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Advancement

Application of SCADA System For Ethanol Production Factory

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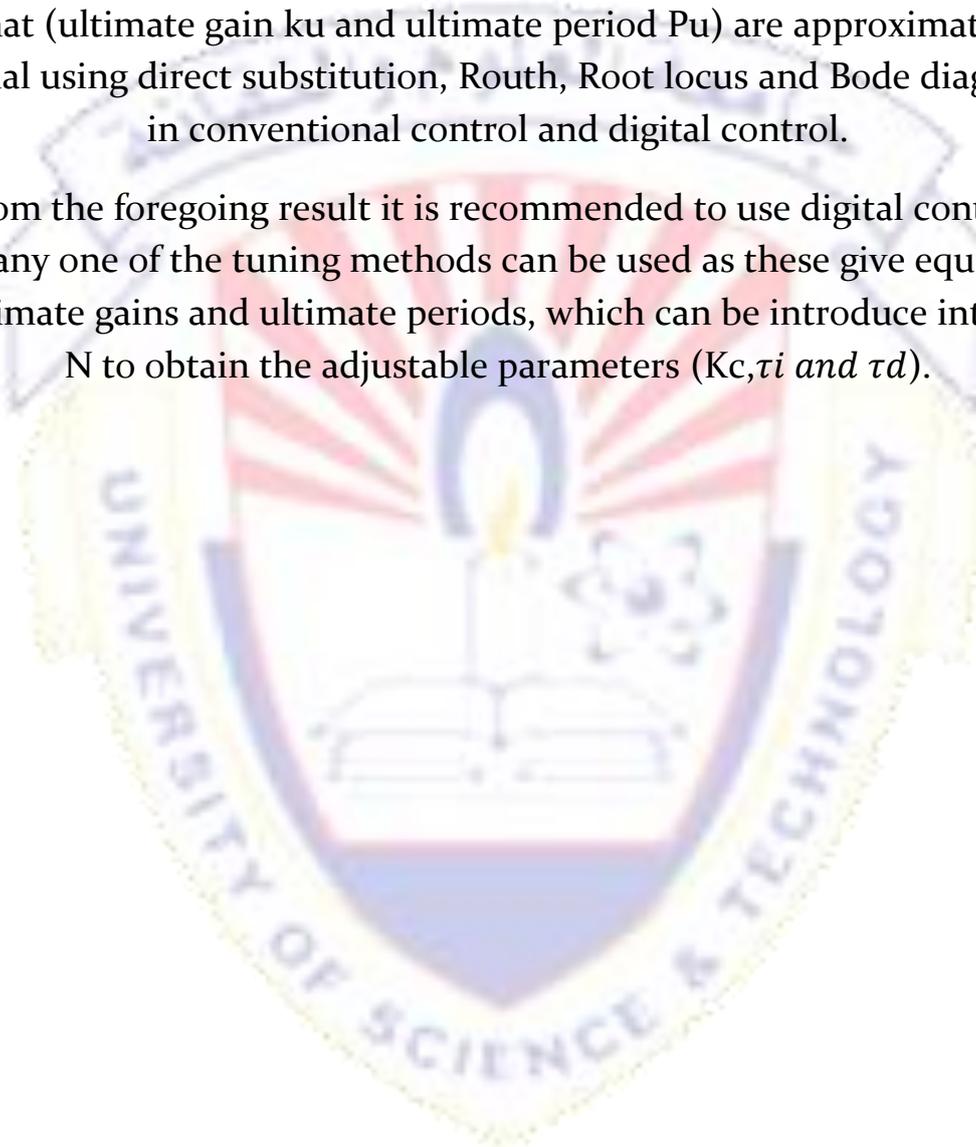
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## Abstract

This study investigated application of SCADA system for ethanol production. A control strategy was developed. The transfer functions were identified and the block diagrams were drawn with each transfer function in its block. Stability and tuning were carried out and analyzed by conventional and digital methods. It's observed that (ultimate gain  $k_u$  and ultimate period  $P_u$ ) are approximately equal using direct substitution, Routh, Root locus and Bode diagram in conventional control and digital control.

From the foregoing result it is recommended to use digital control, any one of the tuning methods can be used as these give equal ultimate gains and ultimate periods, which can be introduce into Z-N to obtain the adjustable parameters ( $K_c, \tau_i$  and  $\tau_d$ ).



## المستخلص

هذه الدراسة عن تطبيق الاسكادا في نظام صناعة الايثانول. انشأت خطة التحكم وضمنت الدوال ورسم المخطط ووضعت كل الدوال. حللت الاستقرار عن طريق الكنترول العادي والرقمي. ولوحظ ان (Ku,Pu) متساوية او قريبة للتساوي باستخدام direct substitution, Root locus Bode diagram عند استخدام الكنترول العادي و الكنترول الرقمي.

من النتائج استوصي باستخدام الكنترول الرقمي لانه اعطى قيم متساوية ل (Ku,Pu) والتي عوضت في جدول Z-N للحصول على قيم الضبط بالاضافة الى انه اكثر سرعة ونتائجه جيدة.



