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28/147, CIVIL LINES
ROORKEE – 247667

ISO – 9001-2008
Certificate No. WSC-215028-A

DIGITAL CONTROL SYSTEM
MODEL : DC-01

- Digital Controller implementation on μP -kit
- Simple Op-amp based analog plant
- CRO display of response
- Design and test new algorithms

INTRODUCTION

Digital control of industrial processes has become very important today because of the advantages it offers and the increased availability of inexpensive computing power of microprocessors. The principal advantages include fixed hardware with complete software flexibility and the feasibility of implementing integration and differentiation on extremely slow varying signals. On the other hand digital controllers have some drawbacks also such as errors due to the processes of sampling and reconstruction, computational errors caused by finite word length, truncation, register overflow, as well as the de-stabilization effects of sampling. A clear understanding of all these aspects is of great value to a student of control engineering.

In the present unit a second order transfer function, simulated with operational amplifiers and passive components, has been chosen as the process to be controlled. This results in a well behaved and near perfect linear process which gives a highly predictable performance and enables the student to concentrate on the design and evaluation of the controller. The digital controller consists of a 8085 based microprocessor kit with analog-to-digital and digital-to-analog interface. The dynamic ranges of the variables in the whole system and that of the built-in square wave test input signal are made compatible. The step response may be displayed and studied using an external measuring CRO.

Software supplied with the system resides in a 8K EPROM. This consists of P, P-I and P-I-D algorithms in which the three gains may be selected out of 16 levels each. All arithmetic calculations are performed in 16-bits and are also available to the user as subroutines. Detailed information and listing of the software is included in the literature, besides suggestions and procedures for conducting experiments. Also included are typical results of some experiments with their theoretical descriptions. Further, the user may write his own programs to implement additional algorithms and study their responses.

EXPERIMENTS:

- Identification of the controlled process
- Study of sampling period variation
- Designing P, PI, PD and PID controllers
- Advanced algorithms implementation
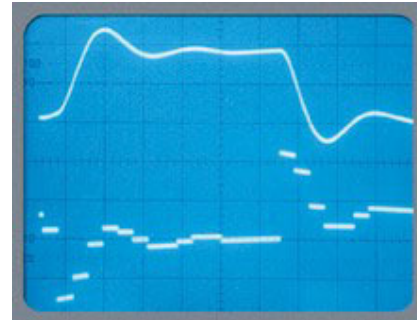
FEATURES AND SPECIFICATIONS

- Second order simulated process (analog process)
- Built-in D/A and A/D circuits (8-bit)
- 8085 based µP kit as digital controller with user software in 8K EPROM
- 16-bit arithmetic for algorithmic calculations
- 16 built-in levels of P, I and D gains each. Complete flexibility for the user to develop own software
- Square wave test input (internal)
- IC regulated internal built-in power supplies
- 220V±10%, 50Hz mains operation
- Detailed literature and patch cords included
- Essential accessory – a CRO

Schematic Diagram & Software Plan

Input + → (Σ) → [A/D] → [8085 based µP kit] → [D/A] → [Second Order Process] → Output

CONTROLLER

Start
↓
Initialise
↓
Get P, I, D coefficients
↓
Read a Sample (8 bit) ← Interrupt
↓
Convert to 16 bit
↓
Calculate P, I and D controls (16 bit) according to coefficient values read
↓
Calculate total control (16 bit)
↓
Overflow ? — Yes → Make corrections
↓ No
Send control output (8 bit)

Enable interrupt

Implementation of PID algorithm