

# Modeling and Simulation of Room Temperature Control Using On-Off and PID Controllers in MATLAB

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## 1. Abstract

A comparative simulation of room temperature control using On-Off and PID controllers is performed in MATLAB. The project aims to analyze system response under normal and disturbed conditions using control strategies to maintain a desired room temperature.

## 2. Introduction

This project models a simplified thermal system where a heater controls the room temperature. Two control strategies are tested:

- On-Off control
- PID control

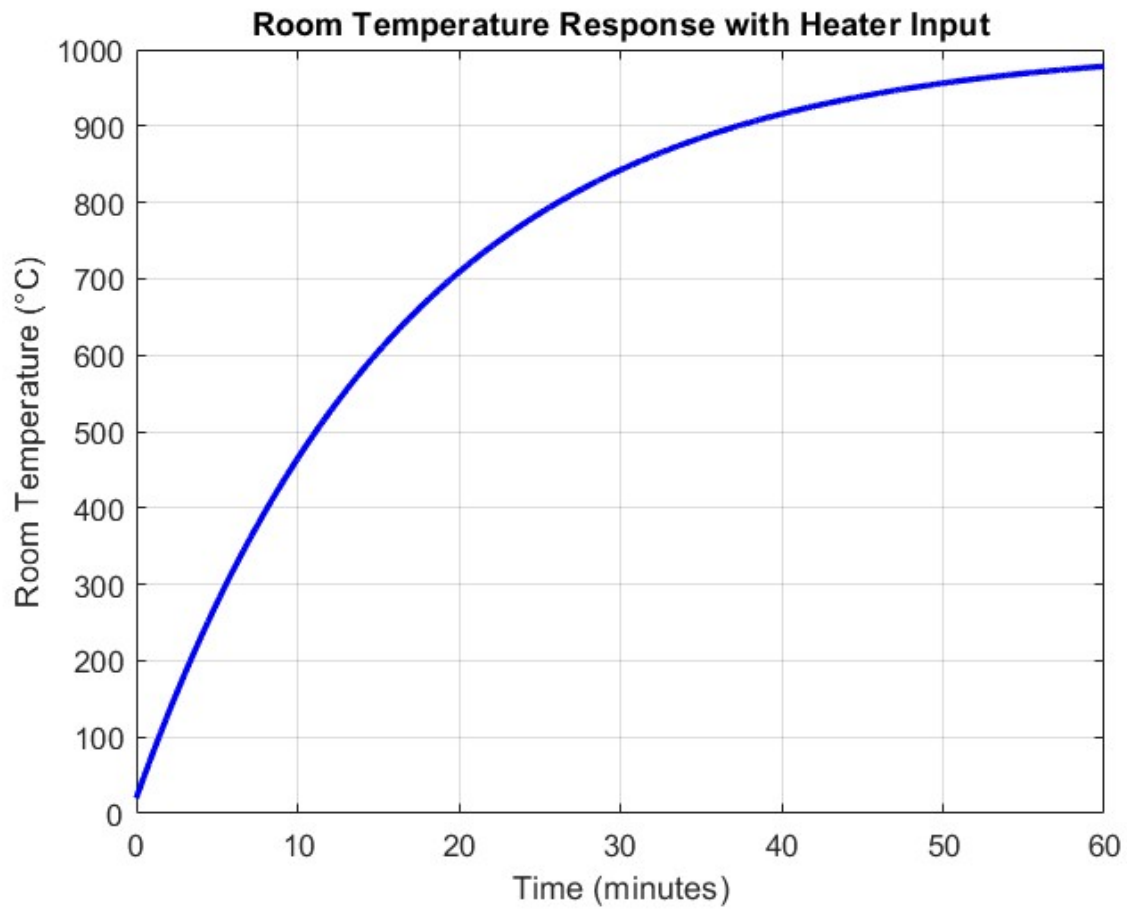
We evaluate the system's response to each method and simulate the effect of environmental disturbances.

## 3. Methodology

- A thermal model of room temperature response to heating is implemented.
- On-Off and PID controllers are modeled.
- Simulations include step input, steady-state performance, and disturbance response.

