Lecture Module - Damping Elements

ME3050 - Dynamics Modeling and Controls

Mechanical Engineering

Tennessee Technological University

Topic 2 - Mechanical Damping

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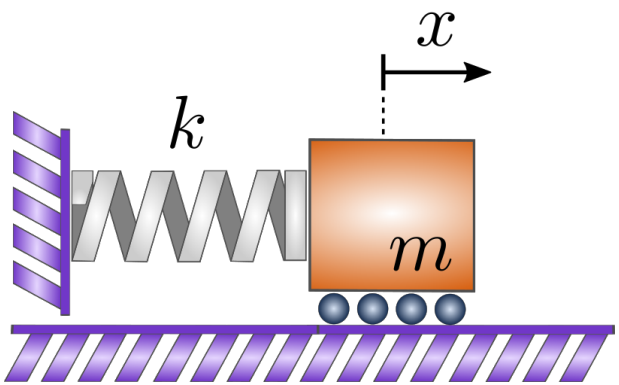
- A Better Model
- Oscillation and Decay
- Sources of Damping
- Dampers Damp!

A Better Model



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

Equation of Motion:

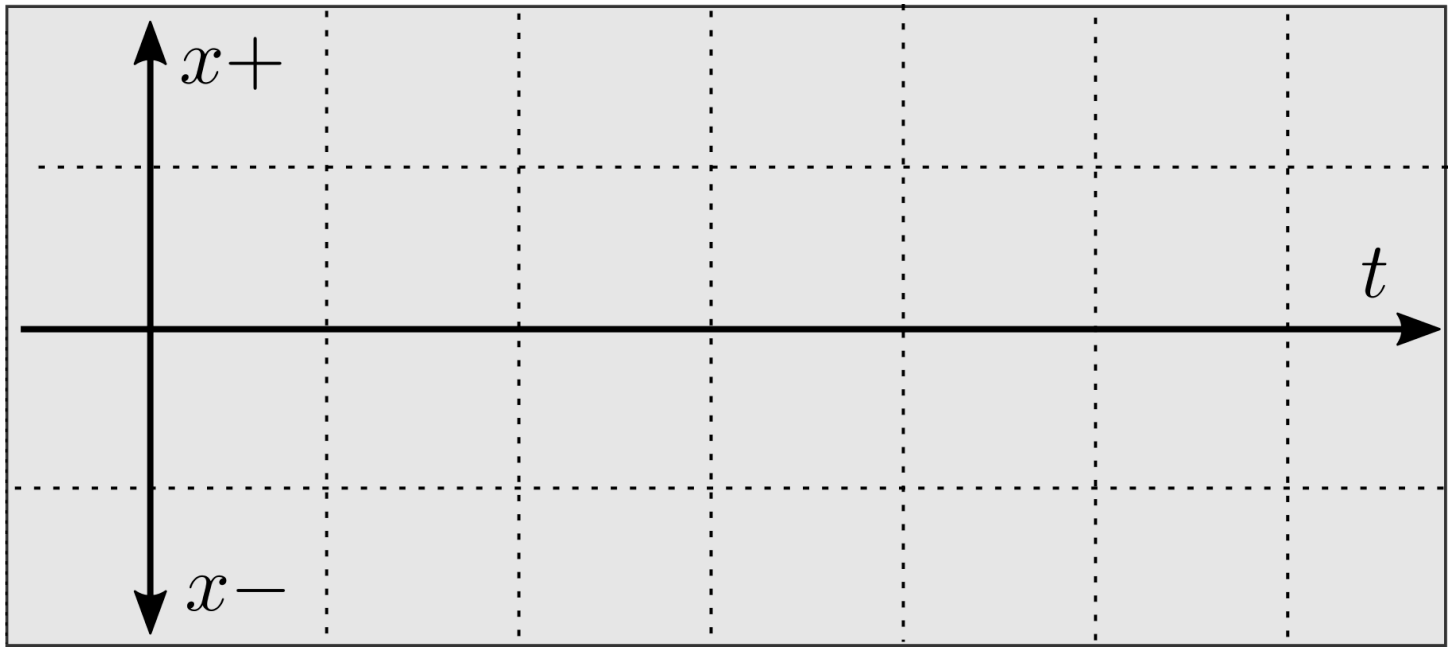
$$m\ddot{x} + kx = 0\ , \quad x(0)\ , \quad \dot{x}(0)$$

