Process Computer Interface

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Interface is an area which cannot be written off lightly. Improvements are constantly aimed at so that a computer compatible interfaces can be developed. The standby equipment not only come into the picture during computer failure but serve as a constant media of communication between computer and the plant and the operator. In this paper various types of standby controllers used in process computer control are described as well as a new approach for interfacing a DDC control loop highly non-linear in nature is discussed.

INTRODUCTION

Direct digital control through process control computer has assumed an enormous role in the recent past. As hardware reliability has increased and more flexible, sophisticated software techniques have been introduced, the trend towards acceptance of computer control has increased. The paper industry has been one of the forerunners in introducing computer control. The reed paper group were the pioneers using an Elliott Computer for control. The advantages of computer control are many. It improves the efficiency of the plant and apart from the control aspect takes care of on line data collection and other chores.

In the past when computer control was still in its infancy, where process control should not be interrupted for want of computer availability conventional analogue controllers were used as standby controllers. A detailed study of interface equipment has been done by Butchart and Shaw (1) Grimsdale (2) and Notley (3). Here an outline of the methods used is just touched upon.

A constant effort has been made towards making Interface Equipment computer compatible as the field of computer technology advanced rapidly. Interface equipment in the early stages of computer control were conventional analogue controllers used in conjunction with a servo-follower. When in computer operation the analogue controller integral term is continuously updated to achieve a smooth transfer from computer to standby control. While in standby operation the computer regularly scans the output of the controller and updates itself.

The disadvantage of this system was that the computer must be aware of the servo follower out put even when on standby control. This led to the inclusion of a boundless control which delivers a raise/lower pulse when the deviation signal exceeds a threshold level and an appropriate feed back voltage across the integral action circuit which backs of the deviation signal. The important feature associated with this type of controller is the bumpless transfer achieved.

DIRECT DIGITAL CONTROL APPROACH TO NON-LINEAR SYSTEM

In recent years direct digital control has been widely applied for process control. The reason for this approach is that this is the best way of putting plant on computer control. In this paper it is proposed to discuss in detail direct digital control of a high order single variable process containing a variable dead time and/or multiple delays especially in the area of standby equipment for such control purposes. The design philosophy is that an adaptive policy for on-line computation and control and a predictive policy for standby requirements is adopted. All DDC software are time shared except the real time model and the standby controller.

It is well known that process involving large dead times are difficult to control using conventional controller. Dead time process are those in which an input change does not produce an output change for a finite time.

The plant considered here can be mathematically represented by:

$$\dddot{X} + A\ddot{X} + B\dot{X} + CX = U$$

Where U = Plant Drive

X = PLANT DISPLACEMENT

$\dot{X}$ = PLANT VELOCITY ETC.

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FIG. 1 gives the system link up. Apart from the control algorithm a dead time evaluating algorithm and Parameter evaluation and modelupdate subroutiness are used to establish a real time model. The method of deriving a DDC Algorithm for regulation of process with variable dead time and/or multiple delays and which can be used with DDC Algorithm of the one through three mode replacement type to regulate process with both variable dead time and minimum phase dynamics is developed in reference (4).

An algorithm utilising velocity storage for computation of actual dead time is also presented in the above reference.

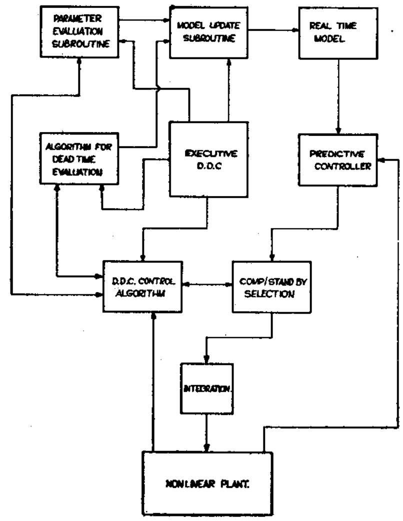

Fig. 1. The system link up

The parameter evaluation subroutine employs an adaptive policy in sensing parameter variation. The complete control policy is described in reference (5).

The subject of study in this paper is the standby controller in an application of this nature. We have shown that the nature of the process is such that conventional controllers are not suitable for standby application. In this particular application we require a controller which is least dependant on the computer and process parameter variations. The updated model is available on taking over control from computer. Prof. Coales and Dr. Billingsley of Cambridge University have developed an universal controller giving a near optimal control of almost any single variable plant whether of high order or non-linear or including pure time delays for small errors. The performance is insensitive to plant characteristics. With adequate plant drive it can control plants for large error.

This controller uses both the process and certain inputs from the real time model on a fast model whose time constant is reduced by some factor (100 — 1000). The input drive of the model is bang — bang. Depending on the output a set of logical operation are carried out and plant drive is suitably set. The controller adopts a predictive policy because of the fast model. An important characteristics of the predictive strategy is that it is insensitive to change in plant parameter. It thus has many of the advantages of an adaptive system. When using this controller to achieve plant drive an integrator may be used and in the steady state the high speed limit cycle of the predictor will result in a very small change in plant input.

When returning DDC routine the real time model is updated keeping the predictor on line. When this is done the DDC loop may take over.

CONCLUSION

The paper has resulted from pure intutive thinking and deep study. The authors have no facility at present to test the software application and would be grateful if relevant comments on the application of this system are made.

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