DRD TECHNOLOGY

DRD Webinar: Transforming Multibody Dynamics Analysis with Physics-Based Simulation

Alex Austin – DRD's Structures Team Lead

Kolton Landreth – T.D. Williamson's Manager of New Product Development

11 March 2025

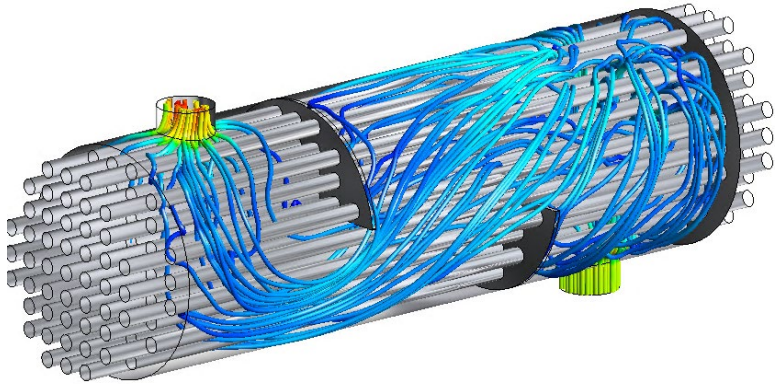
DRD

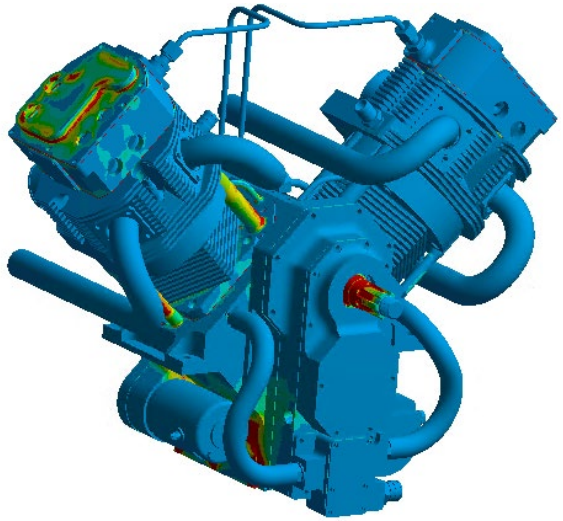
Agenda

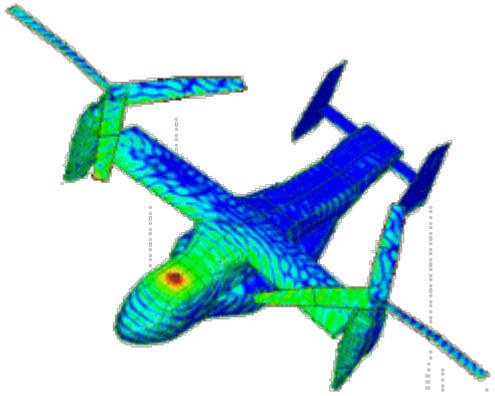
- Dynamics Simulation in Ansys
- What is **M**ulti-**B**ody **D**ynamics (MBD) Simulation?
- Strengths of Ansys Motion
- Ansys Motion Products
- Ansys Motion Capabilities
- Introducing… Kolten Landreth of TDW

Mission Statement

DRD Technology helps engineering teams accelerate product development. With in-house expertise spanning the entire range of physics, we ensure customers succeed when using Ansys simulation tools for virtual prototyping and design verification.







