



# Engineering in Motion: Modeling of Moving Mechanisms in Simcenter 3D Motion


**Host:** Scott Thibault, ATA Engineering

**Speaker:** Trey Rottinghaus, Siemens


**Panelist:** Chris Paulson, Siemens

**Date:** March 9, 2022

 (858) 480-2000

 ata-engineering

 [www.ata-e.com](http://www.ata-e.com)

 @ATAEngineering

# Who Are ATA Engineering?

We are an **employee-owned** small business with a **full-time staff of around 180**, more than 130 of whom are degreed engineers



28  
Ph.D.

70  
M.S.

27  
B.S.

14

Registered  
Professional Engineers

15

Average years of  
experience

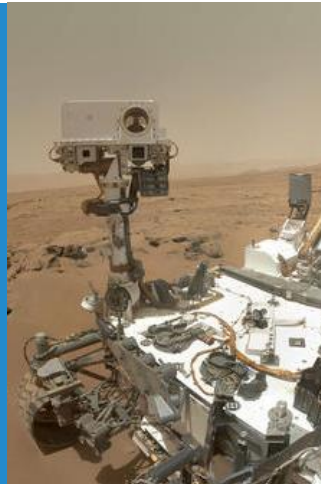


# Our Industries:

ATA Engineering's **high-value engineering services** help solve the most challenging product design challenges



