

Signal and System

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def. **Signal**

x is a Signal $\iff x \in A^B$ where A, B is sets, or it can be represented by x is a function, $f : B \rightarrow A$.

anno. the elements of A^B is functions $f : B \rightarrow A$.

def. **System**

x is a System $\iff x \in (A^B)^{(A^B)}$ where A, B is sets.

def. **continuous time signal**

x is continuous time signal $\iff x \in A^R$ where A is a set.

def. **discrete time signal**

x is discrete time signal $\iff x \in A^Z$ where A is a set.

At this scope, the codomain is typically R , e.g., a continuous time signal is a element in R^R .

oper. **addition of signal**

prer. the domain A and codomain B of the two signals f, g is the same, and B has addition operation.

The addition of the two signals is $f + g$ generated by the equation $(\forall x \in A)[(f + g)(x) = f(x) + g(x)]$.

oper. **scaling of signal**

prer. the codomain B of the signal f has scaling operation with scaling factor in the sets C .

The scaling of the signal f with factor a is af generated by the equation $(\forall x \in A)[(af)(x) = a(f(x))]$ where A is the domain of f .

oper. **addition of system**

prer. the domain and codomain A of the two systems f, g is the same, and A has addition operation.

The addition of the two systems is $f + g$ generated by the equation $(\forall x \in A)[(f + g)(x) = f(x) + g(x)]$.

oper. **scaling of system**

prer. the domain and codomain A of the system f has scaling operation with scaling factor in the sets B .

The scaling of the system f with factor a is af generated by the equation $(\forall x \in A)[(af)(x) = a(f(x))]$.

oper. **composition of system**

prer. the domain and codomain A of the two systems f, g is the same.

The composition of the two system f, g is $f \circ g$ generated by the equation $(\forall x \in A)[(f \circ g)(x) = f(g(x))]$.

prop. **stability of system**

prer. A is the domain and codomain of the system f . The codomain B of A is measurable to $R^+ \cup \{\infty\}$.

f is stable $\iff (\forall x \in A)[(\forall y \in B)[|x(y)| < \infty] \rightarrow (\forall y \in B)[|f(x(y))| < \infty]]$.

anno. $|x|$ is the measurement of x

thm. $((f \text{ is stable}) \wedge (g \text{ is stable})) \rightarrow ((f \circ g) \text{ is stable})$