Lecture 5: Block diagrams

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References:


Ahmed R. *MATLAB Simulink Tutorial*, Udemy.

A block representing a LTI ODE and its transfer function:

\[ \text{Transfer function (Laplace/Fourier)} \]

Combining blocks:

**Series (cascade):**

\[ H(s) = H_1(s) \cdot H_2(s) \]
Parallel (junction):

\[ H(s) = \frac{d}{dt}H_1(s) - \frac{d}{dt}H_2(s) \]

Constructing block diagrams for ODEs using fundamental building blocks:

\[
\frac{dm}{dt} = F(m, \ldots, f) = A\, m + b\, f
\]

LTI ODE

Example first-order system

ODE in integral form:

\[
m(t) = \int_0^t F (\ldots) \, dt
\]

\[
m(t) = \int (-\frac{1}{2} m(t) + f(t)) \, dt
\]

\[
m(s) = \frac{1}{s} \left( -\frac{1}{2} m(s) + f(s) \right)
\]

\[\int dt = \frac{1}{s} \]
Equivalent block diagram:

MATLAB Simulink implementation (first_order_system.slx):