

GHOST: The Culham Computer Graphical Output System

by F.M. Larkin

From the point of view of the computer user, GHOST is a system which provides him with a comprehensive set of computer graphical output facilities. Using simple, but powerful, instructions he can plot graphs, draw contours, annotate scales etc. while causing the picture to be drawn on any selected number of the available output devices. The design emphasis is on flexibility and ease of use.

The prototype version of GHOST has been developed over a period of about 1½ years and has been in use at Culham Laboratory for about 1 year. To date, the development costs, including programming and computer time, total about £20,000.

At present, the GHOST user has a choice of the following graphical output media:-

- (i) 35 mm film
- (ii) 16 mm film
- (iii) photographic "hardcopy" (7" square)
- (iv) C.R.T. display

Media (i) - (iii) are produced "off-line", while a special streamlined version of the GHOST software allows the C.R.T. display to be used "on-line". However, the overall modular design of the software allows the possibility of extending or altering the graphical output hardware fairly simply. The prototype software is largely written in FORTRAN, with a small proportion in KDF9 Usercode.

A more extensive introduction to GHOST is given in:- CLM-P139; "A Graphical Output Language and its Implementation" by F.M. Larkin. A detailed description of the use of GHOST is given in:- CLM-R84; "Users' Guide to the Culham Graphical Output System" by F.M. Larkin.

A layman's account of GHOST is given in the documentary film "Worth a Thousand Words" (16 mm., 25 mins., optical sound), produced by the Computing & Applied Maths. Group, Culham Laboratory.

Copies of the GHOST software, in the form either of punched cards or magnetic tape, together with such documentation as is available, may be obtained through Mr. L.A.J. Verra, Computing and Applied Maths. Group, Culham Laboratory. There will be a nominal charge for this information. At present the laboratory cannot undertake to provide any assistance with installation or maintenance of the software. Details of the copyright position etc. may be obtained through Mr. B.L. Tozer, External Relations Department, Culham Laboratory.

Proposed Improvements to GHOST

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The prototype version of the GHOST computer graphical output system has been in use at Culham Laboratory for about 1 year. In the light of experience gained during this time the following improvements are proposed:-

(a) Improvements to Efficiency (KDF9)

- (i) Re-allocate balance of work between user's job and the subsequent processing job. (This will result in simplification and improved efficiency, but might inconvenience user's core storage).
- (ii) Simplify mapping from mathematical space to plotter space; this will ensure that only one plotter space need be defined, which will be scaled automatically to fit any plotters in use.
- (iii) Rewrite entire system in KDF9 Usercode.
- (iv) Compile processor into absolute binary, thereby saving about 4 mins. on each run.
- (v) Adopt more efficient intermediate storage and retrieval technique.
- (vi) Improve the contour drawing facility.

(b) Extensions to Facilities

- (i) Allow general non-linear mappings from mathematical into plotter space (not possible unless (a)(i) is done).
- (ii) Provide log-log and log-linear scale annotation.
- (iii) Provide convenient stereo pair output routines.
- (iv) Provide surface display facilities.
- (v) Provide light pen input facilities on 338 display.
- (vi) Provide on-line file storage facilities, for subsequent inspection/modification on 338 display.
- (vii) Provide software for incremental plotter output.

(c) General Improvements

- (i) Extend modularity so as to accommodate different types of operating systems (necessary preliminary to (d)(i)).
- (ii) Provide adequate program documentation.
- (iii) Extend diagnostic output capability.

(d) Modifications Anticipating E.E. System 4 or I.B.M. System 360

- (i) Recode in FORTRAN IV, taking advantage of structure of the new machines' software and hardware.
- (ii) Recode in appropriate basic machine language.

The above proposals are not listed in order of priority: so far as GHOST itself is concerned the first heading 'Improvements to Efficiency' is probably the most important; but so far as the new facilities are concerned the work in conjunction with the 338 is the most urgent and important. This is, strictly speaking, not part of the original GHOST concept but it is intimately related to it and we should therefore say a little bit more about what is required in this area.

In line with the treatment of the display as one of many graphical output devices, the present facilities merely allow for the routing of display files from the KDF9 to the 338 at the time of job execution. There are COTAN commands which facilitate the use of the display like this in conjunction with the on-line terminals but this is a relatively inefficient mode and needs to be improved rapidly.

The next step is to provide routing of a sequence of display files from the job under execution to the disc. The COTAN user should then be supplied with commands which enable him to bring these files down from the disc and display them on the 338. These would be relatively simple commands to write and need only give one relatively simple editing facilities.

The final stage would be to allow for the building up, editing and manipulation of display files using the light pen on the 338 and converting these into data structures which can be used as input to user programs. This is clearly a much more difficult (and also more interesting) exercise and should be tackled over a rather longer time scale.