Aerospace



Robotics  
& Controls



Themed  
Entertainment



Defense



Industrial &  
Mining  
Equipment

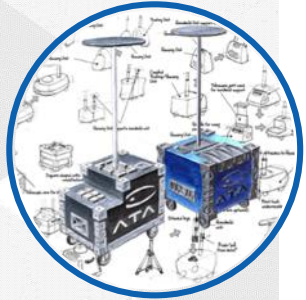


Consumer  
Products



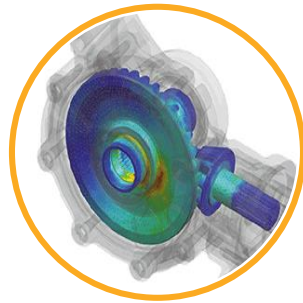
# Our Services

We provide our customers with **complete, integrated solutions**



## Design

From initial concept development to detailed structural design



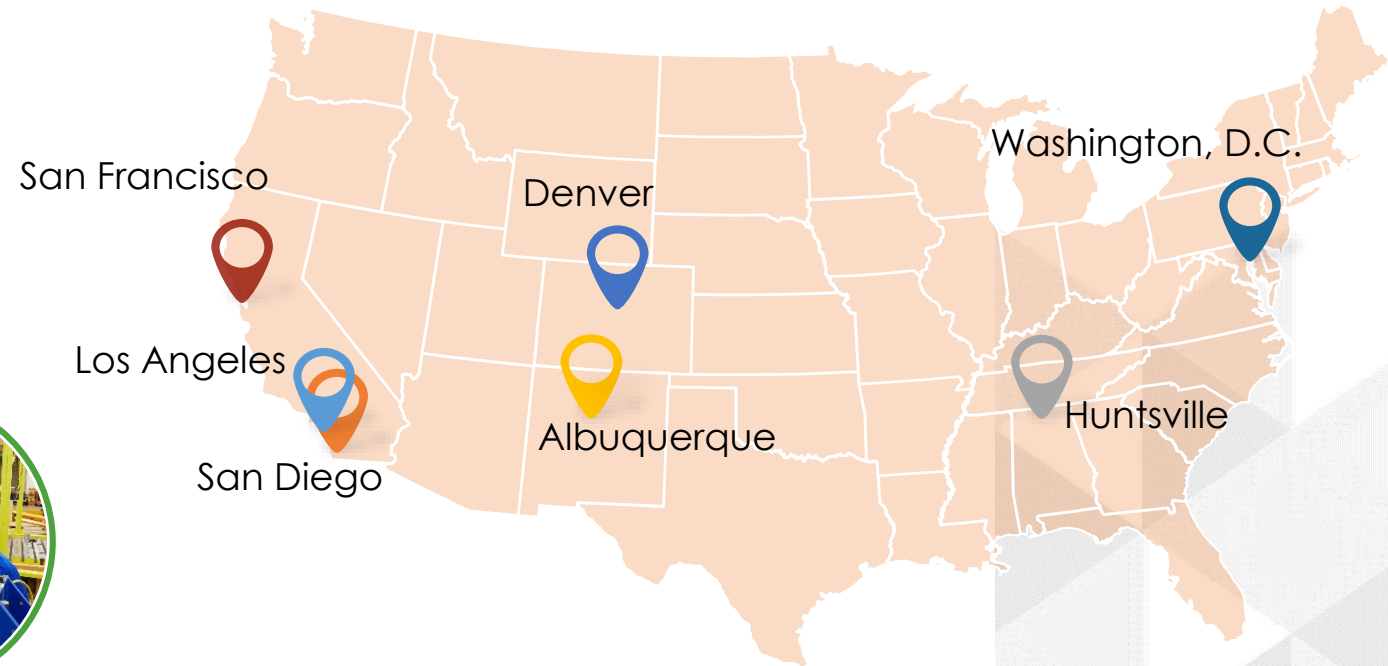
## Analysis

Comprehensive structural, fluid, acoustic, and thermal analysis services

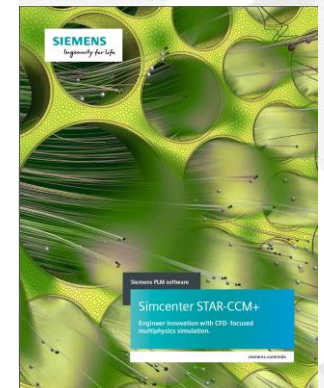


## Test

Industry-leading structural test services for extreme loading environments



ATA Engineering is also a **Siemens Platinum Level Value Added Reseller.**



# Our Software Services

ATA is a Platinum-Level Solution Partner for Siemens Digital Industries Software

<https://www.ata-e.com/software/>

Siemens Value Added Reseller

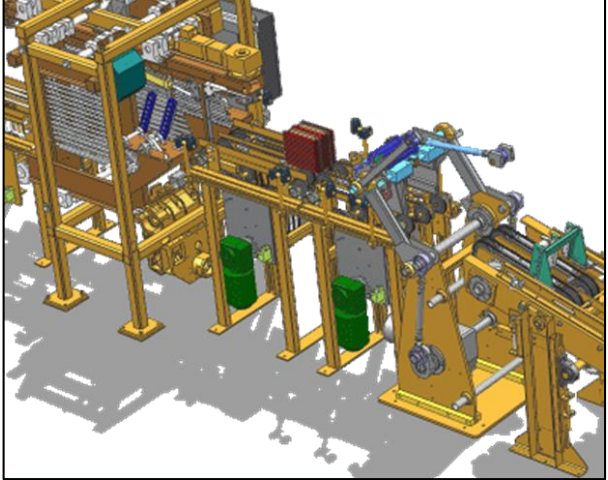
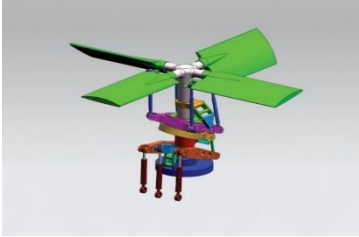
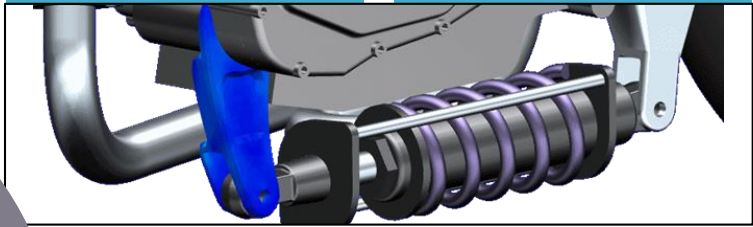
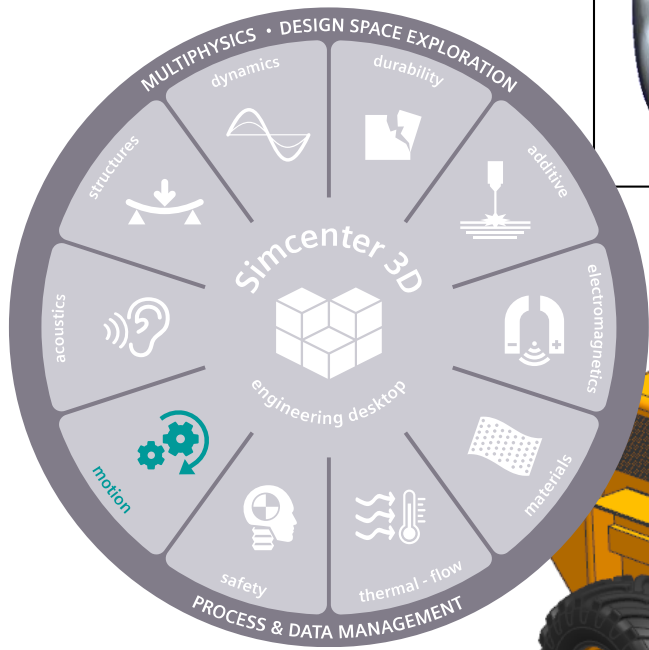




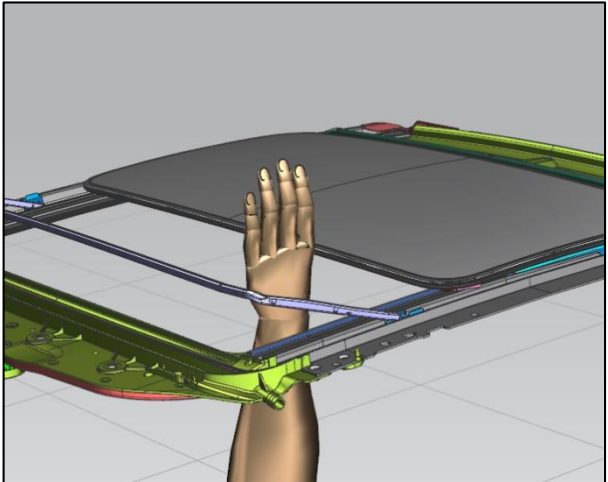
# Simcenter 3D Motion

# Siemens PLM Software Solutions

## Simcenter 3D Motion for Multi-Body Dynamics



- Rigid bodies
- Flexible bodies
- Tire models
- Co-simulation with controls
- Interference checking



# Simcenter 3D Motion

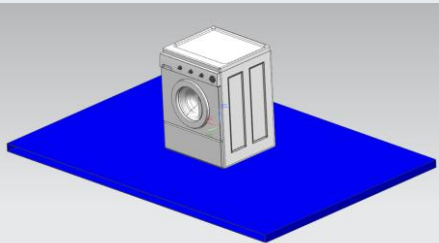
## Multi-body Dynamics workflow

### Simcenter 3D Motion - A complete and integrated Multi-Body Simulation solution

- ✓ Frontload the performance engineering process
- ✓ Accurate and efficient physics-based simulation
- ✓ Process solution: design-simulate-optimize

