# PANEL DISCUSSION ON COMPUTER CONTROLS

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## Is the computer necessary?

The discussion opened by considering whether computer control is really necessary and worthwhile. It was generally agreed that the complexity of modern accelerators and beam lines is such that the required standards of beam quality and operational flexibility cannot be achieved without the use of a computer. The computer offers highly sophisticated data acquisition and treatment for measurements, and should provide the flexible control required for machine studies to improve performance.

## Closed-loop control

The usefulness of using a computer to close loops was a matter for debate. On the one hand it was suggested that it might be better to stabilize the inputs to the system. For real-time applications, special purpose hardware might be preferable and cycle-to-cycle tasks could be left to operators. On the other hand, several successful closed-loop applications were reported. At Los Alamos, a computer loop was programmed to adjust linac-tank tuning as a function of reflected power. This was done to replace an analog controller which was giving trouble, and, although the computer loop performs well, it is still planned to implement the analog control. At Brookhaven, a PDP-8 computer applies a correction function to the radial beam control loop to permit new operating facilities. The function is learned and updated by the computer. At the CERN ISR, automatic adjustment of the injection angle and position is used to minimize betatron oscillations.

It was pointed out that many closed optimizing loops have been developed in the past and then have fallen into disuse. It was suggested that increasing knowledge and stability of the systems involved soon rendered the closed loop redundant.

It was thought that time delays in time-stored computer systems have discouraged the use of real-time control loops. It was thought that the dedicated mini-computer could be a solution to this problem.

## Access to the computer control system

Perhaps the hottest point of discussion was the access of the machine physicist to the accelerator through the computer. The use of a high-level programming language was generally agreed to be essential. This distinguishes machine studies from normal operation where only a limited set of command facilities gives adequate communication.

Two schools of thought became apparent. In one, separate approaches for machine studies and normal operation were proposed. A high level Fortran-like compiler language would be available for studies while normal operation would be catered for with knobs, push-buttons, touch-panel displays, etc. The other viewpoint favored the use of an interpretative language in which the normal operational commands are a sub-set of the language used for machine studies. In fully computerized systems, the hardware and associated driving routines would be the same for both approaches. An interpreter was defined as an operating system which provides on-line subroutine linkage so that no object code is generated.

General agreement was expressed on the need for easy and comprehensive on-line editing and program modification facilities during machine studies. It was suggested that these facilities are more easily provided with an interpreter-based system.

## The computer is here to stay

Since the only debatable point seemed to be the best way to use the computer, the moderator was able to close the discussion by echoing a statement made at an earlier conference when computers were much more speculative, "I think the computer is in the control room to stay".