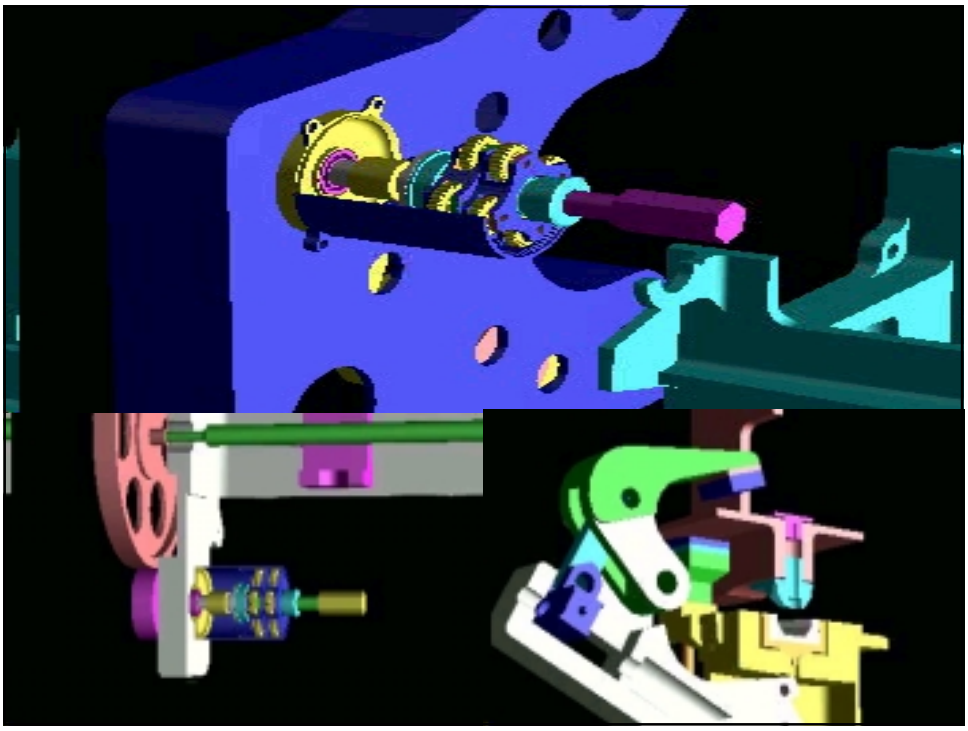

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# Space Station Mechanism Modeling

Presented by:

Tom Peurach
Mechanical Dynamics

In cooperation with:

Jan Favero
and Barry Frazier
The Boeing Company

Mechanical Dynamics
Design Technologies Division

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# Agenda

- Detailed discussion of UG/Mech models
  - Umbilical Mechanism Assembly (UMA)
  - Load Transfer Unit (LTU)
- Overview of mechanisms modeled using ADAMS


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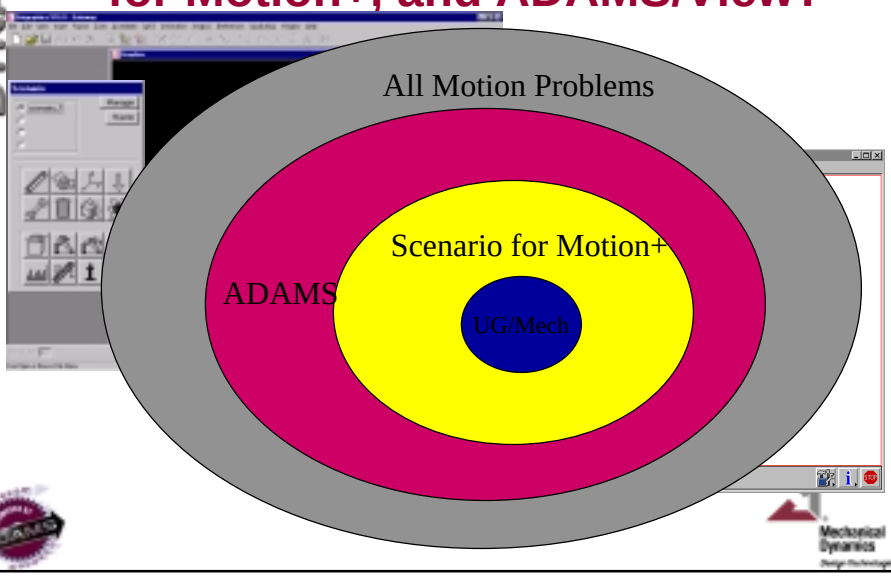
# What are UG/Mechanisms, Scenario for Motion+, and ADAMS/View?