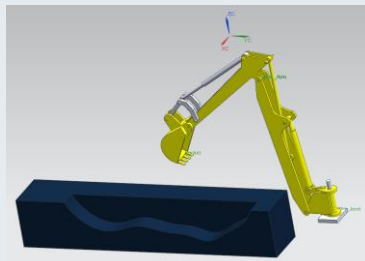
#### CAD

Integrated with CAD:-  
Multi-CAD geometry support  
Synchronous Technology



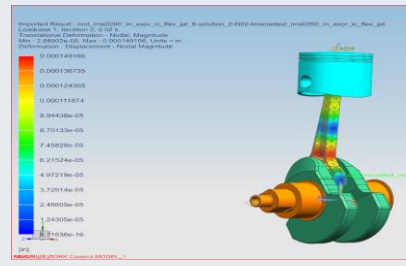
#### Kinematics & Dynamics

Accurately predict a mechanism's performance



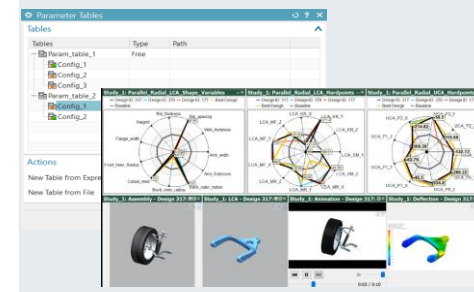
#### Component Flexibility

Flexible modes from Simulation or Test



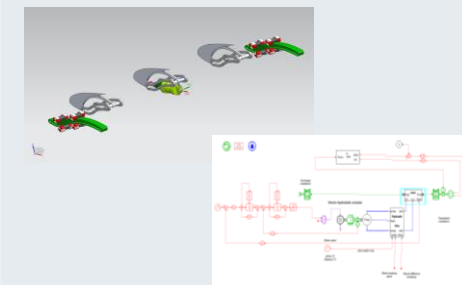
#### Automation, Customization & Optimization

Parameters e.g. by **Excel Customization** and **Scripting** capabilities  
Design Space Exploration



#### Mechatronics MiL/SiL/HiL

Link to **Imagine.Lab Amesim**,  
Matlab/Simulink, Generic cosim (including FMI)





# Simcenter 3D Motion Technical Capabilities

## CAD integration – Create, Import and Edit geometry

### NX CAD integration

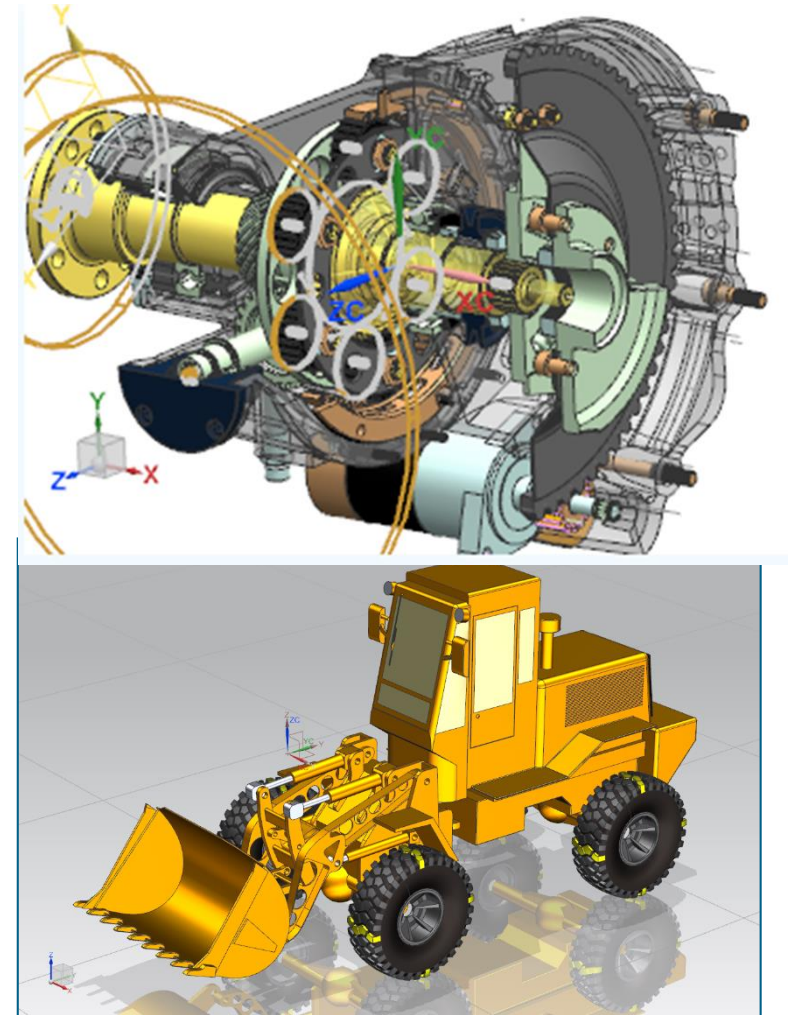
- Quickly convert CAD assembly to a functional motion model.
- Assembly constraints converted to Motion joints, 3D contacts between bodies.
- Stay associative to design.

### CAD Import

- Support for all major CAD formats (NX CAD, Catia, Solid Edge, Solid Works, JT, Parasolid, STEP, IGES, ACIS, AutoCAD).

### CAD Editing

- Synchronous Technology.