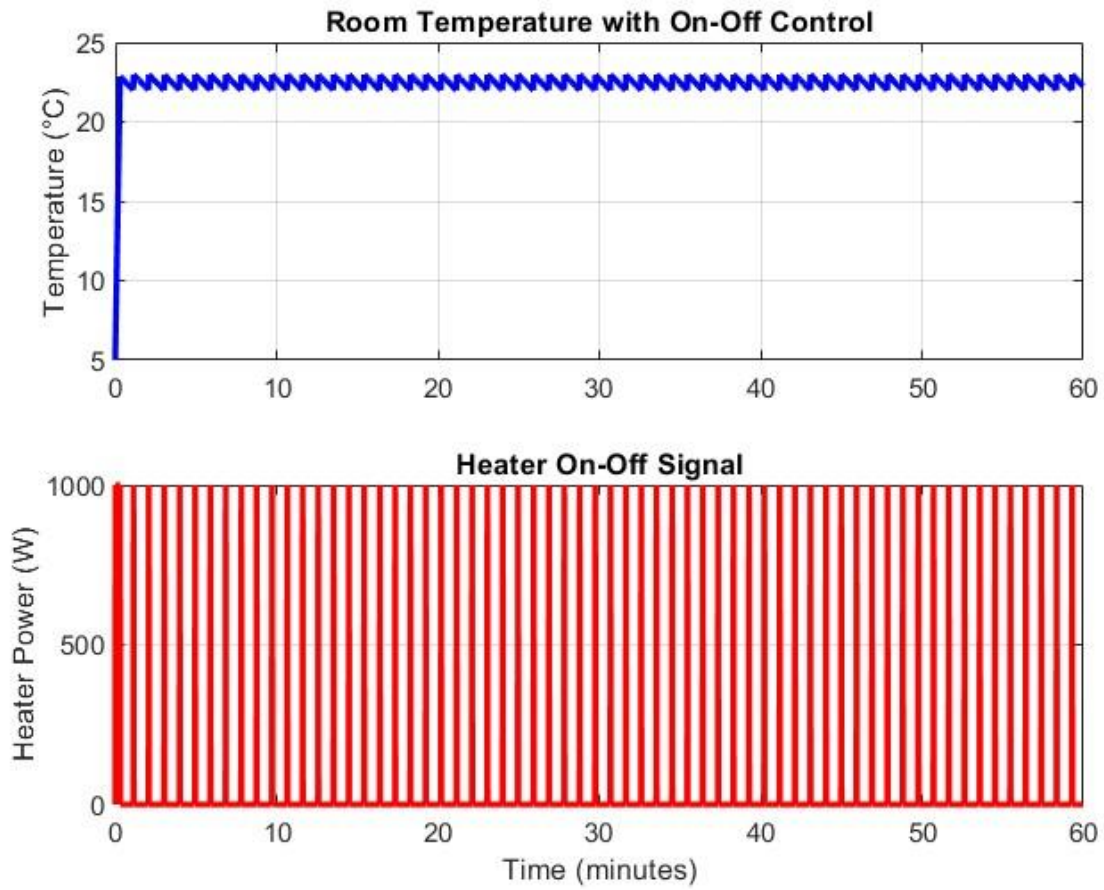
## 4. Simulation Results and Analysis

Figure 1: Room temperature response using On-Off control.