Free Response:

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

A Better Model

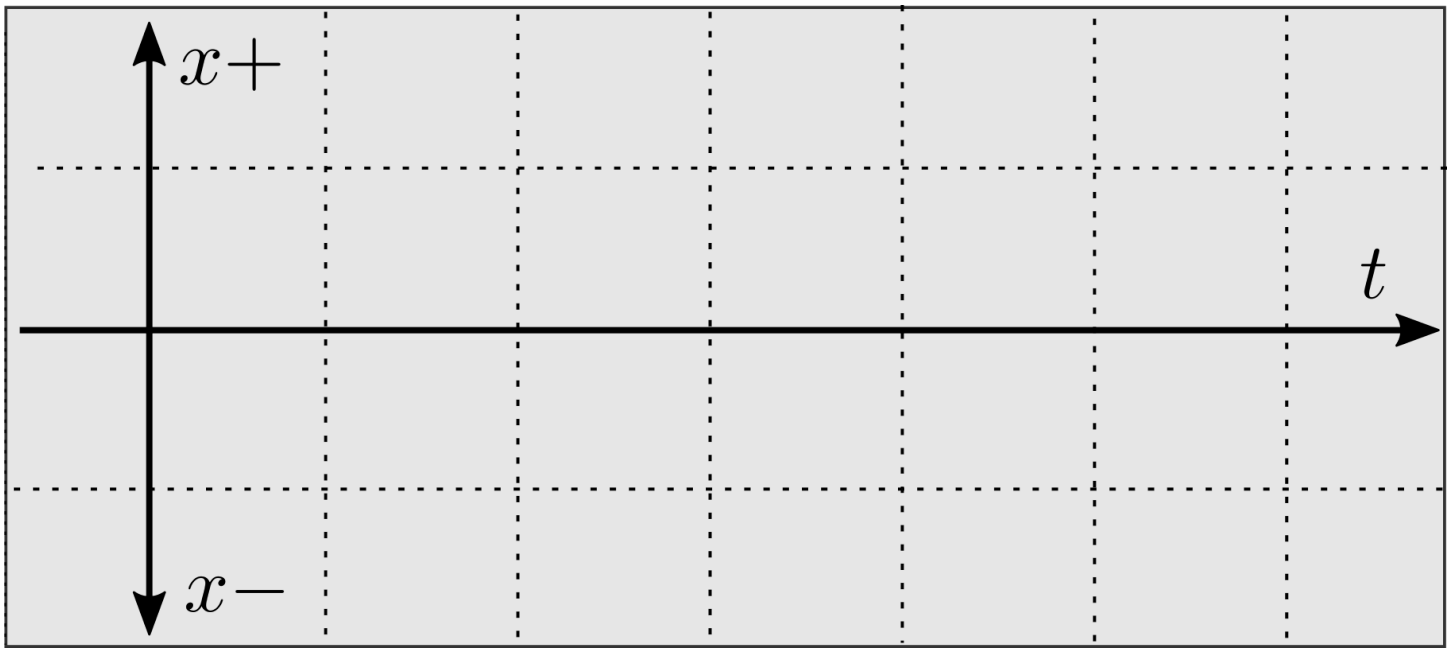
$$x(t) = A\cos\sqrt{\frac{k}{m}}t + B\sin\sqrt{\frac{k}{m}}t$$



Is this valid? Do you believe it?

Oscillation and Decay

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



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.

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

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Dampers Damp!

Dampers Damp!

Rain Dampens...

Image: Wikimedia