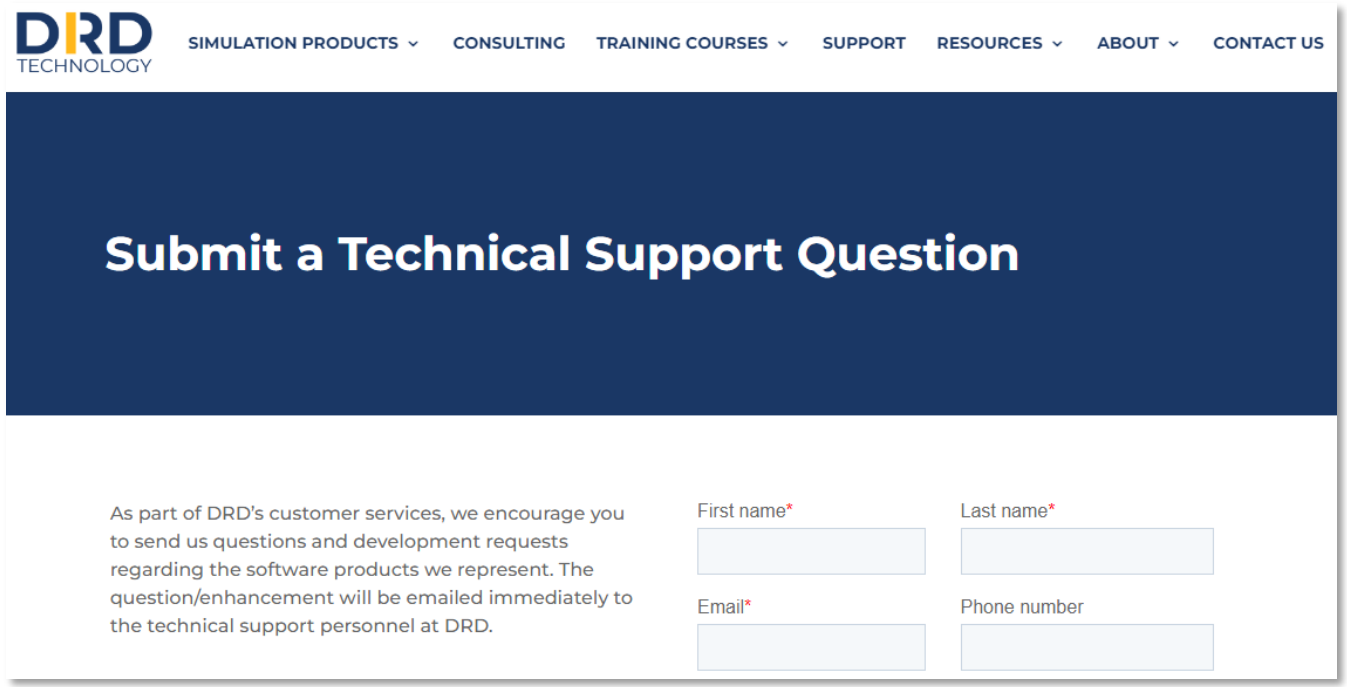
Ansys

CERTIFIED ELITE CHANNEL PARTNER

Technical Support Contact Coordinates

Support:
(918) 743-3013 x1
support@drd.com

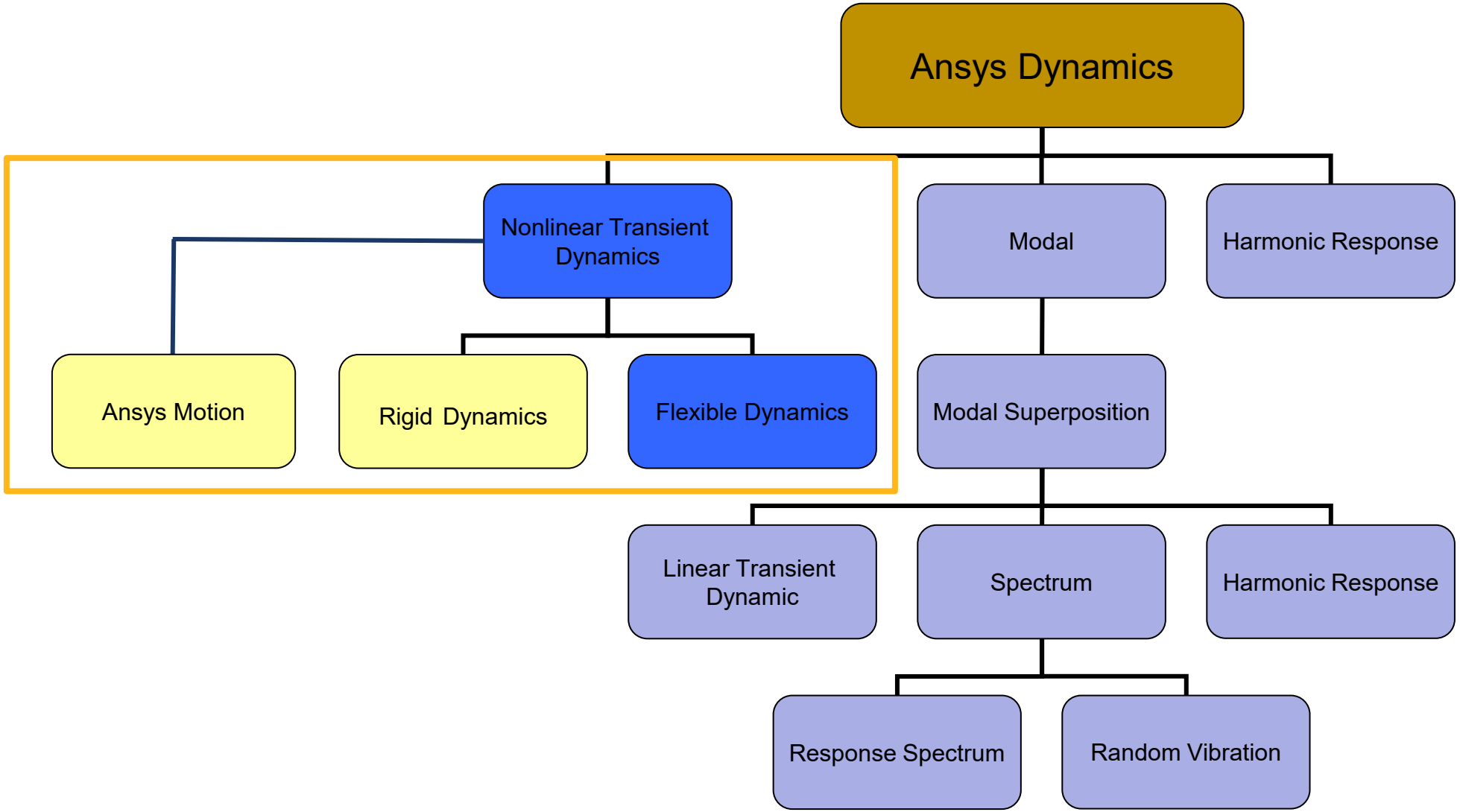
Or through our website at
www.drd.com



For more than five years, I have worked closely with DRD Technology to execute tactical and strategic initiatives here at EaglePicher due to our unprecedented growth. We've been very happy with DRD and will continue to work with them as our business partner for using Ansys tools effectively and efficiently.

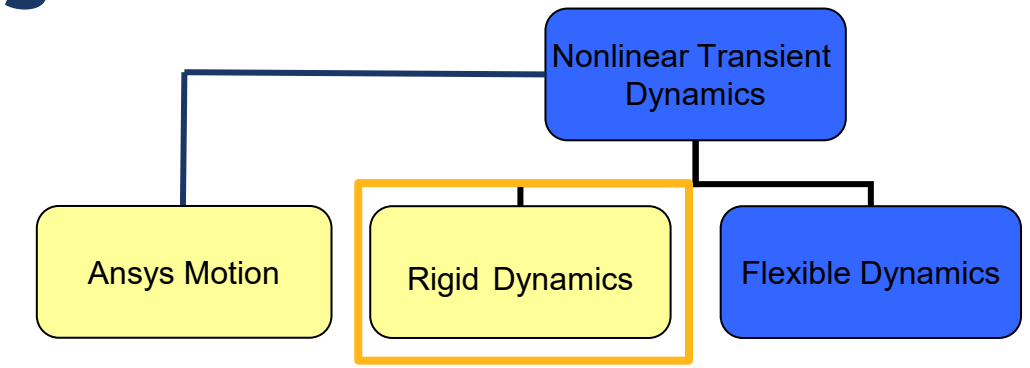
- Doug Austin
Director of Research and Development
EaglePicher™ Technologies, LLC

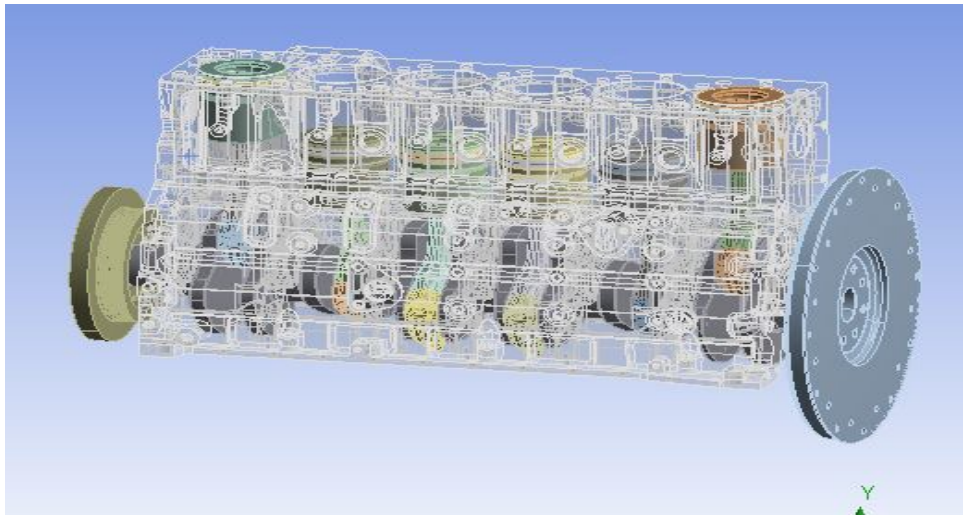
Dynamics Simulation in Ansys



Dynamics Simulation in Ansys

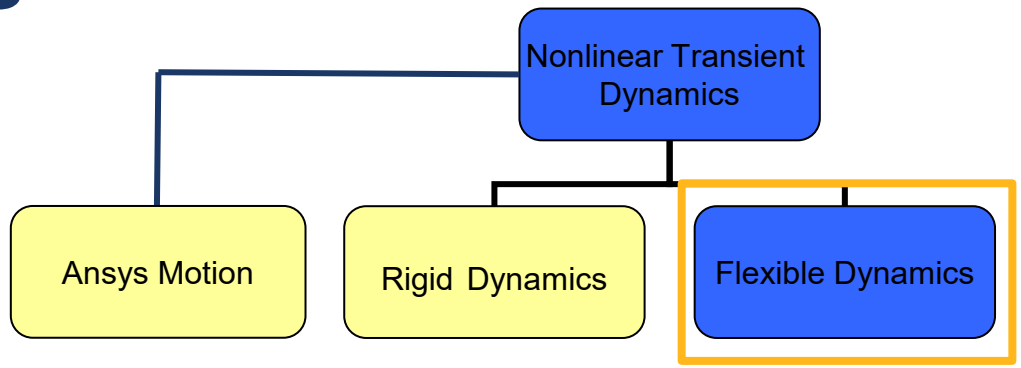
- Consists rigid bodies
- May include condensed parts (CMS super elements)
- Motion due only to joints/contacts
- Goal is determination of Motion and Forces
- Few degrees of freedom, fast solves
- Best suited for short duration large motion analysis
- Contact shock (energy restitution)
- Based on energy conservation