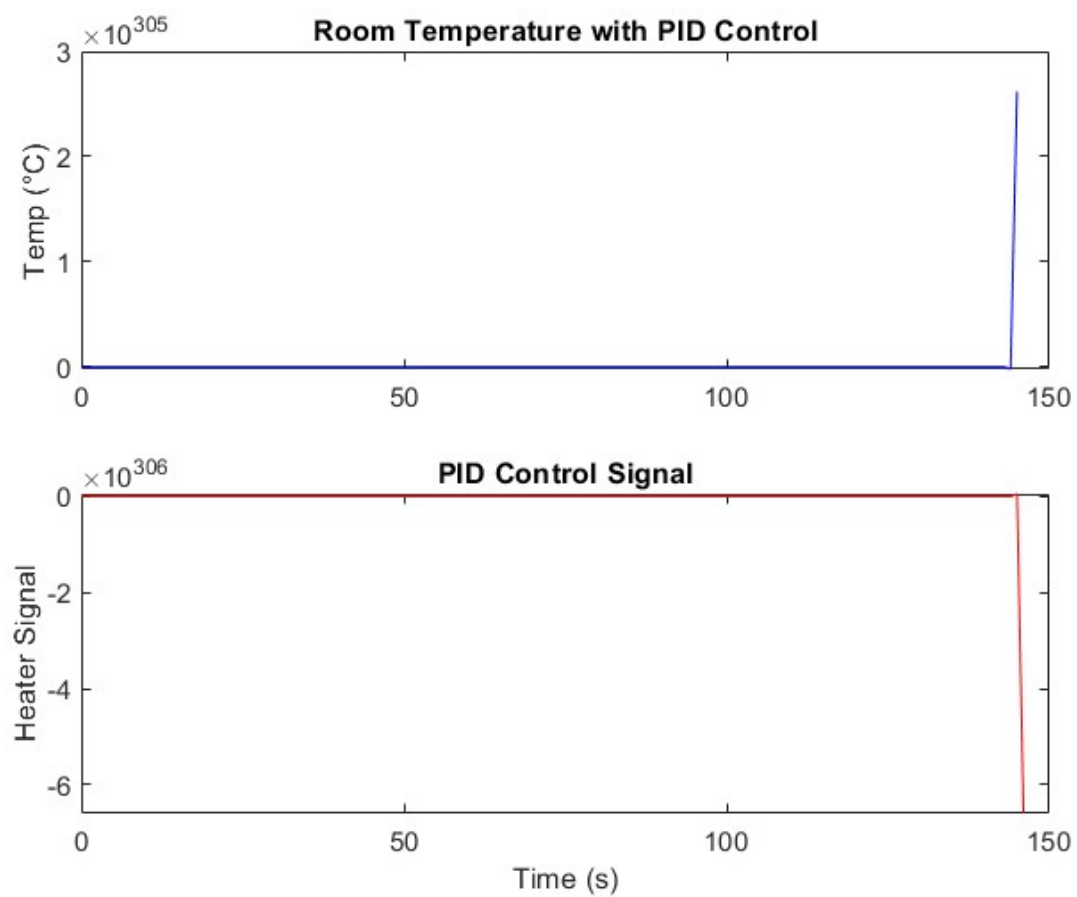
Observation: Sharp oscillations between upper and lower thresholds (20°C to 25°C).

Figure 2: Heater signal in On-Off control.



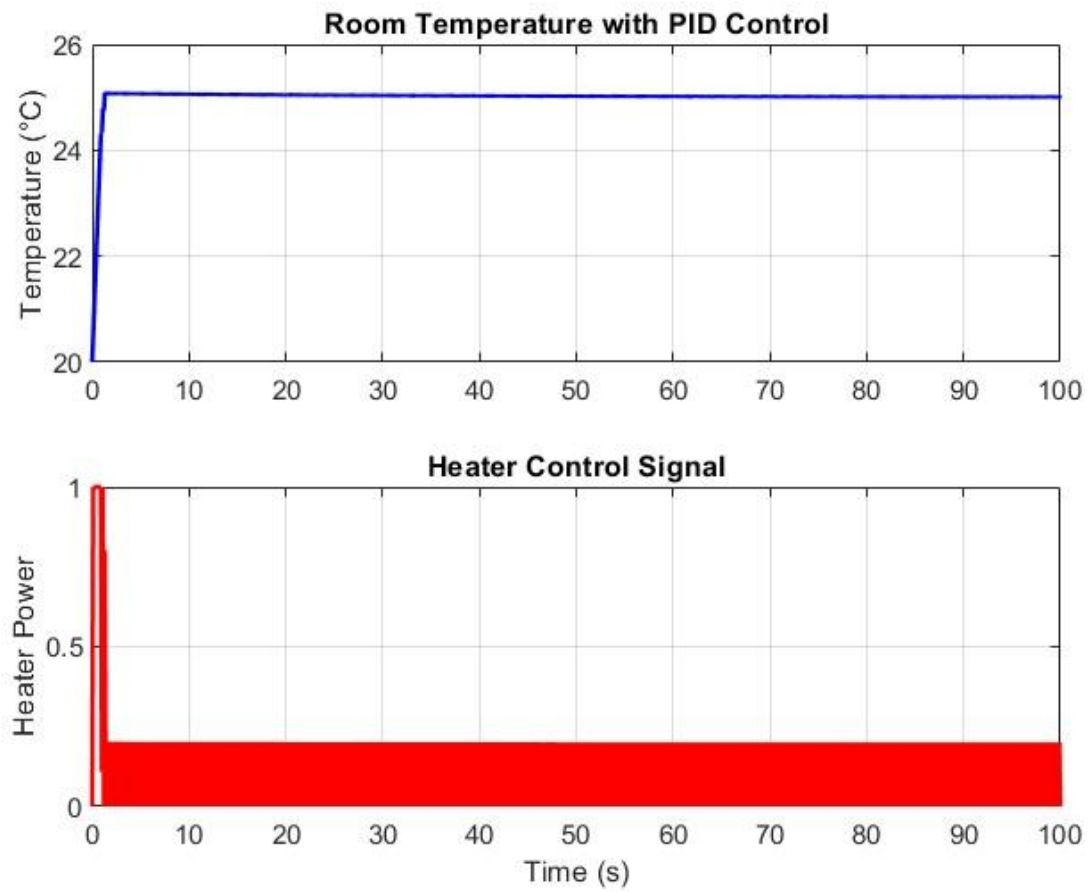
Observation: Frequent switching with discrete behavior.

