K.Ramakrishnan College Of Engineering

Electrical and Electronics Engineering

(Batch-2024-28)

MATLAB WORKSHOP

(5-Days)

Mini Project Name : ROOM TEMPERATURE GAIN CONTROL

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INDEX

S.no	TOPICS	Pg.no
I	Abstract	03
II	Introduction and Software used	04
III	Real Time Example	05
IV	Code and its Explanation Formula and Equation	06
V	Pros and Cons	10
VI	Output	11
VII	Conclusion	12

Abstract

This project focuses on the implementation of a room temperature gain control system using MATLAB. In electronic and control systems, variations in room temperature can affect the gain of component s such as amplifiers and sensors, leading to changes in output performance. To minimize this effect, a temperature-based gain control technique is used.

In this work, a reference temperature of 24°C is selected, and the system gain is adjusted according to the variation in room temperature. A simple mathematical relationship is applied to control the gain, and the output is obtained by multiplying the controlled gain with the input signal. The MATLAB program developed is simple and easy to understand.

The results demonstrate that the gain changes effectively with temperature, helping to maintain a stable output. This project is useful for understanding temperature compensation techniques and is suitable for academic and laboratory applications.

INTRODUCTION AND SOFTWARE USED

Introduction

In many electronic and control systems, the performance of components such as amplifiers and sensors is affected by changes in ambient or room temperature. These temperature variations cause changes in system gain, which may lead to inaccurate or unstable output. To overcome this problem, room temperature gain control is used. Room temperature gain control is a method in which the system gain is adjusted based on the surrounding temperature so that the output remains stable. In this project, a reference temperature is selected, and the gain is varied linearly with temperature changes. MATLAB is used to model and simulate this gain control technique due to its simplicity and powerful computational features. This project helps in understanding basic temperature compensation and gain control concepts used in practical electronic systems.

Software Used

MATLAB (Matrix Laboratory) is used as the primary software tool for this project. MATLAB provides an easy platform for mathematical modeling, simulation, and analysis of control systems. It allows users to write simple programs to calculate gain variations with temperature and observe the corresponding output. The software is widely used in academic and industrial applications, making it suitable for implementing room temperature gain control in a simple and effective manner.

REAL TIME EXAMPLE

Real-Life Example: Temperature Compensation in Audio Amplifier

In an audio amplifier, the gain of transistors changes when the room temperature increases. As temperature rises, the amplifier may produce distorted or louder output. To avoid this, a temperature-based gain control is used. A temperature sensor detects the room temperature and adjusts the amplifier gain automatically. This ensures that the audio output remains clear and stable even when the temperature changes.

Another Real Example: Sensor Signal Conditioning

In industrial sensors such as pressure or gas sensors, the output signal depends on temperature. When room temperature varies, the sensor output may increase or decrease unnecessarily. A room temperature gain control circuit adjusts the gain based on temperature, so the final output remains accurate. This concept can be easily simulated using MATLAB.

Code:

```
clc;
clear;

T = 30;        % Room temperature (°C)
Tref = 24;     % Reference temperature
Gref = 10;     % Gain at reference temperature
k = 0.1;       % Gain factor

Gain = Gref - k*(T - Tref);   % Gain control equation

x = 2;         % Input signal
y = Gain * x;  % Output signal

disp(Gain)
disp(y)
```

Explanation of the MATLAB Code

clc;

Clears the Command Window.

Removes previous outputs so the new results are easy to read.

clear;

Clears all variables from memory.

Ensures old data does not affect the current program.

T = 30; % Room temperature

T represents the current room temperature.

Here, the room temperature is assumed to be 30°C.

Tref = 25; % Reference temperature

Tref is the reference temperature, usually taken as 24°C.

Gain is calculated relative to this temperature.

Gref = 10; % Gain at reference temperature

Gref is the system gain at the reference temperature.

When the temperature is 24°C, the gain is 10.

k = 0.1; % Gain factor

k is the gain variation factor.

It shows how much the gain changes for every 1°C change in temperature.

Gain = Gref - k*(T - Tref); % Gain control equation

This line calculates the actual gain based on room temperature.

If the temperature increases above 24°C, the gain decreases.

If the temperature decreases below 24°C, the gain increases.

This provides temperature compensation.

x = 2; % Input signal

x represents the input signal applied to the system.

It can be voltage, current, or any sensor input.

y = Gain * x; % Output signal

The output y is calculated by multiplying the gain with the input.

This follows the basic system relation:

disp(Gain)

disp(y)

These commands display the calculated gain and the output value in the MATLAB Command Window.

Explanation of the Formula

1.Gain Control Equation

$$G = G_{ref} - k(T - T_{ref})$$

G= Gain at room temperature

Gref= Gain at reference temperature

T= Actual room temperature

Tref= Reference temperature (usually 24°C)

k= Gain variation constant

2.Output equation

y= Gain × x

x→ Input signal

Gain → Amplification factor (controlled by temperature)