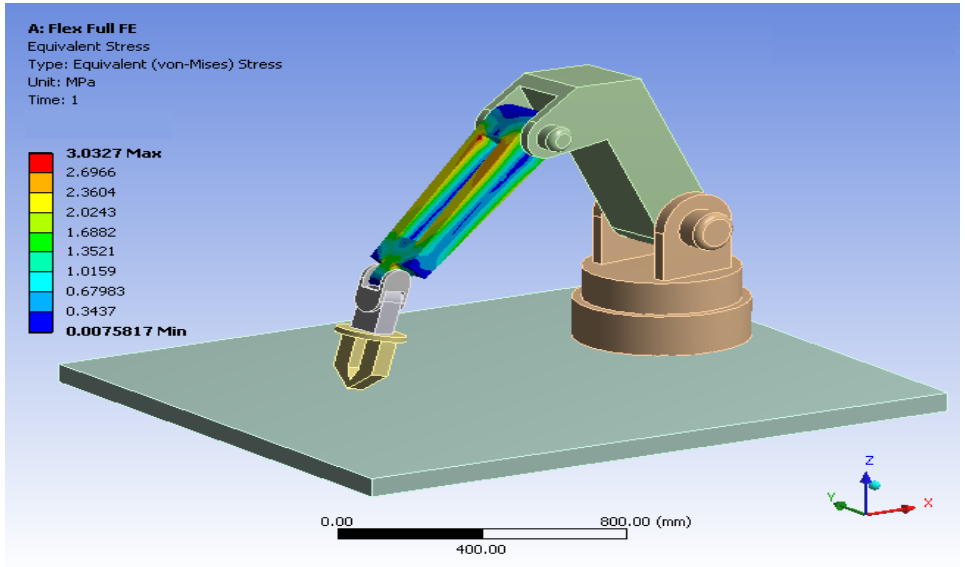




Dynamics Simulation in Ansys

- Consists of rigid **and/or** flexible bodies
- All types of nonlinearities are allowed
- Motion due to joints/contacts and flexible part deformation
- Goal is determination of Motion, Forces, Deformations, and Stresses
- Longer solves, but more results data
- CMS available to speed-up solves

