

Module 6 - Damping Elements

ME3050 - Dynamics Modeling and Controls

Mechanical Engineering

Tennessee Technological University

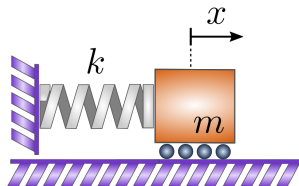
Topic 2 - Mechanical Damping

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- A Better Model
- Oscillation and Decay
- Sources of Damping
- Dampers Damp!

A Better Model

Previously we derived the free response of the mass spring system.



Equation of Motion:

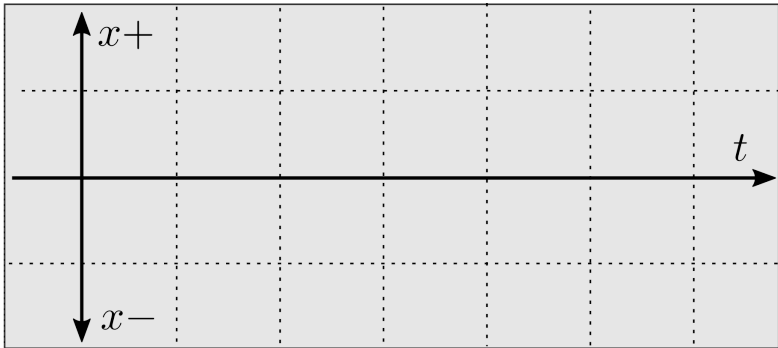
$$m\ddot{x} + kx = 0, \quad x(0), \quad \dot{x}(0)$$

Free Response:

$$x(t) = A \sin\left(\sqrt{\frac{k}{m}}t\right) + B \cos\left(\sqrt{\frac{k}{m}}t\right)$$

A Better Model

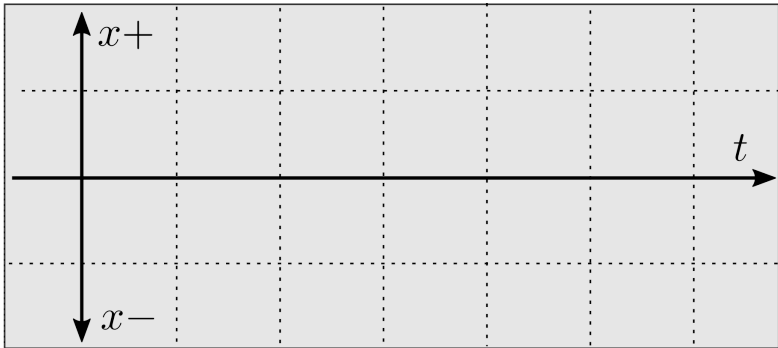
$$x(t) = A \sin \left(\sqrt{\frac{k}{m}} t \right) + B \cos \left(\sqrt{\frac{k}{m}} t \right)$$



Is this valid? Do you believe it?

Oscillation and Decay

$$x(t) = e^{\alpha t} \left[A \sin \left(\sqrt{\frac{k}{m}} t \right) + B \cos \left(\sqrt{\frac{k}{m}} t \right) \right]$$



This is much more realistic.

Oscillation and Decay

How fast does the system response decay? What is steady state value?

Sources of Damping

Damping is a natural phenomenon that cannot be avoided. However in some situations the its influence is significant and in others it is not.



The design of many machines depends on the concept of damping and often a mechanical damper is an intentional component of the design.



Dampers Damp!



Image: Wikimedia

Dampers Damp!

Rain Dampens...