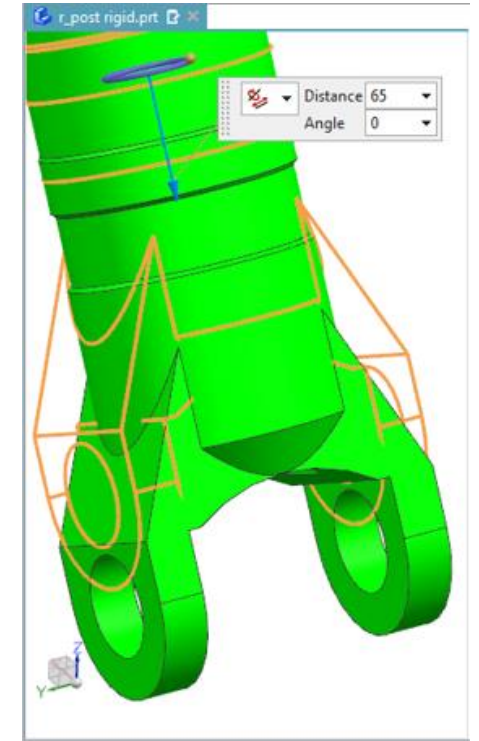
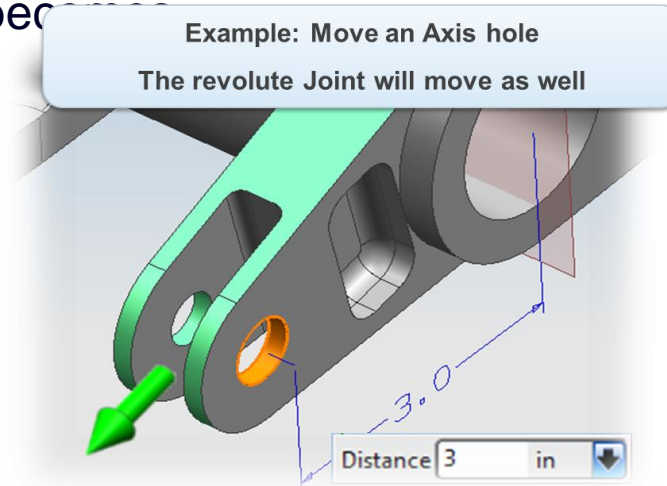
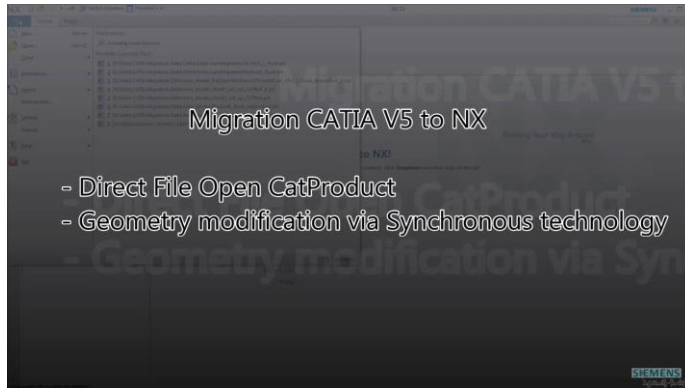


Leverage native CAD from any CAD system for motion analysis

# Simcenter 3D Motion Technical Capabilities

## CAD integration – Synchronous Modeling

- Modify any part quickly and easily – even if you don't know how it was originally created.
- Intuitively edit geometry directly and on-the-fly, independent of part feature history.
- 
- Imported, “dumb” geometry from multi-CAD sources becomes alive.



**Geometry modification and parameterization without need for CAD data and history**

# Simcenter 3D Motion

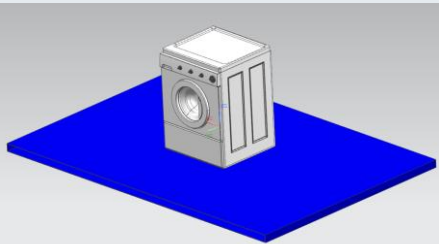
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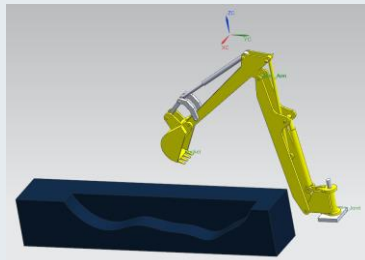
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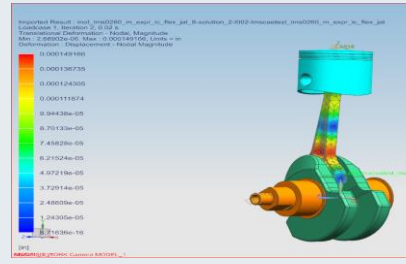
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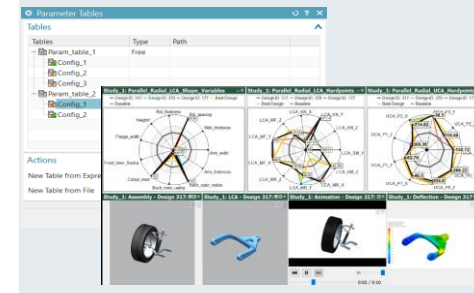
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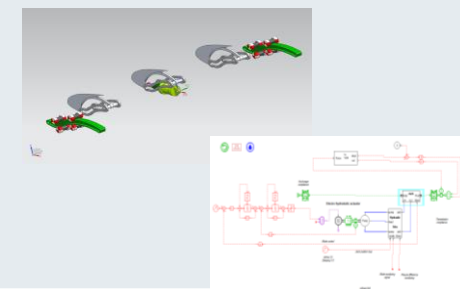
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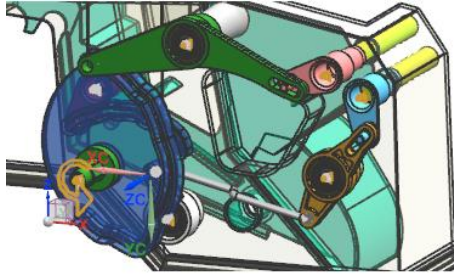
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Link to **Imagine.Lab**  
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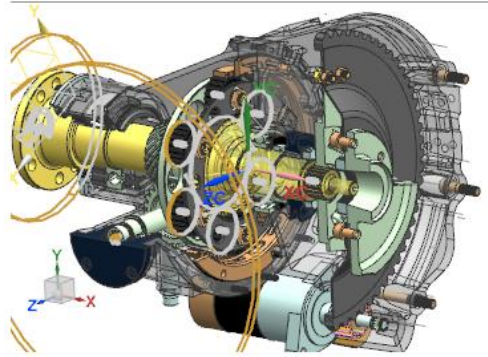
# Kinematics, Dynamics and Stress/Strain

## Important design parameters



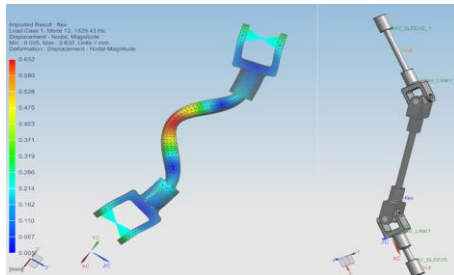
### Kinematics

- Visualization of a mechanism's motion
- Check to determine if parts interfere during operation
- Ensure that velocities and accelerations remain within design limits