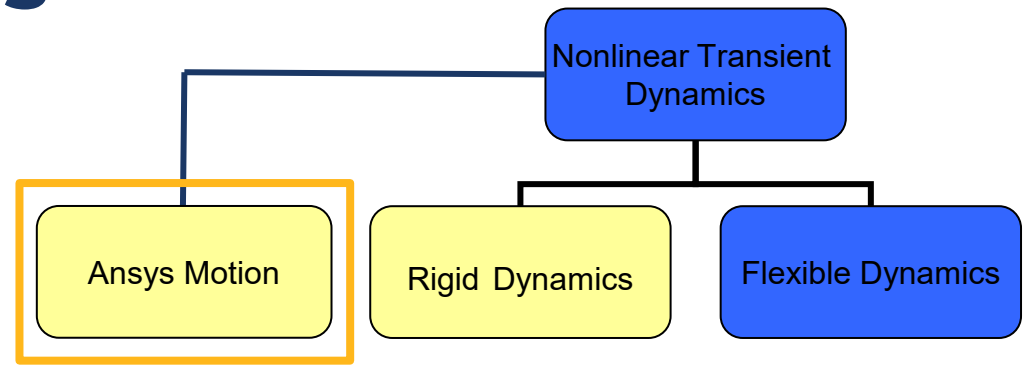


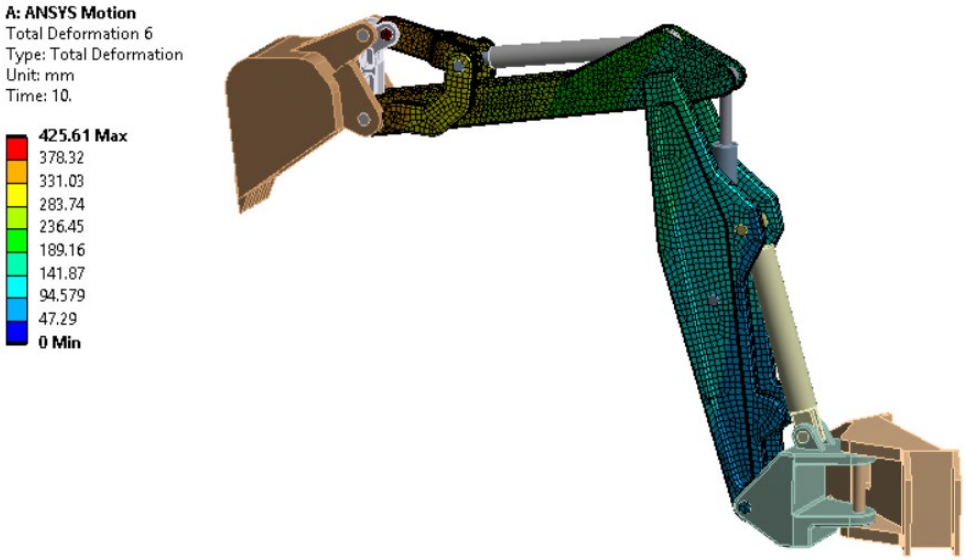


DRD

Dynamics Simulation in Ansys

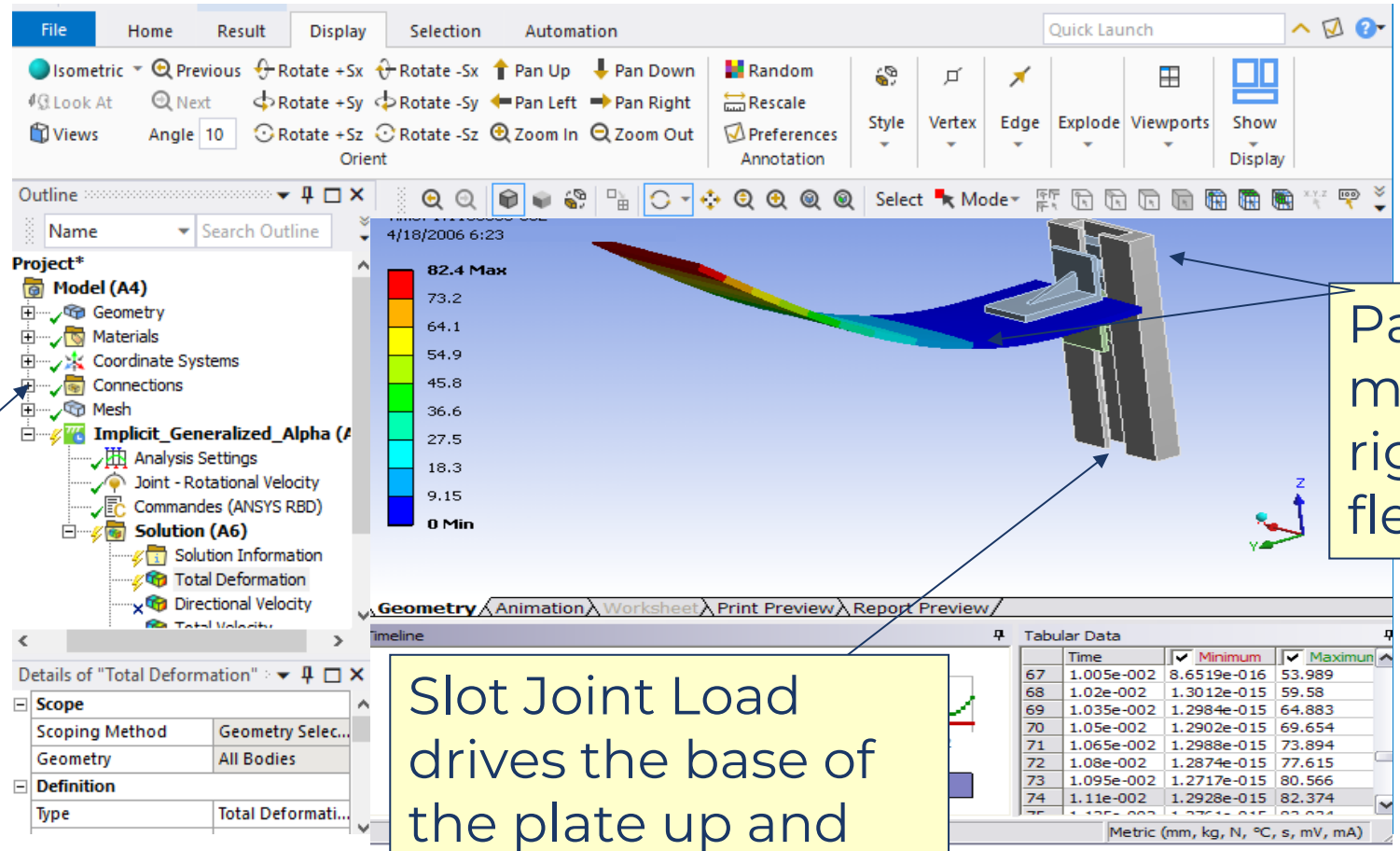
- Consists of rigid bodies, modal-flex bodies **and/or** flexible bodies
- All types of nonlinearities are allowed
- Motion due to joints/contacts and flexible part deformation
- Goal is determination of Motion, Forces, Deformations, and Stresses
- Recommended for high-speed large rotation systems
- Robust for 3D contacts systems
- Specific toolkits available





What is Multi-Body Dynamics (MBD) Simulation?

It is a means of analyzing the dynamic behavior of a system of interconnected bodies consisting of rigid and/or flexible components.



Parts are connected at Joints which allow some relative motion

Parts are modeled as rigid and/or flexible

Slot Joint Load drives the base of the plate up and down

DRD

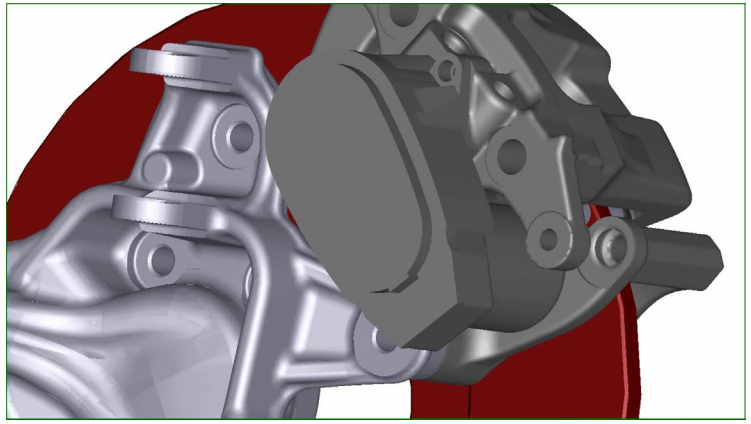
Strengths of Ansys Motion

- Fast simulation speed
- Reliable and accurate solution
- Tightly integrated multi-body and structural analysis solvers
- Good for large degrees of freedom systems
- Elements and connections
- 3D surface contact
- Modal and fully flexible body methods

Ansys Motion Products

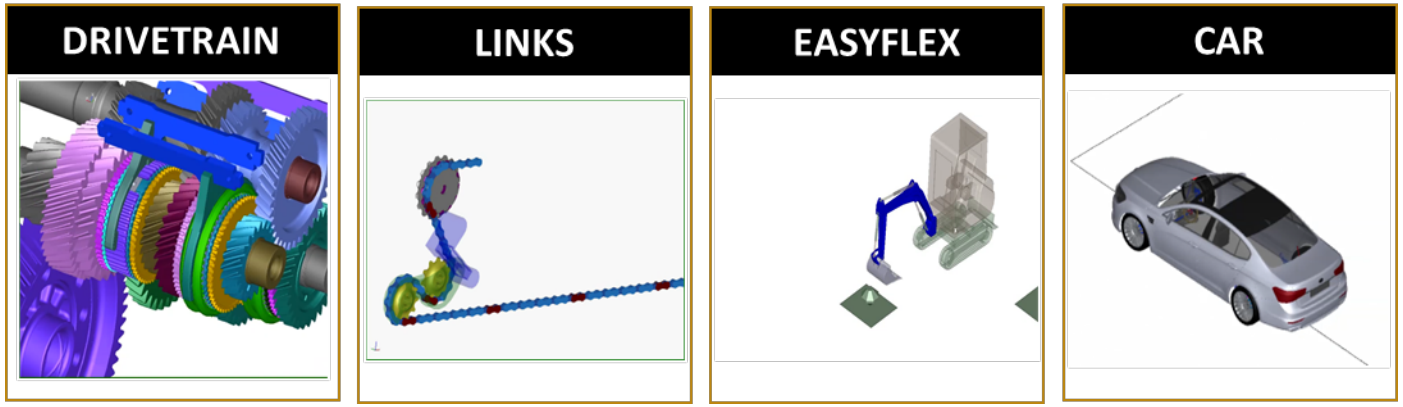
Ansys Motion Premium

- Mechanical UI Pre-Post Processing
- Motion STD Pre-Processing
- Motion STD Post-Processing
- Motion Solver
- Step Translator



Ansys Motion Enterprise

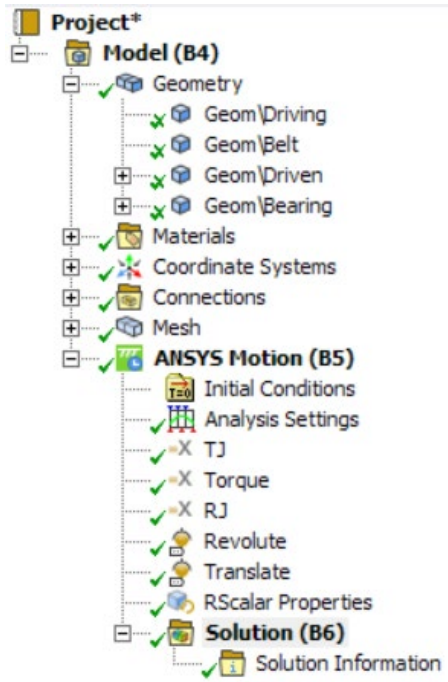
- Ansys Motion Premium
- All Toolkits (Drivetrain, Link, Easy-Flex, Car)
- Parasolid Translator