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# Boeing and the Space Station Program

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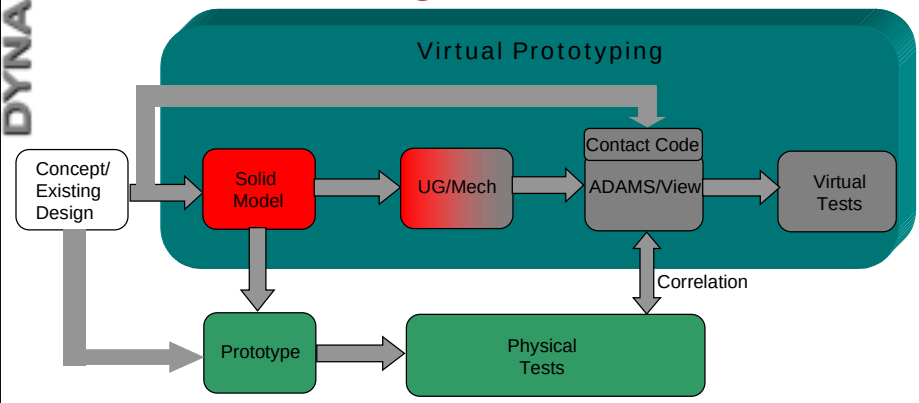
# Design Process

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# Why we Used UG/Mechanisms and ADAMS

- Communicate designs
- Replace physical tests
- Execute virtual tests that are very difficult to test physically
- UG/Mechanisms
  - Build Mechanism Models from CAD Geometry
  - Animations

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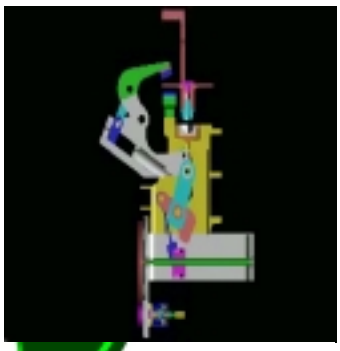
# Case Study: Boeing, Latch Design

- Problem: Valid on-orbit performance of a space station latching mechanism.
- Design Issues
  - Zero Gravity
  - Limited weight
  - Servicing is very difficult
  - Lubrication



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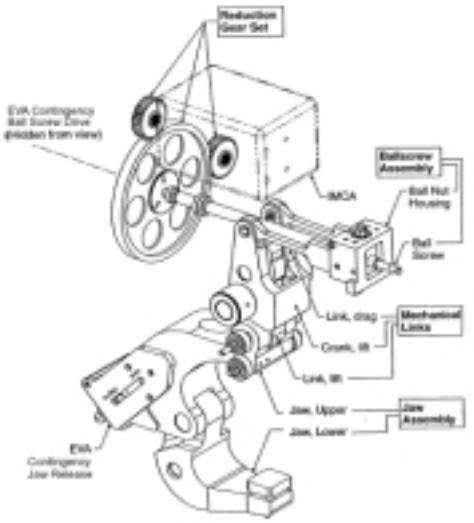
# Mechanism Anatomy