### Dynamics

- Determination of forces/moments for further analyses
- Ensure forces and moments remain within design limits
- Simulate controls (mechatronics, hydraulics) in the system



### Stress/Strain on flexible bodies

- Visualization of stress concentrations during mechanism operation
- Ensure components do not suffer fatigue failures
- Ensure mechanism generates acceptable vibrations and noise

# Simcenter 3D Motion

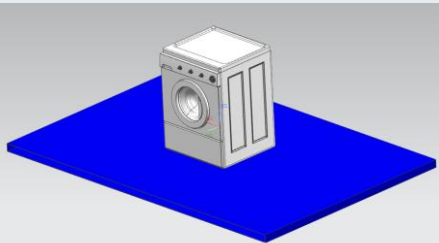
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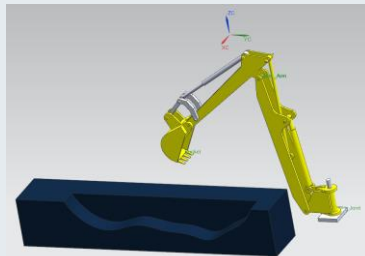
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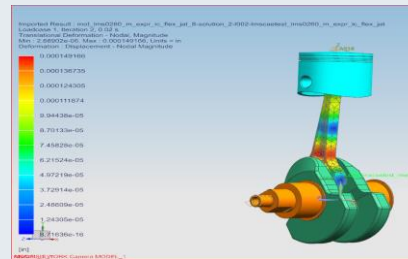
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Accurately predict a  
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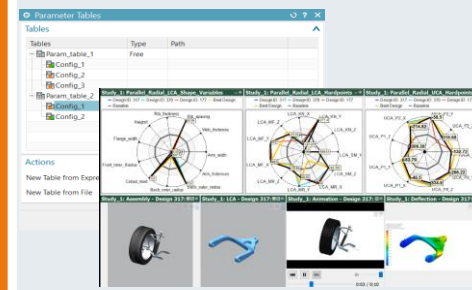
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Flexible modes from  
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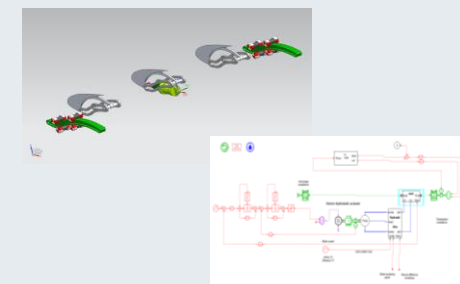
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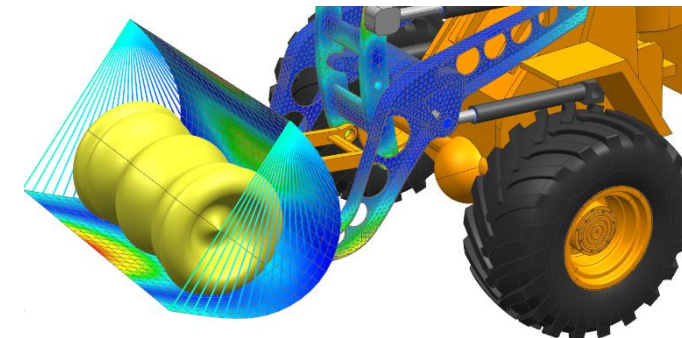
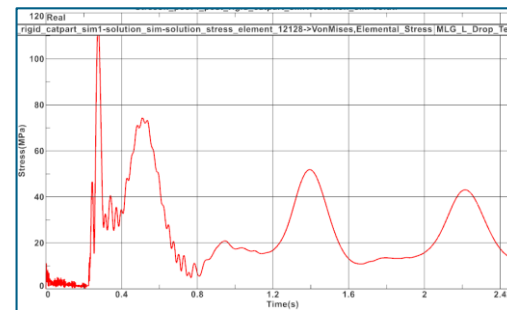
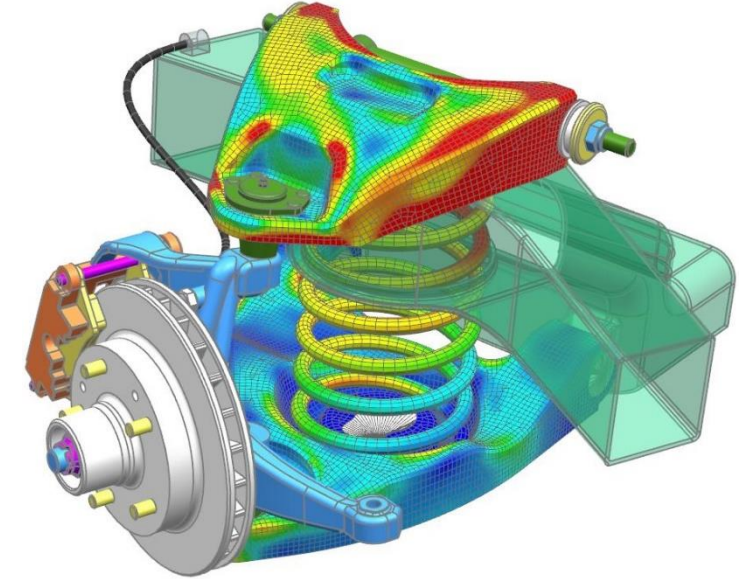
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# Simcenter 3D Motion Technical Capabilities

## Flexible Bodies - Finite Element data in MBS analyses

- Accurate prediction of static and/or dynamic **deformation of components** in a mechanism
  - **time plots** of results at nodes and elements
  - **animations** of the full mechanism, with actual deformation of flexible components for reliable clearance analyses
- **Fully integrated in Simcenter 3D CAD / FE** modeling and simulation platform
  - FE mesh **associativity with CAD** geometry
  - Supporting both **native and 3rd party FE solvers**:  
Simcenter / MSC Nastran, ANSYS, Abaqus
  - Seamless reuse of Motion results for further analyses:  
**Structural, NVH & Acoustics, Durability**