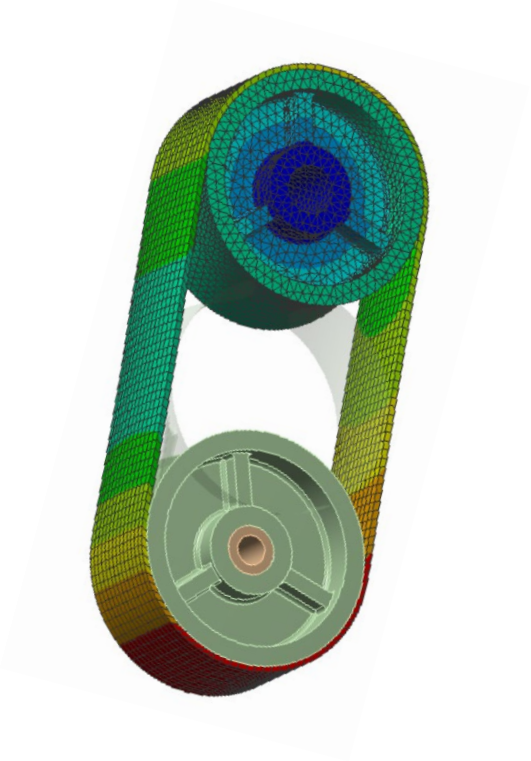


DRD

Ansys Motion in Mechanical GUI

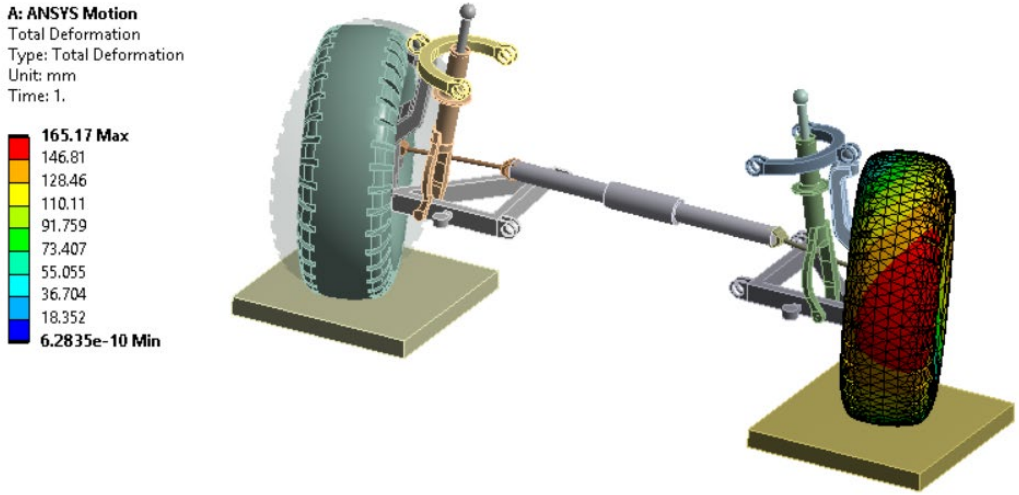
Preprocessing





Provides the power of the Ansys Workbench and Mechanical Environments to facilitate the preprocessing of Ansys Motion models.

Postprocessing



Results are available directly in Mechanical

Ansys Motion Post-Processor can be opened from within Mechanical for other results

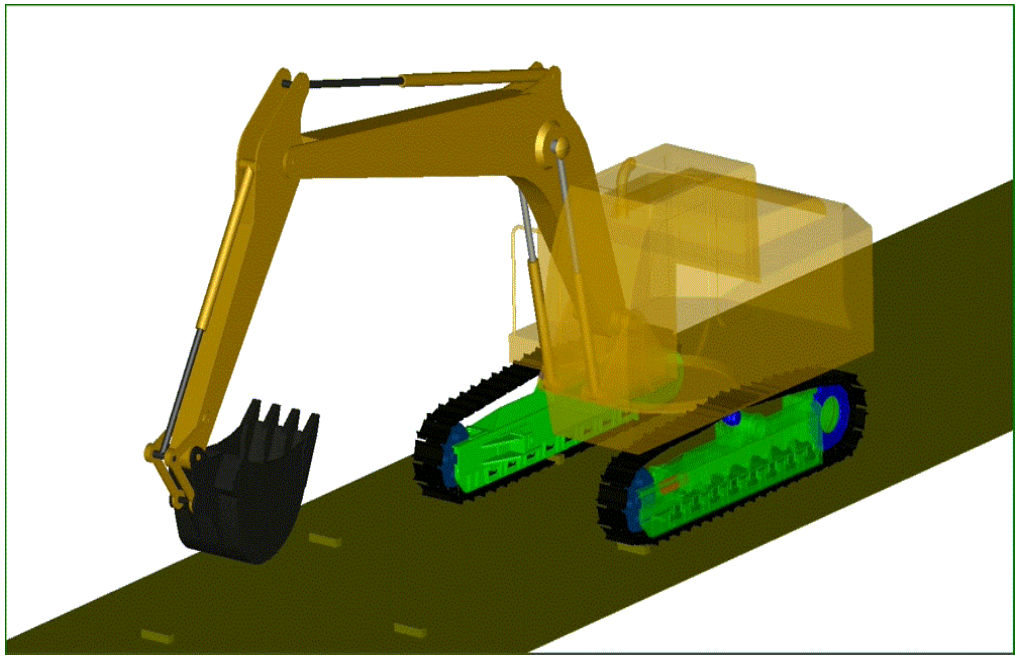
DRD

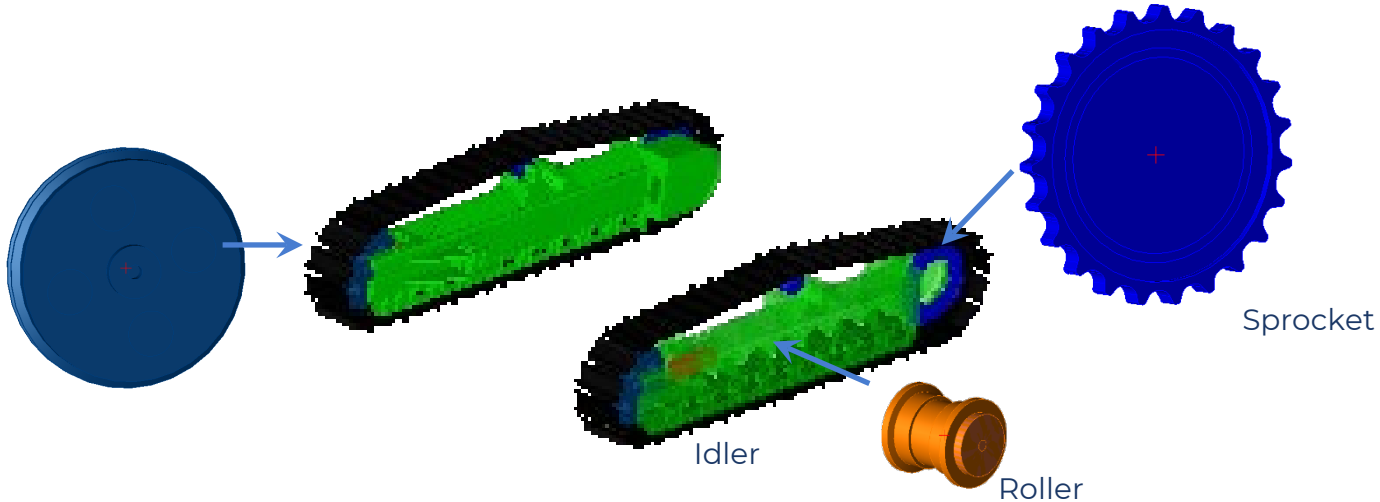
Ansys Motion Solver

- Completely independent of Ansys solvers
- Implicit integration method yields stable and accurate solutions.
- Can include springs/dampers/bushings
- Can include contacts
- Output file in Solution Information contains diagnostics