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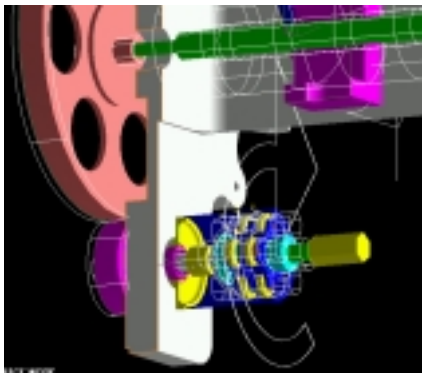
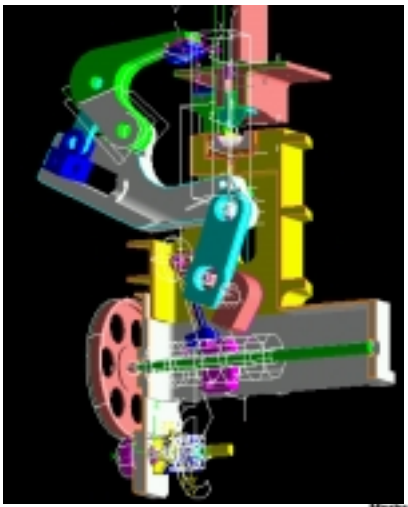
# The Mechanism Anatomy





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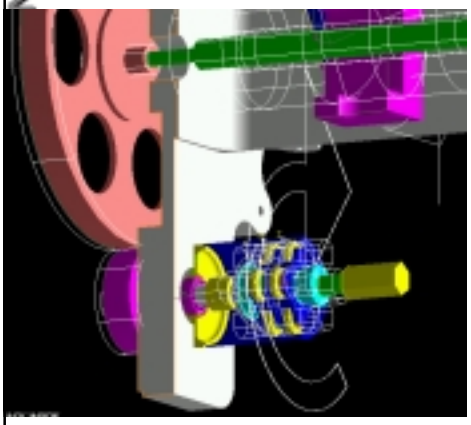
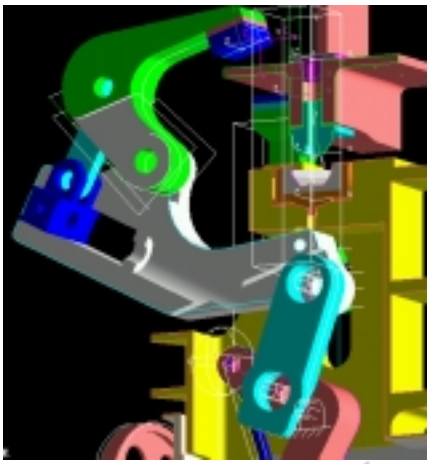
## The Mechanism Anatomy





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## Actual Mechanism

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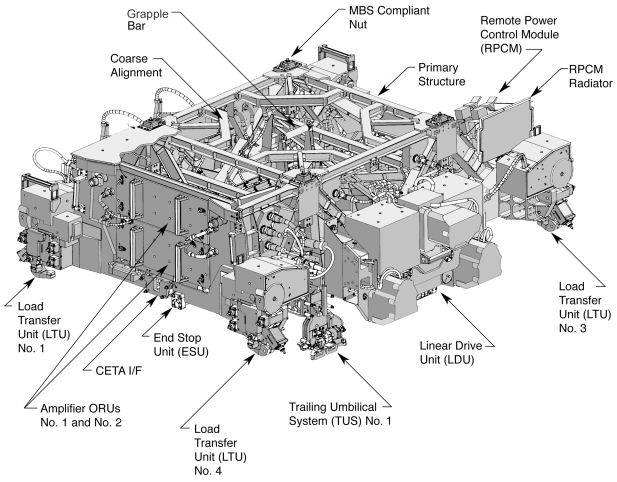
# Mobile Transporter View 1 Manufactured by TRW-Astro

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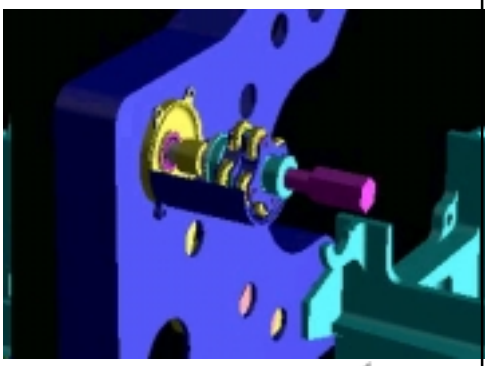
# Case Study: Boeing, Motorized Plug

