Control Engineering
Work Station
Techniques

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LOG C DES GN AUTOMAT C DOCUMENTATION ON M CROPROCESSOR CONF GURAT ON COMPUTER A DED DES GN

Abstract

Control ement on og c de nt on has a ways been an important funct on of contro eng neers. The methodogy of de nt on has changed through tech noogy and market needs. These changes have nc ued or ter a such as comp ex ty or s mp c ty of the in stru ment on system nd stra a nd spec a requ ments of the des gner.

D str buted d g ta contro (DDC) and persona m cro computers (PC) have ntroduced new terms n both de nt on and mp ement on process contro requ ments. Persona computer programs can use nd stra ustrum ent on symbo s to descr be the contro og c. After de nt on s comp eted, documen tat on can be fu y au mat ed. Where these features are not re vo. to nary n terms of typ ca, Computer A d ed Draft ng (CAD) features trans at on of the contro cture to a funct on a gor thm n the process. D str buted contro hardware can be done au mat ca y v a commun cat on nks to the process contro ers.

Th s paper d scusses the ava ab e CAD techno ogy and t s typ ca mp ement on.

Introduction

Three mportant funct ons that process eng neers per form are des gn ng document ong and mp ement on process contro requ ments or og c. New genera ons of m croprocessor based contro systems are extreme y powerful and f ex be. However they are dependent on the process eng neer to program or conf gure the equp ment w th the proper og c to contro the process n the dese red manner.

Programm ng or conf gur ng contro equp ment s a t me consum ng process. The eng neer must rst wr te equ at ons or draw a og ca fo w chart. The og c then s transformed nto anguage that the contro equp ment understands. F na y eg be deta ed document at on has to be created so that the process eng neer has a permanent record of the ng c that s programmed or conf gu red n the equp ment.

After start up of a process there are usu a y probems or bugs n the contro strategy that have to be so ed n order for the process to run smooth y. Th s requ res mark ng up the og c dra w ngs and oad ng the debugged og c once aga n nto the contro equp ment. Several terat ons of th s process may y ed conf us ng document at on.

M n or m cro computer based Computer A ded Draft ng (CAD) packages have so ved these prob ems. Contro s trate es can be mp ement ed, a tered and de bugged qu ck y on the computer screen. Log c s comp ed nto mach ne anguage and down oaded d rect y nto the contro equp ment. Process eng neer conf gur at on m stakes are f agged by the persona computer. D ocument at on s created at the push of a button ut z ng an attached pr nter.

Th s paper ustrates the advantages of a CAD system us ng typ ca examp es of combust on contro og c requ ments for a pusher type s ab reheat ng furnace n the stee ndustry.

The bas es for the d scuss ons are a gor thm contro des gn us ng work stat ons and process test ng for accuracy and comp etens of og c. Spec f c areas to be covered are:

1) Contro eng neer ng CAD a gor thm des gn
2) Summar se econom c ben ef ts of CAD des gn

techn ques
These points combined can ease the high-yield successful implementation of simple or complex control strategies.

**Automated Algorithm Design.**

Efforts to become more competitive and enhance instrument control design have led to automated design of control strategies. With CAD software, sophisticated and programmable control systems can be entered in a flowchart form (instrument setup of systems, in type og c), more accurate y and quickly. Data handling is performed by the computer; free change, rather than concentrating upon the logic design.

Figure 1 (Typical Bootware Logic Configuration on Draw ng) shows an example of the og c a gor thms, function on b ock format used in CAD control design.

CAD software enables the engineer and manager to:

- a) Design og c and program systems without manual y
- b) Ed t and mach ne check for accuracy
- c) Electron a y transfer programs d rect y to instruments
- d) Document on systems sourced automata by as og c s created or changed
- e) Evauate og c w th ve data (spreadsheet/ graph ca y/og ca y)
- f) Check ex st ng contro og c vs documented and update automata y

Engineers need to enhance by network design of nd v dua work stations to centralize computer form a t on systems. nd v dua work stations (microcomputers) enable the engineer to save time. That is no longer does he need to wait to access mainframe computer time. Results of control work can be monitored by personnel. MPS in use for more on-line control of complex systems. Access to centralize computers and perform the nd v dua eng neer f ex b ty for project retr eva w thout paperwork. Thus, cut tng non-productive costs.

Figure 2 (Engineer Design Network) shows a chain of development computer. With microcomputer workstation, the engineer enables the mentioned control information sharing. With good access and the speed of nd v dua work stations. The engineer gains the benefit of both the mainframe and the PC world.

Remote and more economical on design (F GURE 2) and checkout of microprocessor control systems. has added a new level of communications on line and improved the accuracy of design data. Communication has been enabled to monitor and program control systems when under more favorable design conditions.

