a) GAMMA (Graphically Aided Mathematical MACHine)

GAMMA is a fully interactive, general purpose system allowing the user to define, manipulate, and execute his own algorithms on-line in continuous dialogue with the computer. In the field of applied mathematics this kind of interaction is of great interest, in particular for research problems where the user wants to experiment with different formulations and different methods of numerical analysis, and where the feedback of the results determines the algorithms (problems where not only the answer is unknown but also the question and the method of solution are difficult to formulate).

GAMMA was implemented experimentally at CERN in 1968 on a CDC 3100 computer using a CDC 250 display and was moved in 1970 onto the more powerful CDC 3200 computer using a Tektronix T4002 storage tube console as user terminal.

The language of the present system is a mixture of desk calculator language, normal mathematical notation, and the computer’s programming language. For instance, it borrows from desk calculators the structure of accumulators, of temporary storage and of operators (which can be called by a single keypush on a specialized keyboard). On the other hand, as with normal programming languages, the user is able to define his own set of programs and to call for their execution. Basic entities upon which the language is able to operate are not only single variables — as is normal in programming languages such as FORTRAN — but also larger items such as vectors implicitly or explicitly defined. The graphical display is obviously an essential part of the system, allowing the user to display procedures and results (the latter in either graphical or numerical form).

The computer obeys the user’s command as soon as it is typed in, without any noticeable delay since...
b) The FOCUS system

H. Grote

the time needed to obey a single command is of the same order of magnitude as the human response time. However, the execution time for user written programs depends on the complexity of the problem that the computer is asked to solve, but the user is always able to control the process.

The abilities of the system are picked out in comments from users: ‘The two characteristic features of the GAMMA system, namely that it is intrinsically a calculator of functions and that it offers on-line programming and on-line graphical display of calculated results, make it an attractive tool for numerical exploration of mathematical problems. Depending on the problem, the system rapidly provides either sufficient numerical insight to proceed with a further stage of algebraic work, or sufficient numerical insight to decide on how to program for extensive and/or more accurate computation off-line, or sufficient numerical information to regard the problem as solved.’

The following types of problems have been frequently treated on the GAMMA system:

I) Examination of convergence properties of successive approximation schemes and comparison between different schemes

II) Examination of the shapes of complicated curves and their dependence on parameters

III) Function inversion — elimination of a parameter in a parametric representation, for example, given \( F(x) \) and \( G(x) \) find \( F(G) \)

IV) Search for simple functional approximations to given data or curves

V) Qualitative study of parameter fitting to given data or curves

VI) Selection and detailed preparation of figures for scientific reports and publications.

Such problems were studied in both real and complex variables. The complex calculus implemented on GAMMA and the corresponding displays in the complex plane have proved very useful. Another important asset is the on-line production of hard copy of the display.

The GAMMA system has been used regularly over the past three years for an average of about twelve hours a week which has yielded considerable experience with this kind of interactive system. This was very helpful in designing an improved version which is now being implemented on the CDC 6000 computers at CERN. The language adopted has gone back to the algebraic formulation of normal programming languages, while many other basic features of GAMMA have been retained and extended. The new system will be operational on a small scale in a few months’ time and the present GAMMA system on the CDC 3200 computer will then close down.

FOCUS is, basically, a complex file-handling system which was developed at CERN during the years 1967 to 1971. It does the file-handling job for users of the central computers and its tentacles reach out to all corners of the CERN site so that many users, for a variety of purposes, can be linked to the central computers.

The heart of the system is a medium size computer, a CDC 3100, aided by a Hewlett Packard 2116 which serves to concentrate the incoming and outgoing communications. The 3100 is linked to various other computers and terminals and it is from them that it receives data files and to which it sends data files. These input and output files contain different types of data, depending on the terminal. Thus FOCUS receives files from on-line experiments, from remote input/output stations or RIOS and, last but not least, from seventeen teletypes and four Tektronix 4002 displays that are...