- Problem: Valid on-orbit performance of a space station motorized plug.
- Design Issues
  - Zero Gravity
  - Limited weight
  - Servicing is very difficult
  - Lubrication



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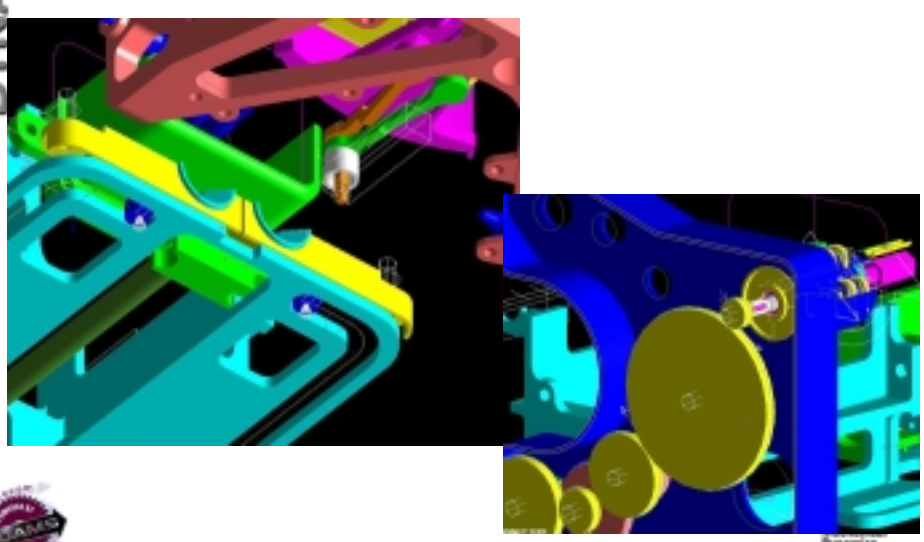
# The Mechanism Anatomy



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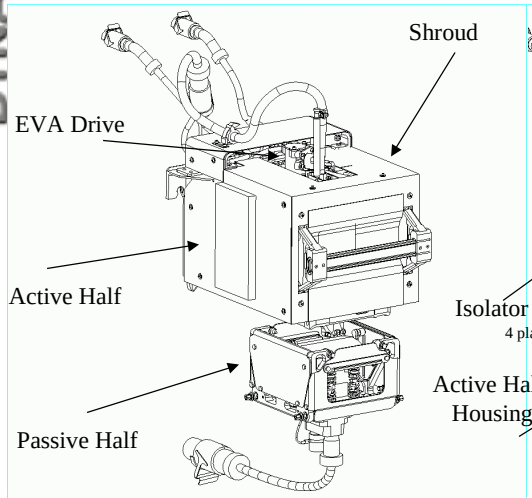
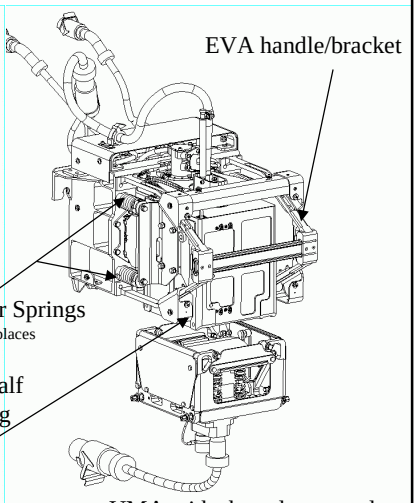
# UMA Active and Passive Halves




