Classifications of systems

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Overview

1. Number of inputs and outputs
2. Continuous vs. Discrete time
3. Linear vs. Nonlinear
4. Causal vs. Non-causal
5. Time-invariant vs. Time-varying
6. Lumped vs. Distributed

Based on the number of inputs and outputs

1. **SISO**: Single Input Single Output
2. **SIMO**: Single Input Multiple Output
3. **MISO**: Multiple Input Single Output
4. **MIMO**: Multiple Input Multiple Output
5. **Autonomous**: No inputs and one or more outputs

Continuous vs. Discrete time

We will discuss both types simultaneously in order to emphasize the similarities (and differences).

Continuous system

1. It has continuous input and output signals
2. We denote continuous time by $t \in \Re$
3. We denote functions of continuous time with round brackets, e.g.: $x(t)$

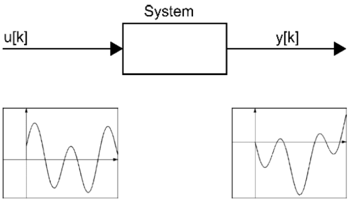
Discrete system

1. It has discrete input and output signals
2. We denote discrete time by $k \in Z$
3. We denote functions of continuous time with square brackets, e.g.: $x[k]$

Continuous

For every moments $t \in \Re$, the system has:

1. A vector of inputs $\mathbf{u}(t)$
2. A vector of outputs $\mathbf{y}(t)$
3. A vector of states $\mathbf{x}(t)$



Discrete

For every moments $k \in Z$, the system has:

1. A vector of inputs $\mathbf{u}[k]$
2. A vector of outputs $\mathbf{y}[k]$
3. A vector of states $\mathbf{x}[k]$