

# EN1740 Computer Aided Visualization and Design

Spring 2012

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### Last Time:

- Finish Top-Down Design
- Form Project Groups

### Tonight:

- Rendering
- Design Analysis
  - Clearance/Interference Checking
  - Sensitivity/Feasibility/Optimization

Additional Reading For Next Time – The second half of Chapt. 4 (pg 96-112) as well as Chapt. 6, Please read Chapt. 8

### Rendering

Photo Quality Images of CAD models





http://www.ptc.com/product/creo/advanced-rendering-extension

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Blank Surface and Curve Layers

- Click Show above model tree and select
  'Layer Tree'
- Highlight the 'All Curves' and 'All Surfaces' Layers
- RMB > Hide
- RMB > Save Status





#### **Render Controls**

- One-stop shop for all things related to rendering
- View > Model Setup >
   Render Control





#### Orientation

- Save an orientation
   so the model can be
   put back in the same
   place for updates
- Use Dynamic
   Orientation
- Remember to Save with a name you'll remember





- Set Colors and Transparency
- View > Color and
   Appearance (or from tool bar)
- From the drop down, select Components
- Select Component
- Select Component and click Apply
- See Advanced tab for transparency



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Appearance Editor



#### **Room Editor**

- Set the stage create a scene for the model
- Using the Position,
  Rotate and Display
  tabs orient the model to
  the space
  - Note: 'Align against...shaded model' tool is quite helpful





- Room Editor (cont.)
- On display tab,

uncheck everything but the Floor and Wall 2



Room Editor

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### EXERCISE - Rendering

#### Room Editor (cont.)

- Click the image editor
- In the Image Editor
   open the ceramic tile and
   wood grain images
- Save each of these
   images as a PTC Color
   Texture (\*.tx3)



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#### Room Editor (cont.)

- Back to Room Editor
- Double click on the textures applied to each wall to edit
- This will launch Room
   Appearance Editor



- -

Room Editor

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## EXERCISE - Rendering

### Room Editor (cont.)

- Set up new textures for the floor and wall 2
  - Create a new appearance
  - Click the Map tab
  - Click on the Color

Texture

From the Color
 Placement dialog open the

textures just created

Assign accordingly



### EXERCISE - Rendering

#### **Render Settings**

• There are a ton of

options, for now:

- Quality to High
- Set Render
- Resolution to High
- Select 'Shadows on Floor' and 'Light Room'





#### Render

• There are a ton of

options, for now:

- Quality to High
- Set Render

Resolution to High

 Select 'Shadows on Floor' and 'Light Room'



### **Design Analysis**

#### Clearance/Interference Checking

- One of the most basic design requirements is that parts fit together
- Due to manufacturing variation, a certain amount of nominal clearance must be specified to assure that this is possible
- Pro/E has a number of ways to evaluate this (Note: None of these I would consider exceptionally good)
  - Pairs Clearance Measures clearance between features, surfaces, quilts, parts or sub-assemblies
  - Global Clearance Highlights parts and sub-assemblies not meeting a minimum clearance specification
  - Global Interference Calculates volume of interference between all parts and sub-assemblies



### **EXAMPLE** - Design Analysis

#### Pairs Clearance

- Analysis > Model > Pair Clearance
- Select feature part or sub-assembly
- Click goggles to show result
- Feature can be saved

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	Analysis F	eature	
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### **EXAMPLE** - Design Analysis

#### **Global Clearance**

- Analysis > Model > Global Clearance
- Specify minimum clearance value
- Click goggles to show result
- System specifies all parts not meeting minimum clearance
- Not smart enough to filter out assembly constraints





### **EXAMPLE** - Design Analysis

BLOCKS.AS

#### **Global Interference**

- Analysis > Model > **Global Interference**
- Specify Parts only or Sub-assembly only
- Click goggles to show result
- System calculates total interference volume
- Graphics windows highlights all interferences



### **Design Analysis**

#### Clearance/Interference Checking

Summary:

- No simple tool to ensure clearances are all correct
- Old fashion method => grab a high-lighter and mark on the prints corresponding dimensions from mating parts.

### **Design Analysis**

Sensitivity, Feasibility and Optimization Studies

- These are the basis for most quantitative design activities
  - Sensitivity Influence of a variable on design objective
  - Feasibility Given a design objective vary one or more variables to get <u>a</u> solution
  - Optimization Given a design objective vary one or more variables to get the best solution
- Above functions are described in the language of Pro/E
- These are very standard design activities that should be available in all CAD packages



### **Design Analysis**

#### Analysis Features and Relations

- Pro/E allows for calculations using part dimensions and properties
  - Parameters are set values inputted by user
  - Relations are used to define calculations
  - Analysis features can be used to update Relations as a result of a component or assembly change

• Relations can also be used to drive part dimensions, but this is not always a best practice in group work

### **EXERCISE** - Design Analysis

#### Sensitivity, Feasibility, Optimization, Analysis Features and Relations

- Using a spring model, we'll explore how to use Pro/E's Design Analysis functions
  - Sensitivity to show effect of wire dia. on rate
  - Feasibility to find design to under yield stress
  - Optimization to minimize volume





### **EXERCISE** - Design Analysis

Sensitivity, Feasibility, Optimization, Analysis Features and Relations

• BEFORE WE DO ANYTHING....we're going to set preference for the model tree

• Make sure that your config.pro points to model tree config file

• Set parameter for mdl\_tree\_cfg\_file in Options dialog



### EXERCISE - Design Analysis

#### Sensitivity, Feasibility, Optimization, Analysis Features and Relations

- Download from Supporting Materials page *spring.prt*
- Open part and take a look
  - Open ends, not ground
  - Constant pitch
  - Constant OD