UMA in launch configuration




UMA with shroud removed

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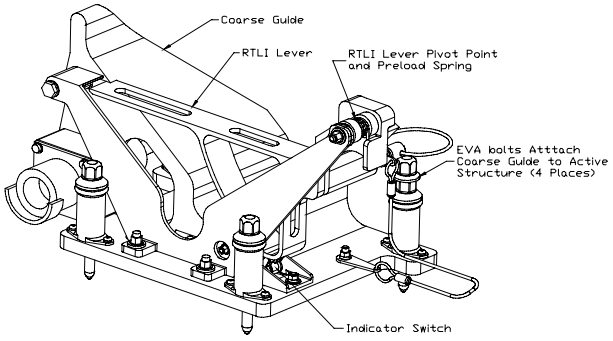
# MTSAS Alignment Guide

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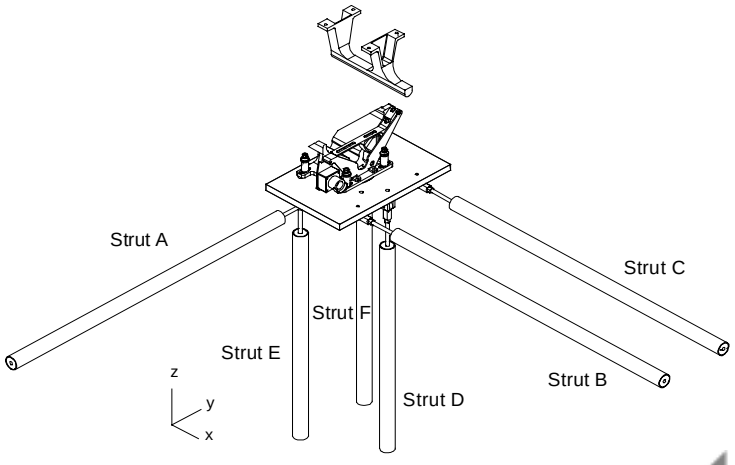
# MTSAS Alignment Guide Test Fixture

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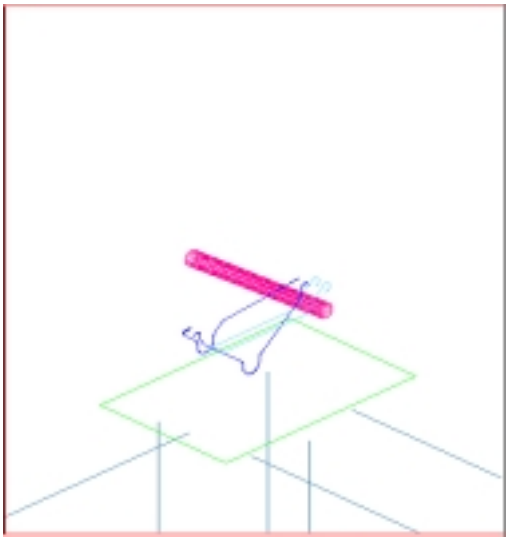
# Alignment Guide Test Fixture Simulation



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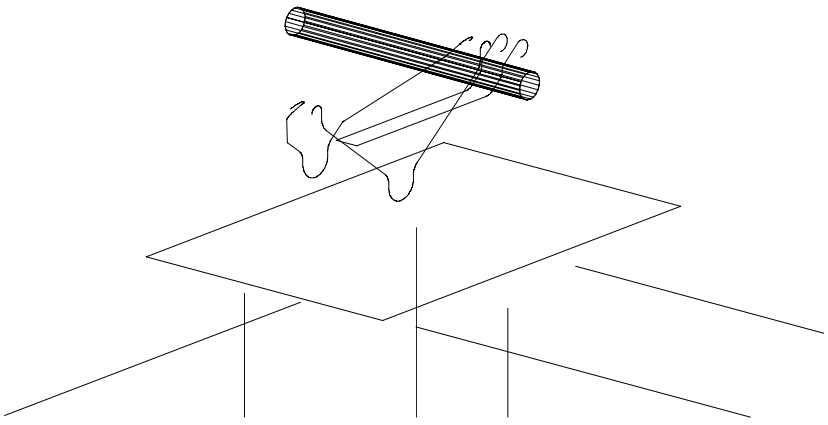
# MTSAS Alignment Guide Model



