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Introduction of LTI

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Outlines

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2 The End

Linear Time-Invariant System (LTI) Overview

Definition

A Linear Time-Invariant (LTI) system is a system whose output response to an input is linear and does not change over time.

Mathematical Representation

The output $y(t)$ of an LTI system is given by the convolution:

$$y(t) = (x * h)(t) = \int_{-\infty}^{\infty} x(\tau)h(t-\tau)\,d\tau$$

where $x(t)$ is the input and $h(t)$ is the impulse response.

Python Example: LTI System Simulation

Code Example

```
import numpy as np
import matplotlib.pyplot as plt
from scipy.signal import lti, step

system = lti([1], [1, 1]) # H(s) = 1/(s+1)
t, y = step(system)
plt.plot(t, y)
plt.xlabel('Time (s)')
plt.ylabel('Response')
plt.title('Step Response of LTI System')
plt.grid(True)
plt.show()
```

LTI System Illustration

Figure: 校徽图示

LTI System Properties Table

Comparison of System Properties

Property	**LTI System**	**Non-LTI System**
Linearity	Yes	Not always
Time-Invariance	Yes	Not always
Superposition	Holds	Not always
Impulse Response	Exists	Not always meaningful
Frequency Response	Well-defined	Not always

Thank You!

Any Questions?

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