Figure 3: Room temperature with PID control (underdamped).



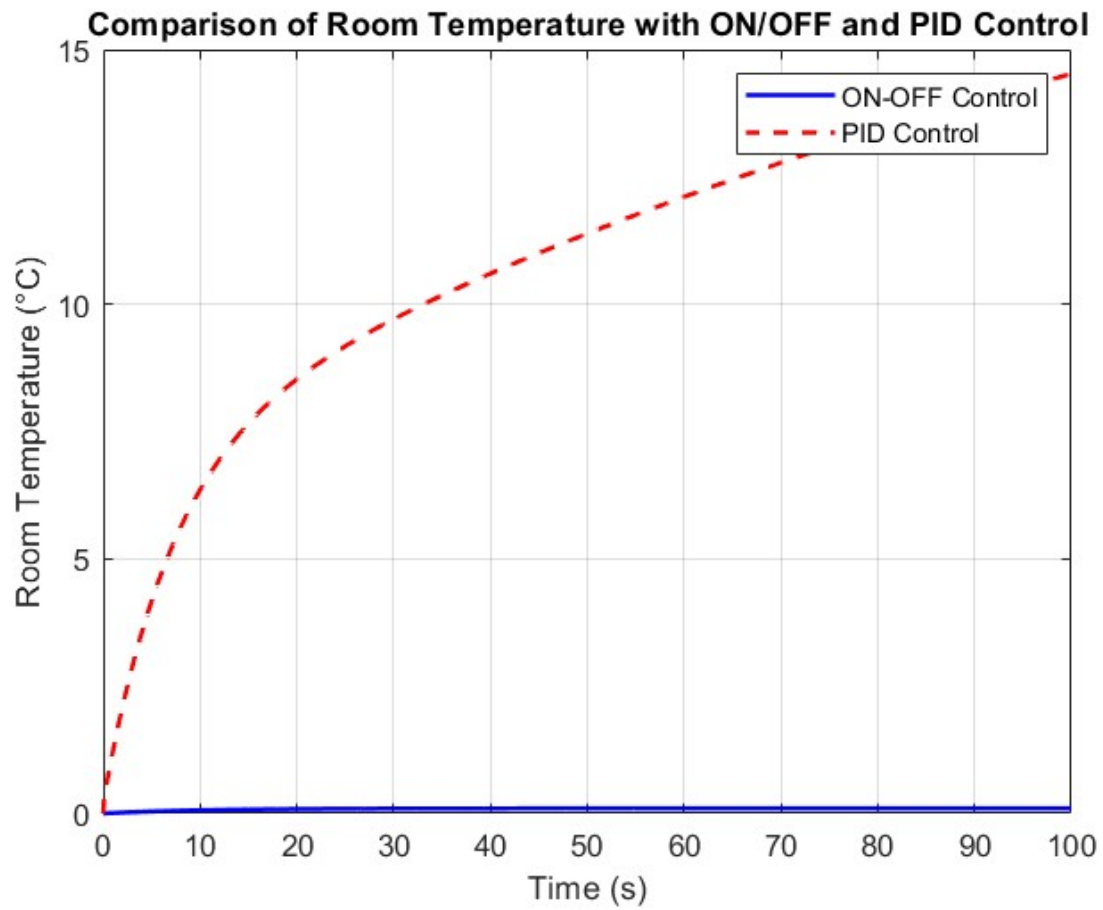
Observation: Smooth rise, small overshoot, stabilizes at setpoint.