# Simcenter 3D Motion

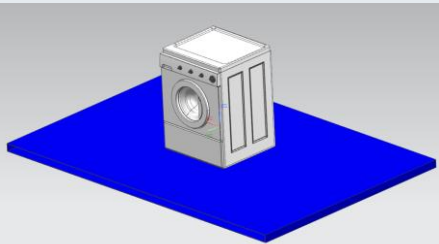
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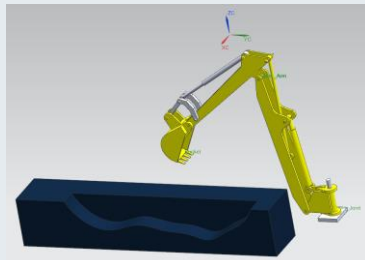
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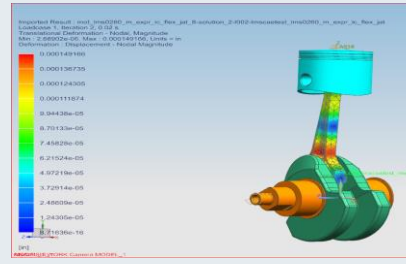
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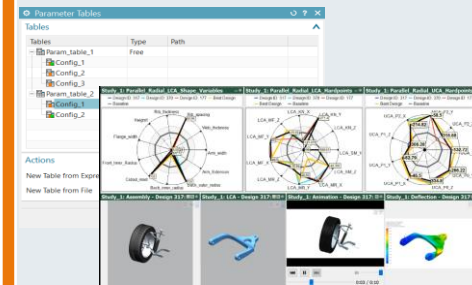
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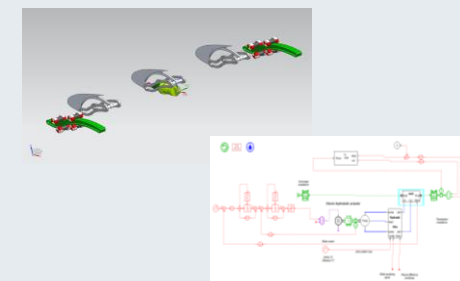
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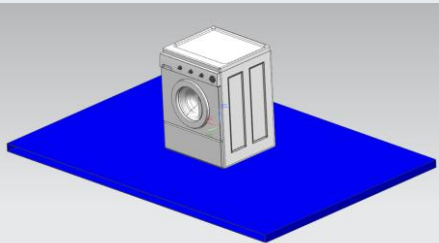
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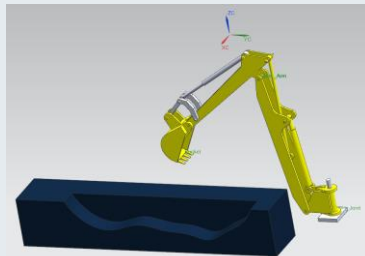
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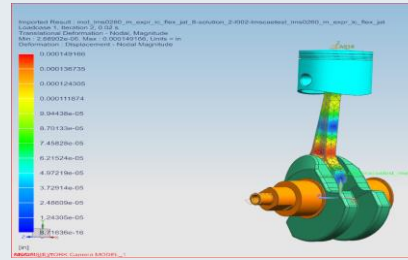
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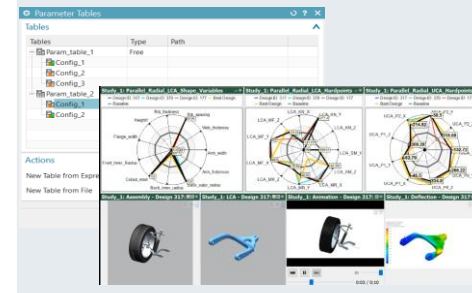
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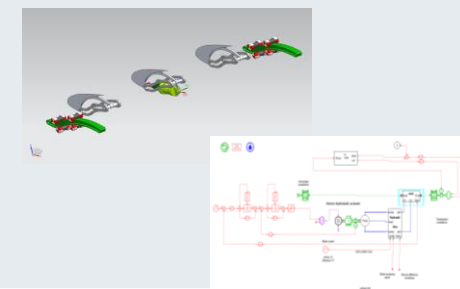
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# Simcenter 3D Motion Technical Capabilities

## Mechatronics - Dynamic simulation of mechatronic systems

Growing complexity of systems requires engineers to validate complete mechatronics system behavior as early as possible in the development cycle

Typical applications:

- Vehicle dynamics: ESP, ABS, Active/Semi-active suspensions, HPAS,..
- Powertrain: EV, ICE,...
- Aerospace: LG Shock Absorber, High Lift Mechanisms,...
- ...

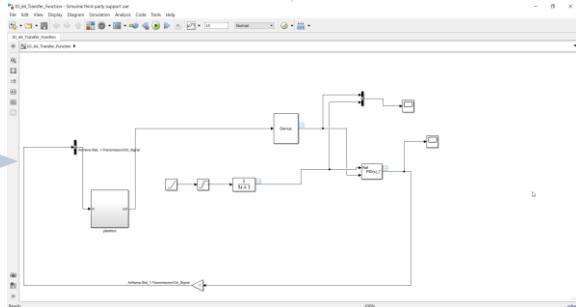
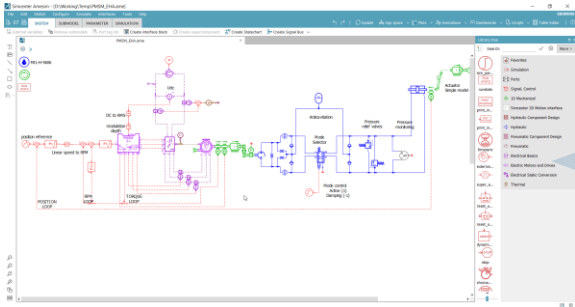
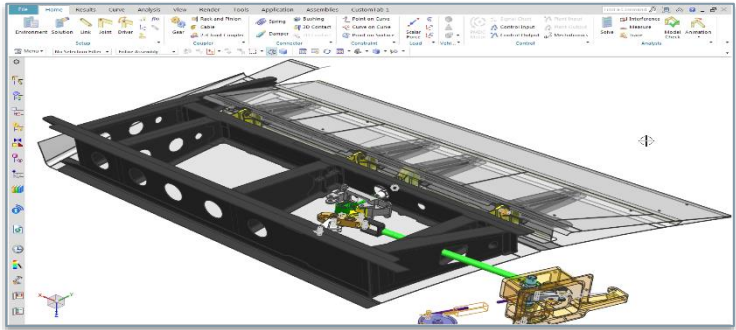
Simcenter 3D Motion Systems and Controls allows for integration with best-in-class modeling and simulation tools for more **robust design of complex nonlinear multi-physics systems**: control systems, sensors, electro-hydraulic actuators



