

PC as control system element of inertial fusion facility

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Abstract

The operation algorithm of inertial fusion facilities is presented. It is shown that the control of inertial fusion facilities (high current z pinches, lasers, heavy ion accelerators) have two very distinguished temporal stage: the technological preparation with typical time scale about hours and the energy transport to the load and the processes into the target (time scale less 10^{-7} sec). Facility control systems have two different parts of control: the technological preparation systems and fast data acquisition systems. The PC as the element of control system is used in both parts.

The technological preparation stage is not strong time limited. Therefore the cheap interfaces like CAMAC under PC control can be suitable. For support of technological parameters the feedback is used widely. Technological systems are conservative part of control and are not changed during facility life.

The time scale of second operation stage is very short. Therefore during this stage the feedback operation is not real practically and data acquisition is main goal of control at this stage. Recorded information is stored in the memory of analog or digital converters. Configuration of this part of control system must be changeable according to experimental requirements. The functions of PC are as follows: preparation of data acquisition systems, data transfer, data processing and information monitoring. The supervisor system unites the both parts in to control complex.

1. Introduction

Large physical facilities are the unique installations. Control systems of ones are different and determined the facility specific. However, the facility of the same research direction have similar operation algorithms and control systems. In this paper the facilities for inertial fusion are considered. The experimental base of these researches are the heavy ions accelerators, high power lasers and megaamperes z pinches. For control system of heavy ions accelerators the wide experience of accelerator's technique is used.

Table 1

Working cycle stage	Technological preparation	Energy storage	Shot
Stage duration	hours	Minutes	microseconds
Procedures	mechanical adjusting, target installation and so on.	Capacitor battery charging	energy transport, processes in target
Feed-backs	yes	Yes	No
Parameters number	up to 10^3	up to 10^2	up to 10^3
Information speed producing about one parameter	10^3 bit/sec	10^4 bit/sec	$10^{13} \div 10^{14}$ bit/sec

The operation of laser and z-pinch facilities have some specifics that determine the control system structure, namely:

- there are two very distinguished temporal stage of facility operation: the stage of technological preparation and the stage of pulsed power producing and processes in target;
- wide range of facility processes duration : from seconds at the working cycle (shots) preparation stage up to 10^{-9} sec at final stage of shot;
- seldom repetition of working cycles (several shots per day).

The typical characteristic of inertial fusion facility working cycle is shown in the Table 1.

It is possible to see that control tasks are very different on the stages of working cycle. The realization of control requires the set of different systems. According to analysis of control tasks the PC is suitable for any systems of control.

2. Control systems structure

Fig.1 shows the typical structure of the inertial fusion control [1,2]. The technological preparation system operates before the start of the working cycle. There are a lot of parameters of control but ones change slowly. The speed of information processing is not more 10^6 bit/sec and PC is quite suitable as the element of feed-back. For PC connection to facility equipment the interfaces like VME or CAMAC are used. When technological parameters (vacuum, mechanical elements, gas pressure and so on) are ready the charging the energy storage systems (usually capacity battery) are started. After finish of charging the PC fixes the all technological parameters and permits the start

of shot. Technological Preparation Systems are conservative parts of facility control and practically don't change during facility life.

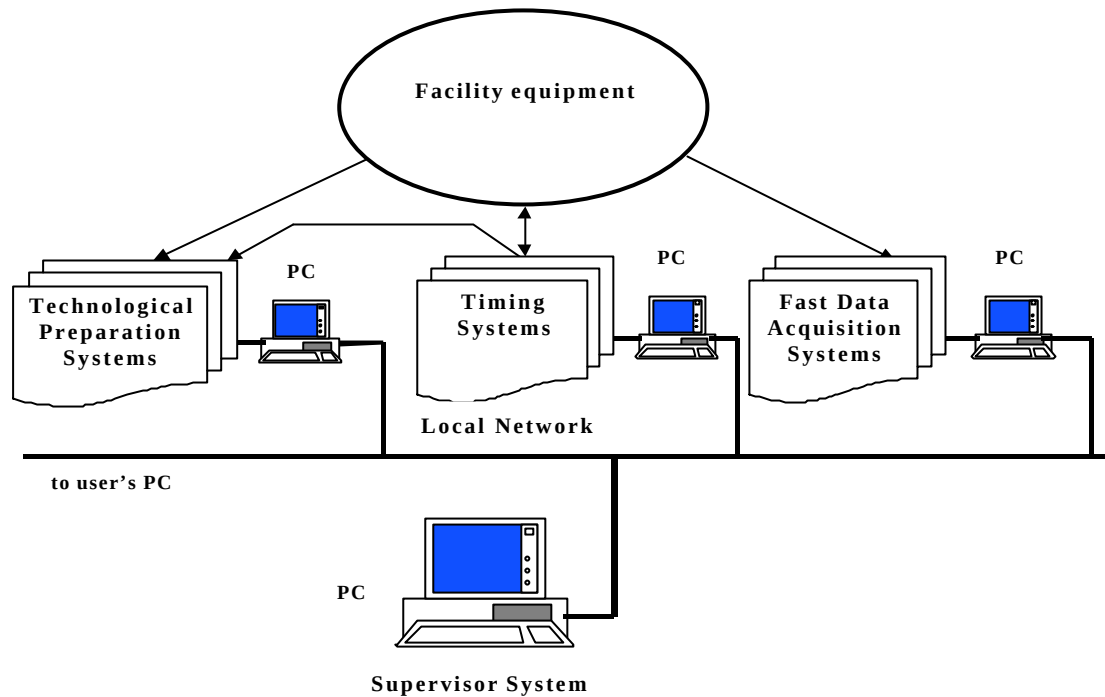


Fig.1. Typical structure of fusion facility control

The function of Timing System is synchronization of operation of different facility parts. Usually this systems contain $10^2 - 10^3$ output channels. In the some case this systems have function of time measurement also [3]. For fusion facilities the precision of timing and adjusting are in range $\sim 10^{-9}$ sec. The all communication operations (channels time setting, channels operation testing) are executed during intermission between shots and PC possibility is enough for ones.

The Fast Data Acquisition Systems provides the waveform parameters recording during the shot and preprocessing of this information flow. The range of this signals duration is $10^{-5} - 10^{-9}$ sec. There are a lot of ADC types for measurement in time range $10^{-5} - 10^{-7}$ sec. The different interfaces (as example, CAMAC, VME) can be used. For recording more fast signals the devices of TEKTRONIX type are used. Usually this devices have interfaces GRIB or RS-232. Information about wave form of signals during the shot time accumulates in the fast ADC memory. PC's function of this system are:

- preparation of measuring channels to pulse recording;
- data preprocessing for correction of different distortions;
- transfer of information from ADC memory to supervisor data base.

These procedures are produced during intermission between shot. The PC possibility is quit enough for executions of ones.

References

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