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2.72 Elements of Mechanical Design  
Spring 2009

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*2.72*

*Elements of  
Mechanical Design*

*'Lecture' 11:  
Screw drives*

# Schedule and reading assignment

## Quiz

- ❑ Bolted joint qualifying Thursday March 19<sup>th</sup>

## Topics

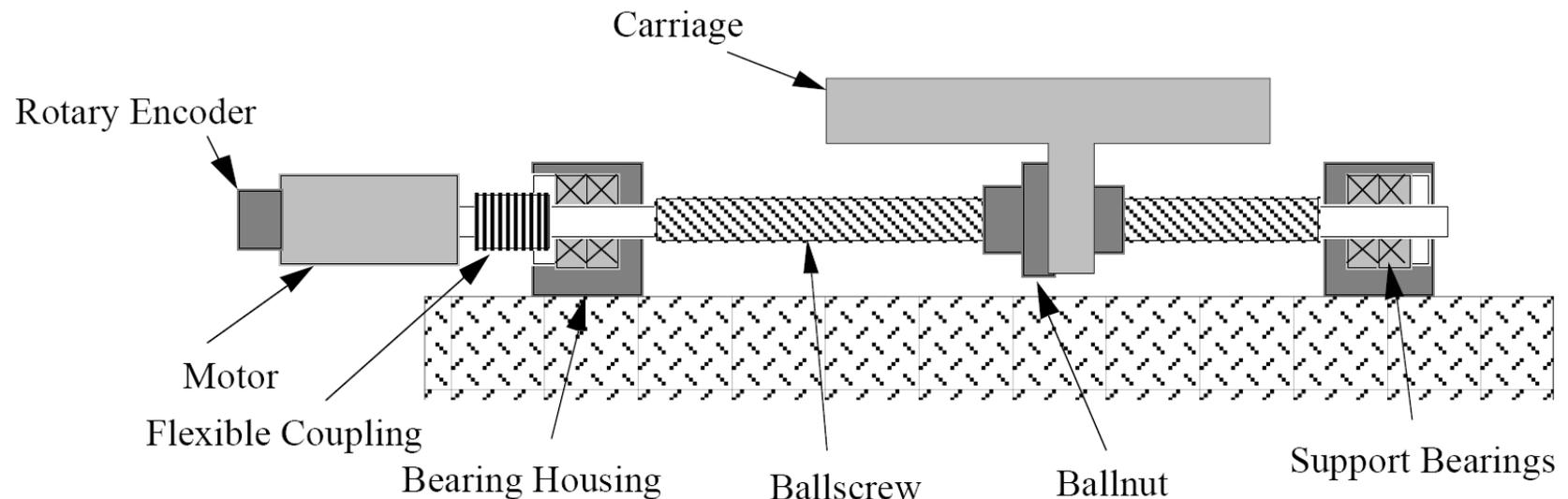
- ❑ Screw drive group activity - 90% hands on

## Reading assignment

- *Read:*
  - 13.1 – 13.7
  - 17.1 & 17.3
- *Skim:*
  - Rest of Ch. 17

# Screws

Convert rotary motion into linear motion:



## Types of “lead screws”:

- Sliding contact thread lead screws
- Ball screws
- Hydrostatic lead screws
- Others

# Typical screw types



Image by [jgelens](#) on Flickr.

Images removed due to copyright restrictions. Please see

<http://news.thomasnet.com/images/large/455/455175.jpg>

<http://www.danahermotion.com/website/com/eng/img/product/LeadScrew2Nut.jpg>

# Errors

## Some error sources

- ❑ Misalignment
  - *Bearings, Carriage*
  
- ❑ Geometry
  - *Straightness*
  - *Varying pitch diameter (periodic error and backlash)*
  - *Errors in thread-contacting elements*
  
- ❑ Loads
  - *Elastic*
  - *Vibration*

## Active error management

- ❑ Periodic errors can be mapped
- ❑ Linear position sensors

# Preload – why...

## Nut-screw:

- ❑ Backlash
- ❑ Use two nuts that are preloaded against each other
- ❑ Use oversize rolling elements
- ❑ Use a split-circumferentially clamped nut

## Screw-machine:

- ❑ Backlash
- ❑ Buckling
- ❑ Straightness
- ❑ Vibration

# Cross feed design exercise

**Kinematic (trade off)**

**Loads and power (limits)**

**Constraints (bearing, flexure?)**

**Preload (Nut-screw and screw-machine)**

**Stress/fatigue**

**Errors (Causes, systematic, random)**