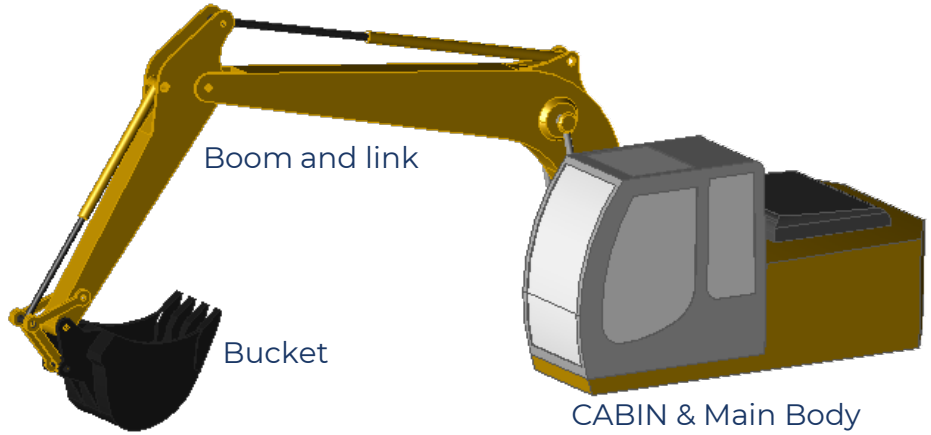
Dynamics analysis of excavator system on a rough road

- **Analysis Purpose**
  - Calculate the forces applied on the sub-frame parts under rough road conditions
- **Major characteristics**
  - Tracked vehicle is controlled for straight running.
  - This system is highly non-linear due to contact.
  - 1,300 contact pairs are required.
- **Develop a model**
  - Sub frame is modeled using Ansys Motion Links toolkit.
  - Idler tension spring is modelled using a spring element.
  - General contacts are used to represent the contacts between Roller, Sprocket, Idler and Track in Sub frame System.
  - Contact between rough road and track.





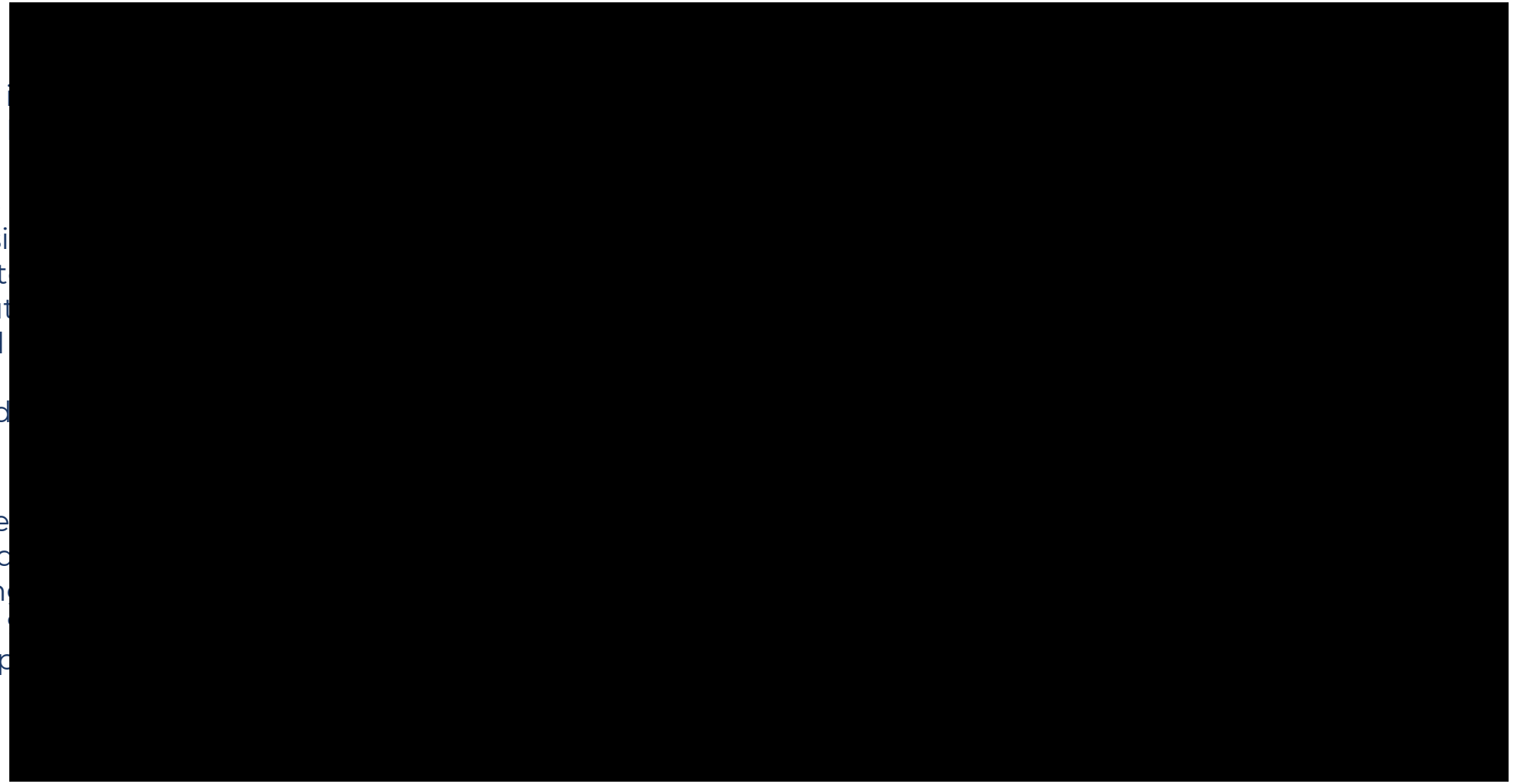
< Sub frame System >



< Upper Component >

Automotive, Transmission Synchro

- **Analysis Purpose**
  - The simulation goal i
    characteristic when
- **Major characteristics**
  - Synchronizer analysi
    teeth and blocking t
    sleeve teeth and clut
  - The cone shape and
    meshing time.
  - Synchronizer moved
- **Develop a model**
  - Bodies are connecte
  - Contacts are defined
  - Input shaft is rotatin
  - Sleeve is rotating as
  - Operating force is ap
- **Simulation Results**
  - Meshing time(period) is 0.0683sec.
  - The gear set (6^{th} stage) is synchronized well.