### **EXERCISE** - Design Analysis

#### Sensitivity, Feasibility, Optimization, Analysis Features and Relations

- Rename dimensions
  - od for Outside Diameter
  - len for Overall Length
  - wdia for Wire Diameter
  - pitch for Pitch
- RMB on dimension
- Properties
- Dimension Text Tab
- Dimension Name
- May have to turn on Annotations to see Helical Sweep dim's







### **EXERCISE** - Design Analysis

#### Sensitivity, Feasibility, Optimization, Analysis Features and Relations

- Create an Analysis Feature
- Name feature SPR\_RATE
  - NOTE: Must hit return in dialog for changes to take effect
- Select Relation
- Click Next



### **EXERCISE** - Design Analysis

Sensitivity, Feasibility, Optimization, Analysis Features and Relations

- Relations dialog box is launched
- Expand the Local Parameters section
- Create a parameter called *shrmod* for Shear Modulus and enter a value of 11.5e6





### **EXERCISE** - Design Analysis

Sensitivity, Feasibility, Optimization, Analysis Features and Relations

- Write a relation to estimate the spring rate
  - Number of coils N=L/p
  - Spring rate k=Gd<sup>4</sup>/8D<sup>3</sup>N
  - USE DIMENSION NAMES FOR VARIABLES
- Select Execute/Verify icon
- Ans: k=4.24
- Click OK
- Click Check





## EXERCISE - Design Analysis

#### Sensitivity, Feasibility, Optimization, Analysis Features and Relations

- Add the result to the model tree
  - From the model tree, click Settings > Tree Columns
  - From Type select Feat Params
  - Type sprt in Name and press Enter
  - Click OK
  - Notice the 4.24lb/in is listed in the model tree
- Save Tree settings in startup directory



### **EXERCISE** - Design Analysis

Sensitivity, Feasibility, Optimization, Analysis Features and Relations

- Perform a Sensitivity Analysis
  - Evaluate the effect of wire diameter on stiffness
  - Analysis > Sensitivity
     Analysis



### **EXERCISE** - Design Analysis

Sensitivity, Feasibility, Optimization, Analysis Features and Relations

- Click Dimension
- 2 Select the wire diameter of the spring
- Specify range as .025 to .040
- 4 Click the select button in Parameters to Plot
- **5** Select SPRT:SPR\_RATE for the spring rate
- 6 Click OK
- 7 Click Compute



### EXERCISE - Design Analysis

Sensitivity, Feasibility, Optimization, Analysis Features and Relations

- Take a look at the plotted results
- Sensitivity Analysis illustrates the influence a particular variable has on design objective



### **EXERCISE** - Design Analysis

#### Sensitivity, Feasibility, Optimization, Analysis Features and Relations

- Modify the Analysis Feature
  - RMB on Analysis feature in model tree
  - Edit Definition
  - Next in the ANALYSIS dialog
- Write an expression to determine the load at a deflection of .200in
  - Call the variable inld
  - P<sub>i</sub>=kδ





### EXERCISE - Design Analysis

#### Sensitivity, Feasibility, Optimization, Analysis Features and Relations

 Add this result to the model tree as was done prior



### EXERCISE - Design Analysis

#### Sensitivity, Feasibility, Optimization, Analysis Features and Relations

#### • Perform a Feasibility Analysis

- Have Pro/E find the correct wire diameter to have a 1lbf installed load (at .200in deflection)
- Analysis >
   Feasibility/Optimization...



### **EXERCISE** - Design Analysis

Sensitivity, Feasibility, Optimization, Analysis Features and Relations

- Click Feasibility
- 2 Click Add... in Design Constraints
- In Design Constraint dialog change Parameter to INLD:SPR\_RATE
- Check Set radio button
- 5 Click OK
- 6 Click Cancel



Optimization/Feasibility

File Run Options

Study Type/Name

Design Constraints Parameter

Op | Value

Optimization

Goal None



Delete

1 💿 Feasibility

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### EXERCISE - Design Analysis

Sensitivity, Feasibility, Optimization, Analysis Features and Relations

- Change Value to 1.0
- 2 Click Add Dimension... in Design Variables
- Select the wire diameter dimension
- Graphics Window
   Click OK

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### EXERCISE - Design Analysis

#### Sensitivity, Feasibility, Optimization, Analysis Features and Relations

- Change the range to .025in minimum and .045in maximum
- Click Compute

Optimization/Feasi	ibilit <b>y</b>			
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### EXERCISE - Design Analysis

#### Sensitivity, Feasibility, Optimization, Analysis Features and Relations





### **EXERCISE** - Design Analysis

#### Sensitivity, Feasibility, Optimization, Analysis Features and Relations

Optimization/Feasibility Click Close on the dialog File Run Options 🗋 📂 ~~ box Study Type/Name Optimization Feasibility A message stating the Name FEAS1 model has changed pops up Goal SHRMOD:SPR\_RATE None Confirm to accept the Design Constraints Parameter Оp Value changes INLD:SPR\_RATE 1.000000 🔳 Confirm Model Change The model has changed as the result of Optimization. Press Confirm to keep the changes or press Undo to restore the original model or press Cancel to return to Design Study. Delete Add... Confirm Undo Cancel Design Variables Variable Min Max wdia:SPRING 0.025000 0.045000 Add Dimension... Add Parameter. Delete Compute Undo Close

### **EXERCISE** - Design Analysis

#### Sensitivity, Feasibility, Optimization, Analysis Features and Relations

• Regenerate the window and notice that the installed load in the model tree is now .997lbf