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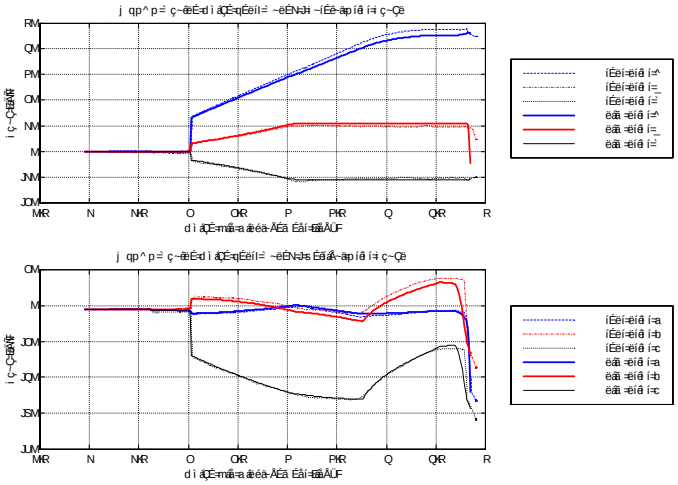
# MTSAS Alignment Guide
# Test & Analysis Correlation





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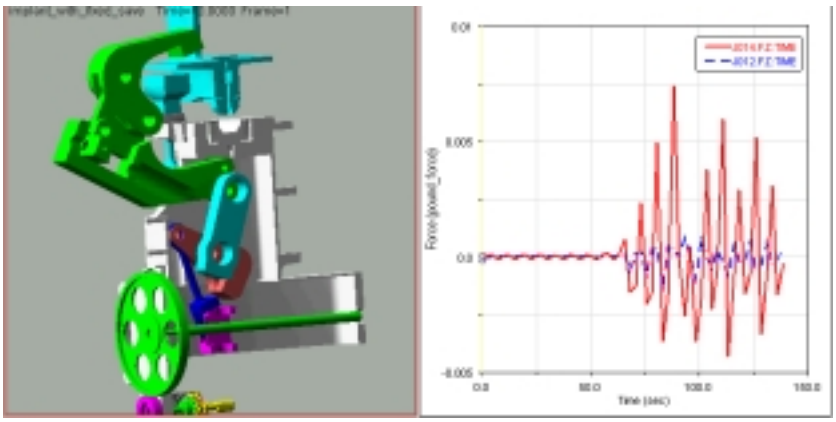
# Using Scenario For Motion+



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# Benefits of Virtual Prototyping at Boeing

- Identified design issues before physical prototypes.
- Built a reliable product
- Decreased dependence on hardware prototypes
- Helped meet time requirements
- Enhanced communications


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# Lessons Learned

- UG/Mech model development is much quicker than ADAMS by itself.
- Contact modeling is still a significant problem.
- Scenario for Motion+ contacts may help.
- Flexibility is important.
- Friction…!
- Parametric studies are valuable.
- Parametric solids help in analysis model preparation
- The design and analysis community understanding each others needs helps
- Integrated CAD / CAE tools make it possible for analysis to stay in sync with the design cycle
- Easy to use CAD / CAE tools make it possible for the designer to do preliminary analysis
- Integrated CAD / CAE post-processing tools help with understanding the design


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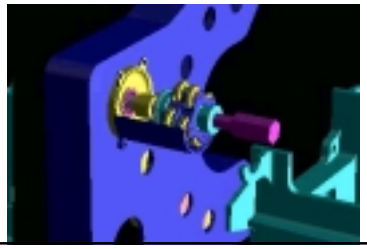
# Conclusions

- UG/Mech only used for pre/post processing
- Modeling drives a detailed understanding of mechanism characteristics
- DOE and parametric studies provide insight over possible operating range
- Approach helps define derived requirements
- Correlation to test data validates modeling effort



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