y→ Output signal

Pro and Cons

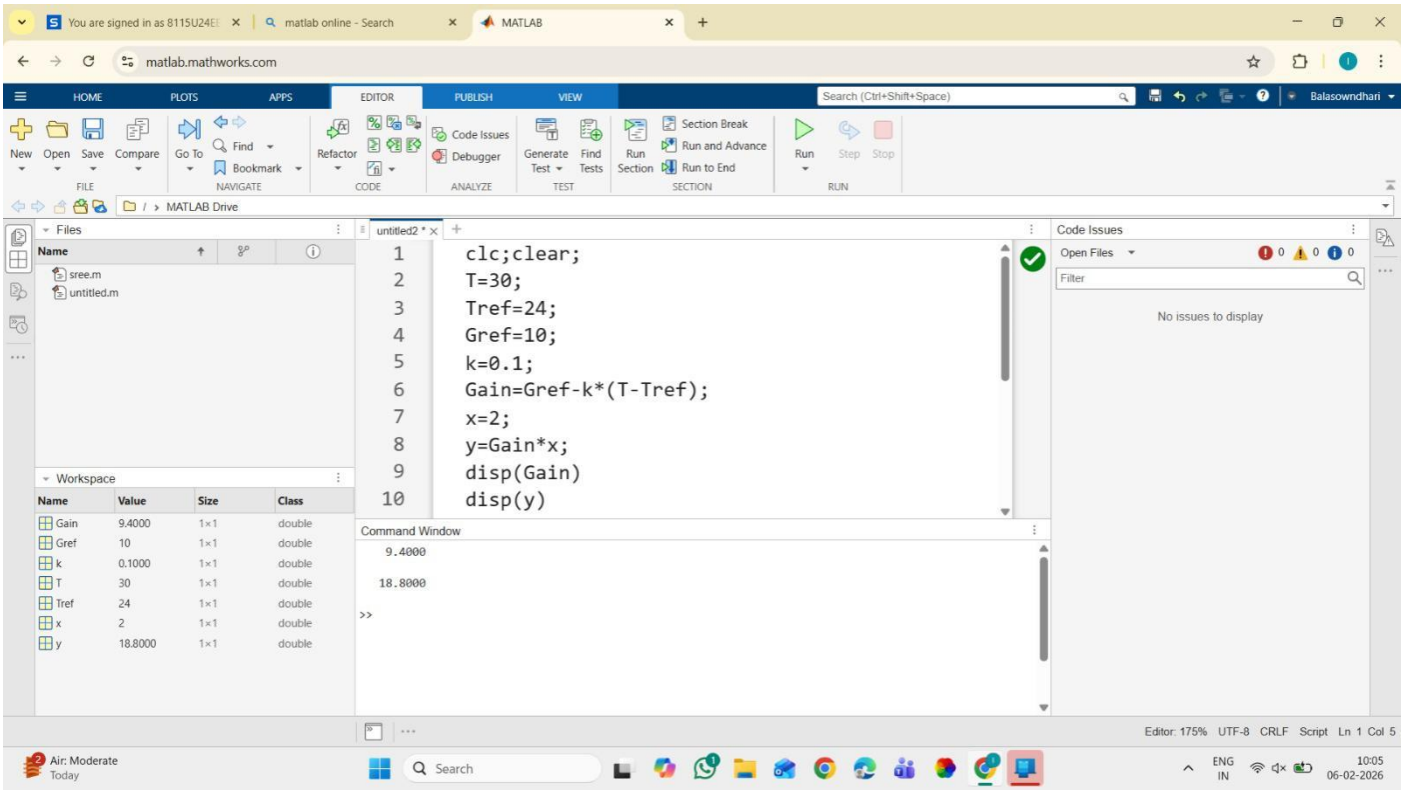
Pros

- Simple and easy to understand
- Reduces effect of temperature changes
- Maintains stable output
- Easy to simulate using MATLAB
- Useful for learning gain control concept

Cons

- Uses only a simple linear model
- Not real-time (simulation only)
- No hardware implementation
- Accuracy depends on assumed values
- No feedback control.

Output


matlab.mathworks.com
HOME
PLOTS
APPS
EDITOR
PUBLISH
VIEW
MATLAB Drive
Files
sree.m
untitled.m
untitled2 *
1 clc;clear;
2 T=30;
3 Tref=24;
4 Gref=10;
5 k=0.1;
6 Gain=Gref-k*(T-Tref);
7 x=2;
8 y=Gain*x;
9 disp(Gain)
10 disp(y)
Code Issues
No issues to display
Workspace
Name Value Size Class
Gain 9.4000 1×1 double
Gref 10 1×1 double
k 0.1000 1×1 double
T 30 1×1 double
Tref 24 1×1 double
x 2 1×1 double
y 18.8000 1×1 double
Command Window
9.4000
18.8000
>>

Conclusion

This project presented the design and implementation of a room temperature gain control system using MATLAB. Temperature variations in the surrounding environment can significantly affect the performance of electronic and control systems by altering their gain characteristics. To address this issue, a simple temperature-based gain control method was developed using a mathematical model.

In this work, a reference temperature of 24°C was chosen, and the system gain was adjusted according to changes in room temperature. When the room temperature increased, the gain was reduced, and when the temperature decreased, the gain was increased. This controlled gain was then applied to the input signal to obtain a stable output. The MATLAB program was kept simple, making it easy to understand and implement for academic purposes.

The results obtained from the program clearly show the relationship between temperature, gain, and output. The project demonstrates how temperature compensation can be achieved using basic equations and simulation techniques. Overall, this project provides a clear understanding of room temperature gain control and highlights the importance of maintaining consistent system performance under varying environmental conditions. It is useful for learning fundamental concepts related to gain control and temperature compensation in electronic and control systems.