# Introduction

## 1.1 Control

Control means methods to force parameters in the environment to have specific value, like making the temperature in a room stay at 21°C.

## 1.2 Classification of control

### 1.2.1 Conventional control

It happens manually like closing and opening the valve manually or decreasing and increasing temperature manually.

### 1.2.2 Automatic control

#### 1.2.2.1 Digital control

Is a branch of control theory that uses digital computers to act as system controllers. Depending on the requirements, a digital control system can take the form of a microcomputer to an ASIC to a standard desktop computer. Since a digital computer is a discrete system, the Laplace transform is replaced with the Z-transform. Also since a digital computer has finite precision, extra care is needed to ensure the error in coefficients, A/D conversion, D/A conversion etc. are not producing undesired or unplanned effects.

The application of digital control can readily be understood in the use of feedback since the creation of the first digital controller in the early 1940s the price of digital computers has dropped considerably, which has made them key pieces to control systems for several reasons:

- Inexpensive: under \$5 for many microcontrollers
- Flexible: easy to configure and reconfigure through software
- Scalable: programs can scale to the limits of the memory or storage space without extra cost
- Adaptable: parameters of the program can change with time.
- Static operation: digital computers are much less prone to environmental conditions than capacitor inductor, etc.

## **1.3 SCADA**

SCADA is an acronym for Supervisory Control and Data Acquisition. SCADA systems are used to monitor and control a plant or equipment in industries such as telecommunications, energy, oil, and gas refining and transportation and other distributed processes. Also SCADA system refers to central system that monitors and controls complete site or system spread out over a long distance. Thus SCADA system used for safe and efficient control of the pipe line system.

These systems encompass the transfer of data between a SCADA Central host computer and a number of Remote Terminal Units (RTUs) and programmable logic controllers (PLCs), and the central host and the operator terminals. A SCADA system gather information (such as where a leak on a pipeline has occurred ) , transfers the information back to a central sit , then alerts the home station that a leak has occurred, carrying out necessary analysis and control , such as determining if the leak is critical , and displaying the information in a logical and organized fashion. Today many systems are monitored using the infrastructure of the corporate local area network (LAN) wide area network (WAN). Wireless technologies are now being widely deployed for purposes of monitoring

### **1.4 Distributed control system (DCS)**

1. The data acquisition and control functions are performed by a number of distributed microprocessor-based units situated near to the devices being controlled.
2. DCS systems have evolved into systems providing very sophisticated analog (e.g. loop) control capability. A closely integrated set of operator interfaces (or man machine interfaces) is provided to allow for easy system configurations and operator control. The data highway is normally capable of fairly high speeds (typically 1 Mbps up to 10 Mbps).

### **1.5 Programmable logic controller (PLC)**

Since the late 1970s, PLCs have replaced hardwired relays with a combination of ladder–logic software and solid state electronic input and output modules. They are often used in the implementation of a SCADA

RTU as they offer a standard hardware solution, which is very economically priced.

### **1.6 Typical considerations when putting a SCADA system together are**

- Overall control requirements
- Sequence logic
- Analog loop control
- Ratio and number of analog to digital points
- Speed of control and data acquisition
- Master/operator control stations
- Type of displays required
- Historical archiving requirements
- System consideration
- Reliability/availability
- Speed of communications/update time/system scan rates
- System redundancy
- Expansion capability
- Application software and modeling

### **1.7 Remote terminal units**

An RTU (sometimes referred to as a remote telemetry unit) as the title implies, is a standalone data acquisition and control unit, generally microprocessor based.

There is also a facility to be configured locally by some RTU programming unit.

Although traditionally the RTU communicates back to some central station.

### **1.8 PLCs used as RTUs**

A PLC or programmable logic controller is a computer based solid state device that controls industrial equipment and processes. It was initially designed to perform the logic functions executed by relays, drum switches and mechanical timer/counters. Analog control is now a standard part of the PLC operation as well.

The advantage of a PLC over the RTU offerings from various manufacturers is that it can be used in a general-purpose role and can easily be set up for a variety of different functions.

## **1.9 Stability**

Although a controller may be stable when implemented as an analog controller, it could be unstable when implemented as a digital controller due to a large sampling interval. During sampling the aliasing modifies the cut off parameters. Thus the sample rate characterizes the transient response and stability of the compensated system, and must update the values at the controller input often enough so as to not cause instability.

When substituting the frequency into the z operator, regular stability criteria still apply to discrete control systems Nyquist criteria apply to z-domain transfer functions as well as being general for complex valued functions. Bode stability criteria apply similarly. Jury criterion determines the discrete system stability about its characteristic polynomial.

## **1.10 Computer Simulation**

Digital simulation is a very useful tool for solving equations describing chemical engineering system.

## **1.11 MATLAB**

Is a multi-paradigm numerical computing environment and fourth generation programming language. A proprietary programming language developed by math works. MATLAB allows matrix manipulations, plotting of function and data, implementation of algorithms creation of user interface and interfacing with programs written in other languages, including C,C++,C#, Java, fortran and Python.

## **1.12 objective of the study**

The objective of the study is:

- To make a control to an ethanol plant that is controlled by using MATLAB.

To connect the local control station with central SCADA system