# Representation of LTI systems by differential and difference equations

LTI systems are completely characterized by their impulse response.

Differential and difference equations are a different (and very important) way to model LTI systems.

* Differential equations link the rates of change of the input and output in CT systems.
* Difference equations link the present, future, and past values of the input and output in DT systems.

We focus on linear constant coefficient differential/difference equations (LCCDE).

## LCC differential equations

The constant parameters and quantify the contribution of each derivative to the behavior of the system.

In most practical systems, . is the order of the DE.

To solve the DE, we need to know auxiliary (initial) conditions at time .

An important set of initial conditions is when the LTI system is initially at rest at time , which means that and are zero for . Formally,