# Simcenter 3D Motion Technical Capabilities

## Mechatronics - Systems and Controls

Simcenter 3D Motion Systems and Controls allows for integration with best-in-class modeling and simulation tools for more **robust design of complex nonlinear multi-physics systems**: control systems, sensors, electro-hydraulic actuators



# Simcenter 3D Motion

## Development of Mars Rover at JPL

### Business challenges

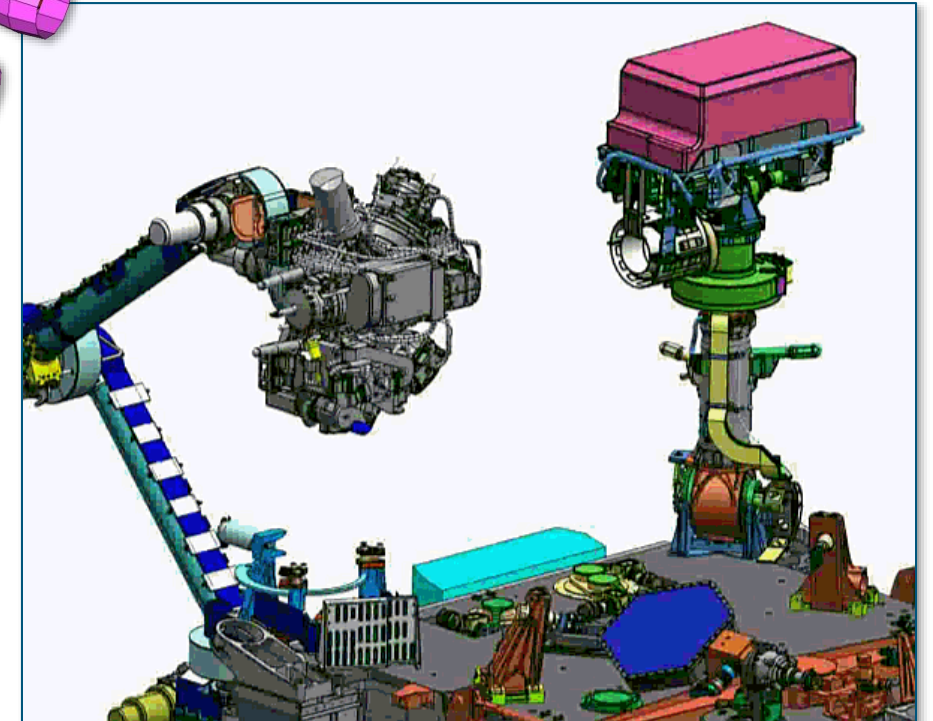
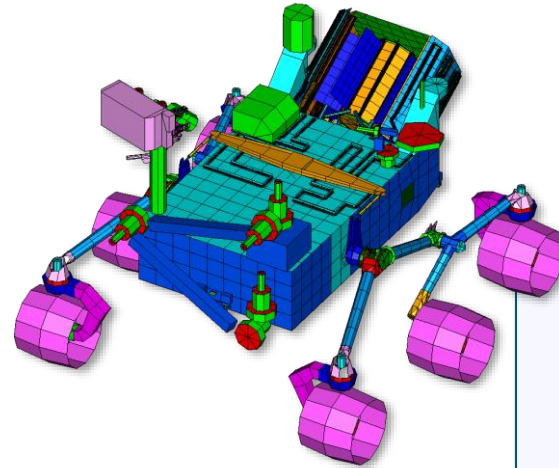
- Tighter schedules
- More moving parts

### Keys to success

- Single software platform (NX) from design through manufacturing
- Digital assembly model of entire Mars Science Laboratory
- Multi-discipline simulation with NX CAE software

### Results

- **Faster** design-analysis-redesign iterations
- **Less** manual work and less rework, **increased** efficiency
- **More** confidence in the hardware modeling, the design implementation, and mission simulations



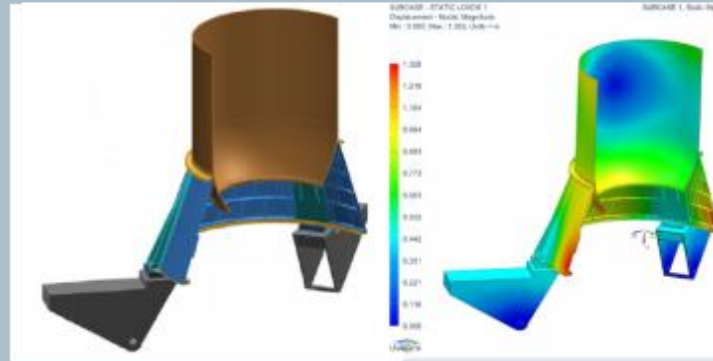
# Orbital ATK

## Enhance performance of NASA's next-generation launch vehicle

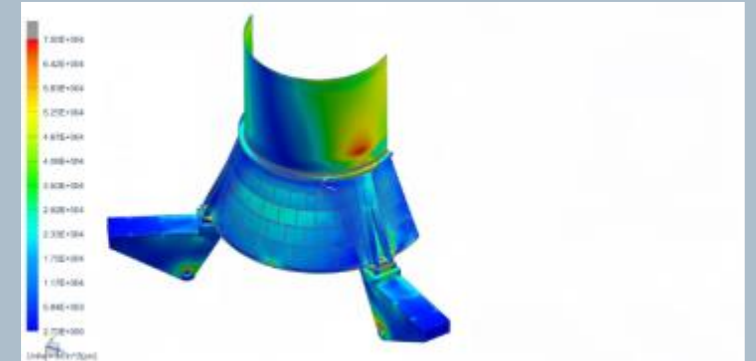


- Faster creation of analysis models
- Analysis plays a greater role in the design process
- Higher confidence in accuracy of analysis models