The CAD diagram of a bock approach rather than the ad- der programm method of system programm. Features of commercial systems are available. CAD systems have been used for text, system magnification, cut, paste and symbol manipulations. However, these on-line capabilities represent a small portion of features. The manual or computerized features that append to the integrated control systems are:

- On m monitor ng (e.g., real-time power flow)
- On m tun ng conf gur at on
- Cross reference
- Macros (groups of og c)
- Self-document ng
- Unit at on factors
- Various cat on
- Draw ng informat on by ayers
- Hardware cab ng and contro strategy nte grat on

Log c mp ementation on systems performed on the screen by connecting the screen that represents the function of blocks (m a go thms) such as P D s. Summers as we as advanced a gor thms. Lines are then drawn between the symbols to represent the interconnect of the various a gor thms. The computer matches these lines to determine where inputs to each block come from or where outputs go. A change made to the CAD program changes the connection of the system. The CAD program has not found errors in the control configuration on then the control can be d rect y loaded to the control e v a commun cat on networks.

With a PC engineer design work stations installed. The str buted control systems commun cat on in ghway * og c draw ng can be used to control the outputs of a b ock on the screen. That s a square root extractor or P D b ock reflector current on the rea pro cess v a ues d rect y on the og c draw ng S m ar y og c gate status represented by state (1 or 0).

When constructing the design configuration on draw ng commun y used is op s made as macros (brary used) for later reference. An example would be a flow chart operation with square root extractor and integrator to be used in the design of a project. The og c could be saved as a macro and reuse ed for use in the configuration of several systems. The manual design is more flexible and the design becomes more convenient as the larger and more redundant the og c.

Un que y og c draw ng can be made up of various layers each with its own informat on on app cat on. As
an example configuration can be on a layer, fed through the control circuitry on another and described on another. Thus, the possibility for one drawing to contain all the information required from primary input devices (transmitter) through final output devices (control actuator) could depend on the configuration. When the drawing is printed, layers required are defined.

The verification function necessary to assure the control strategy depicted in the documentation versus the strategy actually being used by the processor processor is the same. The verification process looks at the CAD control and documentation and the actual control memory and tabulates on the differences. The mundane task of manually checking against engineering against CAD documentation and the actual control system is performed by the computer engineer. The feedback is sent to the customer for making decisions on content and design. Some tuning parameters can be accepted automatically.

**Reheating Furnace Application:**

As an example application on a furnace application system, the project is to design and develop a system for CAD implementation. The project can be defined as follows:

The project is to modernize the existing control system of a sub-push reheat furnace by replacing the old pneumatic systems with the modern processor-based system.

A total of zones are used to heat the absorber to full temperature. The five zones consist of a soak zone, north, south, top, and bottom. Two preheat zones are top and bottom, and two heating zones are top and bottom. The soaks are pushed through the five zones toward the rolling mill. Each zone has its independent furnace control, governed by a setpoint generated from the zone temperature. The soak zone furnace is fueled by natural gas, a one where the four heating zones from other coke oven gas or oil.

FUTURE 3 (Reheat Supervisory Control) shows an overview picture of the control strategy and the combustion section on the future development of the furnace control strategy. FUTURE 4 (Furnace Combustion Strategy) shows how the upgraded data for the reheat furnace control system can be achieved on a function on aughs with CAD techniques.

To clarify the interconnection of CAD generated control logic and system control, FUTURE 6 (Function Block vs. Input Output) shows the relationship of the function block with the control system and the internal connections. This is the real world input/output connection point for the microprocessor control.

**Economic Benefits Summary:**

Computer added design has many hard to define (e.g., a) benefits. Never the less, a significant increase in product yields, the new design, and the new design engineer the following are some of the benefits found through experience:

- Tangible benefits:
  - Increased engineering productivity (up to 50% less time for design)
  - Centralized management of design (don't recreate the wheel)
  - Document control on automata and high accuracy
  - Training of new engineers on tricks of the trade, increased
  - Decreased time for startup of (ess travel and process down time)
  - Increased transportation cost, keeping the cost (up to 80% reusable)
  - Extended factory testing
  - Improved control reliability
  - System cost savings on design and construction take more effort
  - Many what conditions can be tested safely

Intangible benefits:

- Increased opportunity time (do more engineering)
- Owner acceptance and getting them understand design and changes
- Consistency of documentation on improves acceptance and the amount of time spent on control design and debugging
Conclusion

Computer aided design is available and applicable to process control today. Much has been done in control design automation and a growth testing with regard to microprocessor based systems. Advantages of computer aided design are both quantifiable and not quantifiable. Complex and simple algorithms can be designed and debugged much more quickly and efficiently on CAD systems.

As a note, future control design with CAD systems are currently incorporating rule based expert systems to generate control design. This is the next horizon which will be useful to control engineers. Based with the evidence and economy, CAD control design systems the economic benefits are seen to multiply.

References


FIGURE 2  Engineering Design Network
FIGURE 3  Reheat Supervisory Control
FIGURE 4  Furnace Combustion Strategy (prior to function block logic)
FIGURE 6  Function Block Logic vs. Input Output