Figure 4: Heater signal with PID.



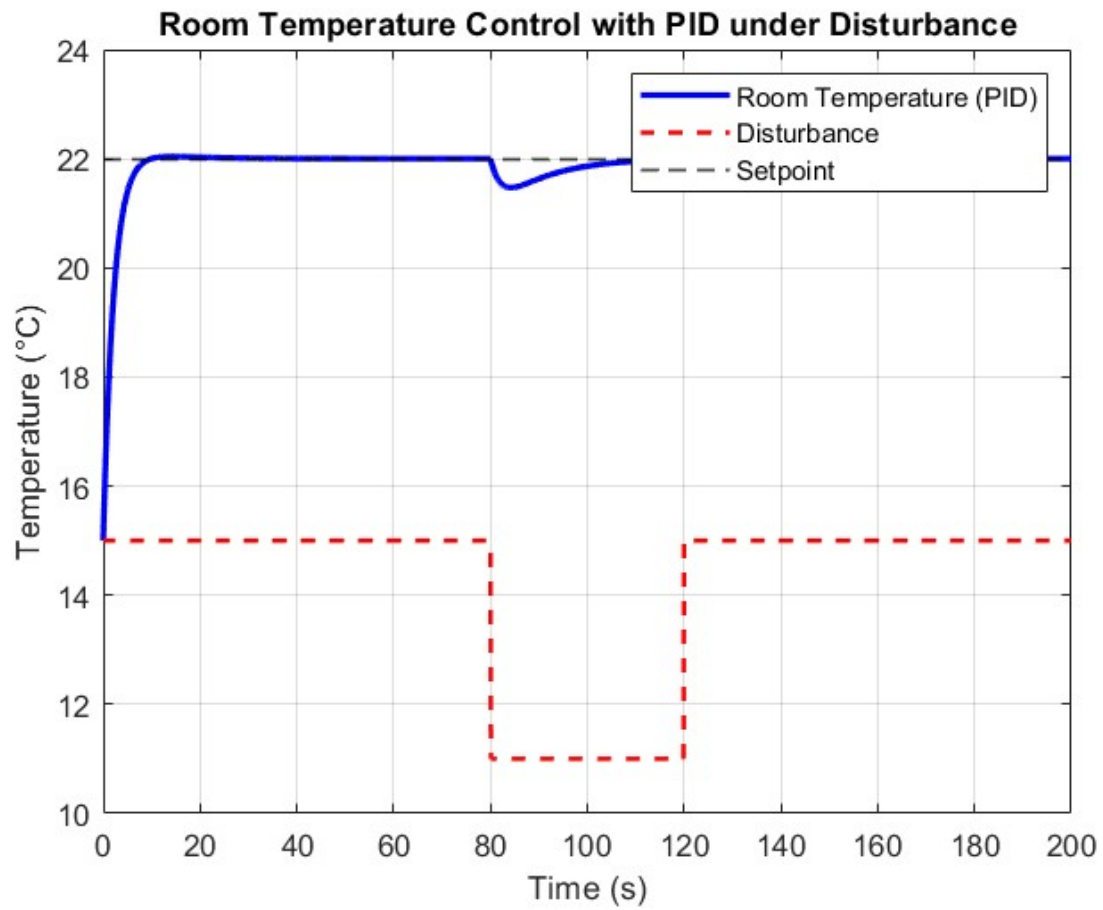
Observation: Analog control effort, less abrupt.

Figure 5: PID response with initial offset.



Observation: Controlled convergence with minimal steady-state error.

Figure 6: PID response with external disturbance.



Observation: Sudden dip during disturbance, recovery to setpoint confirms robust control.

## 5. Conclusion

The PID controller demonstrates smoother, more stable control compared to the On-Off method. It responds better to disturbances and offers fine-tuned thermal management.

## 6. References

- Control Systems Engineering by Norman S. Nise
- MATLAB documentation

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