### Redesigning launch-pad structures for adequate clearance



SLS's solid rocket booster structure



FEA Analysis on rocket structure

- Integrating CAD and CAE
- No data translation

“The main intent was to use Simcenter 3D Motion to capture the timing sequence of the rocket taking off and the retractable launch mounts moving back ”

Ramesh Krishnan  
Senior Staff Engineer, Engineering Processes and Tools Group

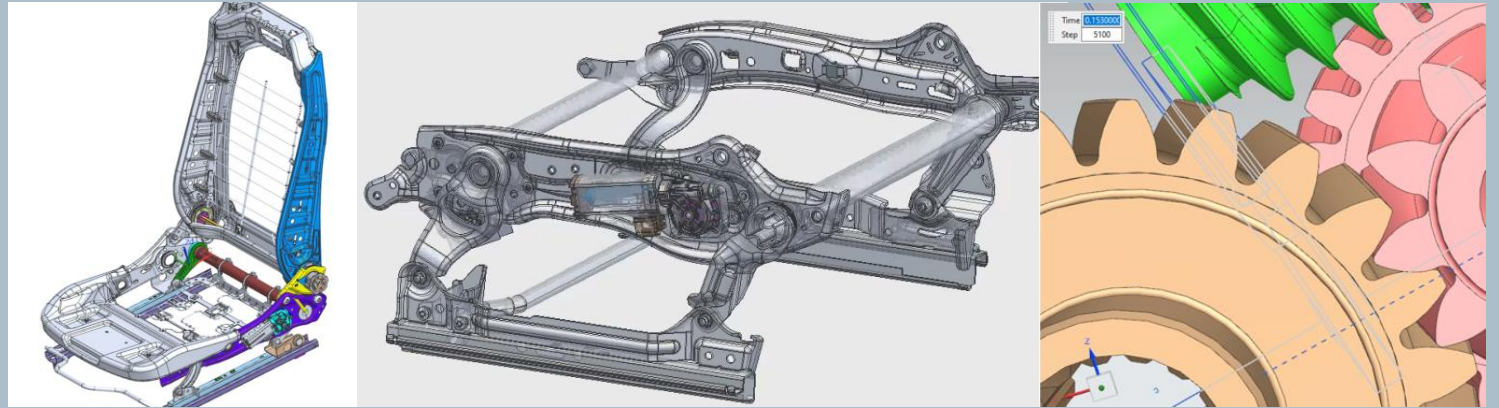
# Faurecia

## Accurately calculate mechanical behavior of seats for Cockpit of the Future



- **Simulation process time reduced by 90% thanks to Automation**
- **Accurately calculated mechanical behavior of seats mechanisms**
- **Reduced time to develop seat model by 75%**

### Faurecia integrates motion, vibration and acoustics simulation for Cockpit of the Future



#### Associativity with CAD data

- Use Simcenter 3D Motion for mechanisms simulation
- Leverage geometry parameterization to quickly run multiple simulations
- Collaborate with Simcenter 3D customer support, including dedicated Simcenter 3D support engineer

#### Performance prediction and quick optimization

**“Our goal is to expand the use of Simcenter 3D at Faurecia targeting systematic use of functional simulation in the design process for any new products, such as recliner, tracks etc.”**

Mohamed Ben-Tkaya, Functional Simulation Expert at Faurecia

# Simcenter 3D Motion Summary

## “Best in Class” Solver

- Support critical engineering decisions
- Increase productivity

## Industry standard Tire & Roads formats

- Virtual assessment of tire forces in full system analyses

## Mechatronic Systems

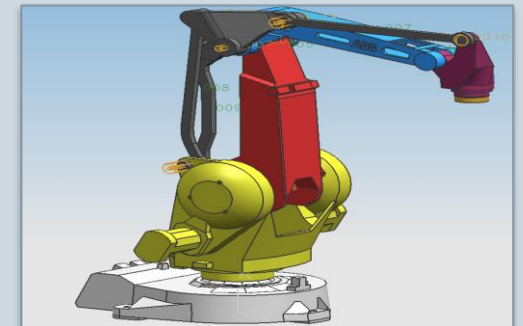
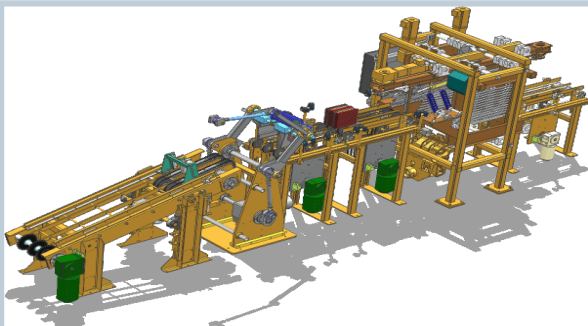
- more robust design of complex multi-physics systems:

## Flexible Bodies

- More accurate prediction
- Gain insight in the **frequency response** of a mechanism

## Fully CAD – associative

Natively integrated in NX -- interfaces to common CAD packages available



For More Information, Contact:



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Manager, Business Development

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Phone: (256) 850-3856  
Mobile: (802) 296-1617

E-mail: [scott.thibault@ata-e.com](mailto:scott.thibault@ata-e.com)

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