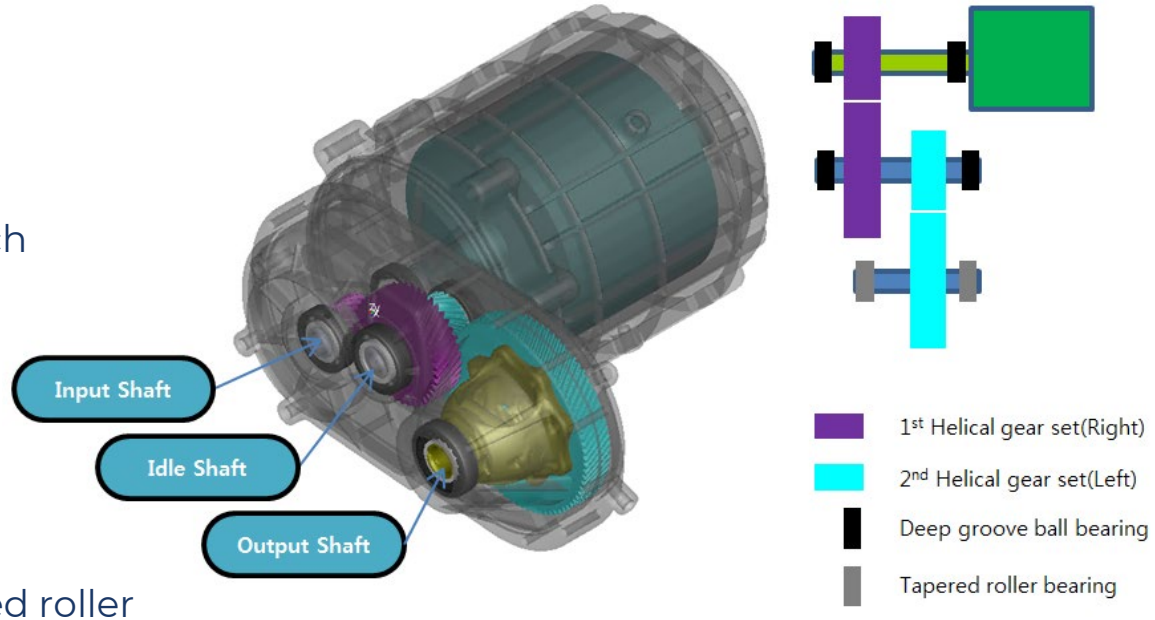


Whine of an E-Axle

- **Analysis Purpose**
  - This simulation goal is to analyze a whine noise characteristics of E-axle which consists of the gear train and motor system.

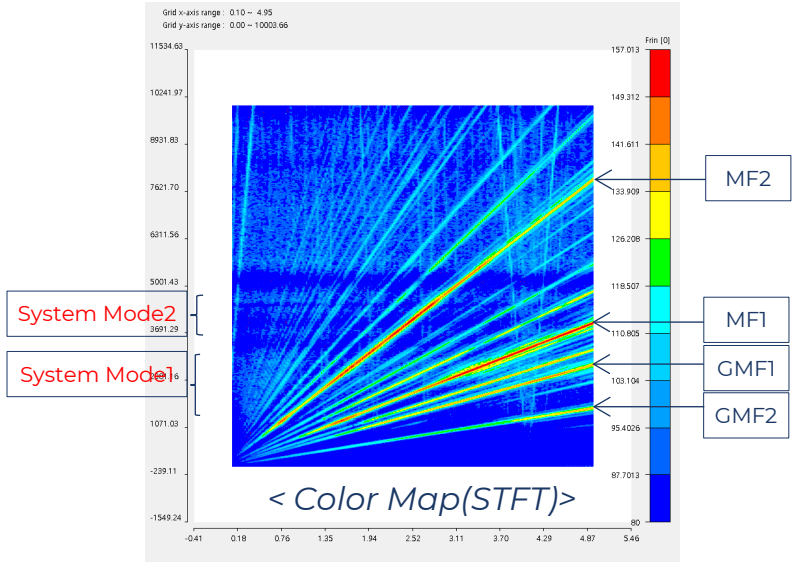
- **Major characteristics**
  - Gear excitation force is calculated while considering the misalignment
    under the variable driving condition.
  - The misalignments are determined by the stiffness of each component.
  - Motor variable torque estimate by its specifications.

- **Develop a model**
  - Drivetrain toolkit had been used in order to represent
    major components characteristics.
    (2-External gear set, 4-Deep groove ball bearing, 2-Tapered roller bearing)
  - The case is modeled by FE modal body(Linearized body)
  - Symmetric shafts are modeled by the beam shaft, and asymmetric shaft is modeled by FE modal body(Diff case)
  - Driving RPM increases from 0rpm to 10,000rpm.
  - Also, driving RPM considers the motor specifications.
  - Torque is loaded with 200Nm at output shaft.



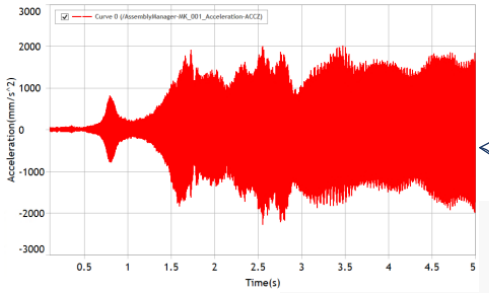
Whine of an E-Axle Cont...

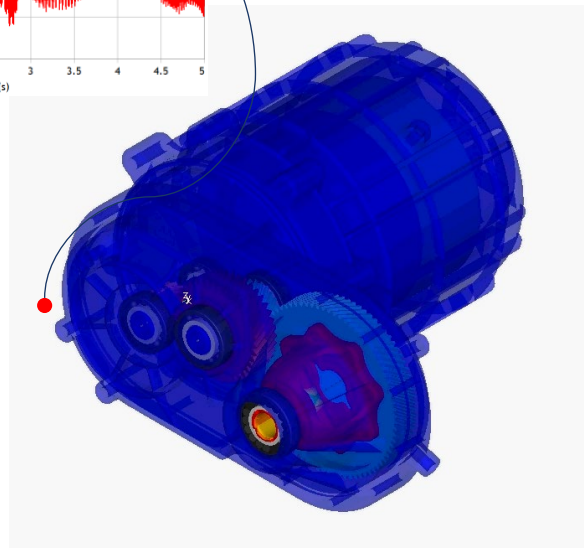
- **Simulation Results**
  - The color map which is created by the acceleration data shows the whine noise of GMF and MF.
  - The harmonics of GMF and MF are shown well.
  - Motor excitation force is estimated as the main noise source of the system.
  - The noise of the 1st gear set is higher than that of 2nd gear set.
  - The vibrations of system modes are shown at the specific frequencies.

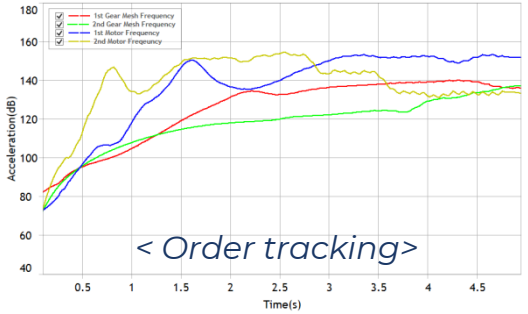


< Color Map(STFT)>

< Z Acceleration raw data >

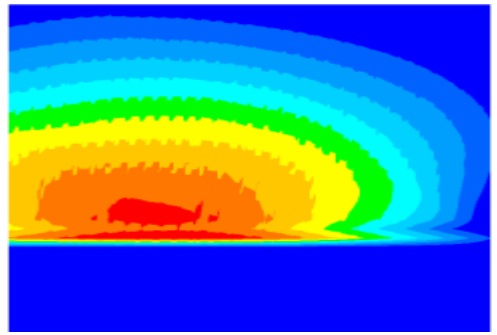


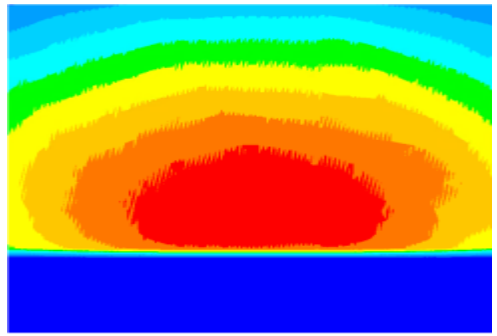




< Order tracking>

GMF : Gear Mesh Frequency
MF : Motor Frequency


<Tooth Pressure(1st)>


<Tooth Pressure(2nd)>

Introducing...

