to be analysed. When the pass is complete and all the histograms have been built up in memory, they may be displayed individually, in combinations, with different scaling factors, etc. If it appears that the control cards were badly chosen, they may all be displayed, and the necessary changes made using the light pen entry of characters technique described above. Another pass of the sample
event tape can then be initiated, and thus the best control card set for a production run is built up on-line.

It will be understood from the above examples that at the present stage of development with the VISTA consoles the entire program has to be pre-programmed so that only particular branches of the program may be chosen on-line, or the various options to be set on-line must be given to the program as data. With the Culler-Fried system the program itself may be changed or developed on-line. On the other hand at present the Culler-Fried system cannot deal with the large amounts of data or computation which can be handled by the 6600-VISTA system. (The Culler-Fried system is considered to be unsuitable for implementation on a 6600 computer.) Finally at present the VISTA system is "expensive" in its use of the 6600 in that each program/console requires one of the seven control points and the entire program/data central memory field length is kept throughout the run which proceeds relatively slowly because of the need for human response. In the future it is hoped some kind of rollin/rollout mechanism, swapping programs in and out of central memory, will be developed to alleviate this problem.

References: The Culler-Fried system and some applications are described in "On-line Computing" (McGraw-Hill) recently published, and edited by W. Karplus. W. Benson of L.R.L. Berkeley who was responsible for the VISTA software is currently visiting CERN. J. Colomans (e.g. ref. UCEL 17340) has led the magnet design work using VISTA, and Esther Coleman is developing the on-line SIMIX programs, both at L.R.L. Berkeley.

---

**PROGRAM LIBRARY**

**Minimisation Program MINUIT**

This new program is available in the Library under the code D506. It was written by M. Roos/DD and P. James/TC, and is based on program MINROS. MINUIT has a large number of options, including all those of MINROS. It handles the unallowed regions internally, and is designed to compute the true errors. The computing procedure has also been modified. The authors find it to be somewhat faster than MINROS. The form of the user supplied subroutine FCN is identical with that used for MINFUN, MINROS and MINCON, except that the checks for the forbidden regions should be omitted. Information regarding these regions have to be supplied on data cards; consequently the latter will differ from those used for the other minimisation programs. The program runs on both 6600 and 3600 computers. (For the 3600, the user should supply a function subroutine TAN(X)). Long write-ups and card decks are obtainable from the Computer Documentation Office.

A. Koppanyi DD

---

**COMPUTER SEMINAR**

**Wednesday, 24th May**

14.30 Theory Conference Room

"Computer Architecture, Implementation and Realisation"
Professor G.A. Blanuw
Turente Institute of Technology, Netherlands

Abstract:

A distinction between computer architecture, implementation and realisation is made. The limitations and usefulness of this distinction are discussed and placed in a historic perspective. Current trends in each of these three areas are considered.

P.M. Blackall DD

---

**OPERATIONS**

If anyone finds a mechanical fault in any item of unit record equipment (punches, reproducers and interpreters) would be please leave a card in the unit indicating the fault and notify Pierre Benassi (telephone 3107) as soon as possible.

Neil Spoonley
Charles Symons