Kolton Landreth

Manager, New Product Development at T.D. Williamson


TDW

DRD Webinar - ANSYS Motion

03/11/2025

Kolton Landreth
Manager, New Product Development

Global Footprint, Tulsa Headquarters

35+ locations
3 manufacturing plants
50+ channel partners

Three Business Lines

Pigging Solutions

Mitigate internal corrosion, increase efficiency and throughput and perform pre-ILI cleaning to assure inspection results.

Pipeline Integrity

Diagnose undetected threats, prioritize integrity response and extend asset life.

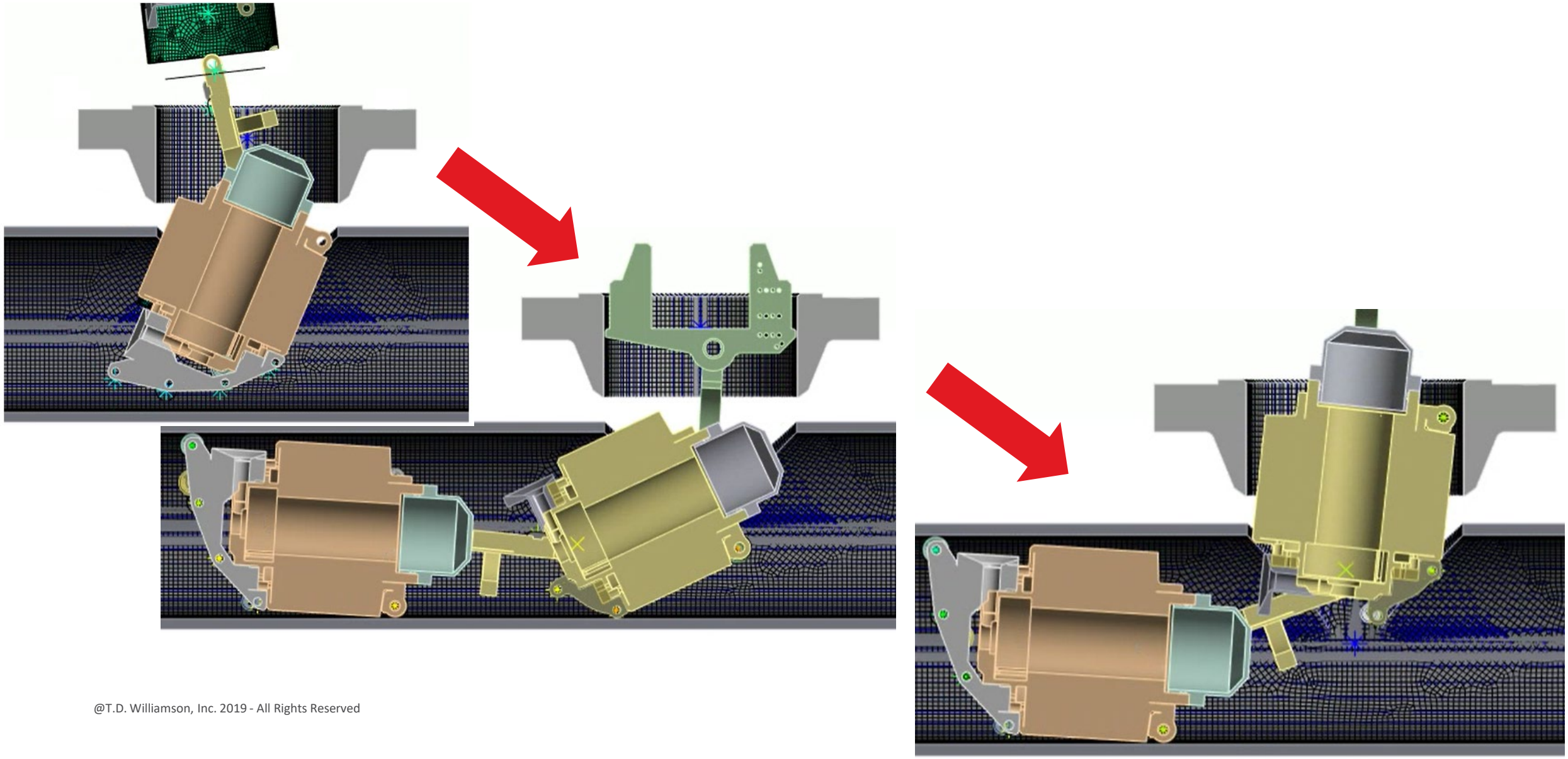
Intervention & Isolation

Improve line versatility, preserve uptime and keep product in the pipe.

Application

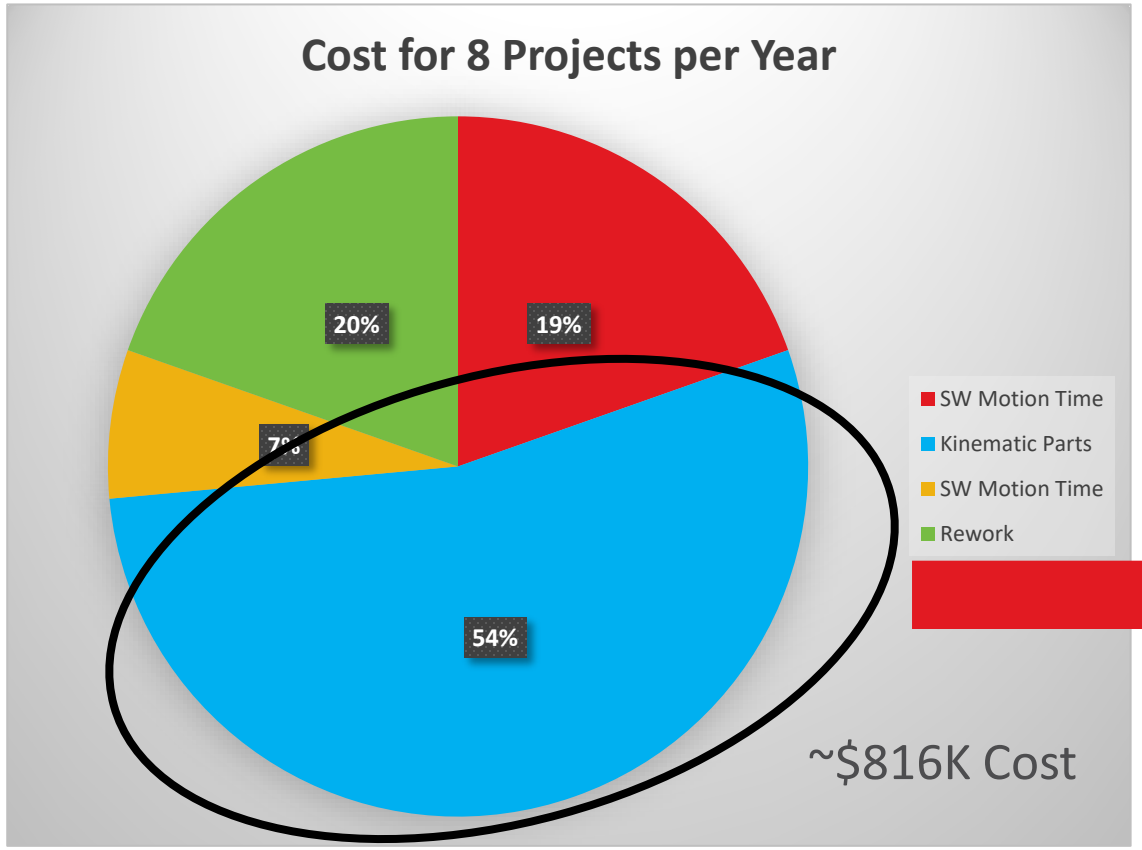
Software – User Experience

Software – User Experience

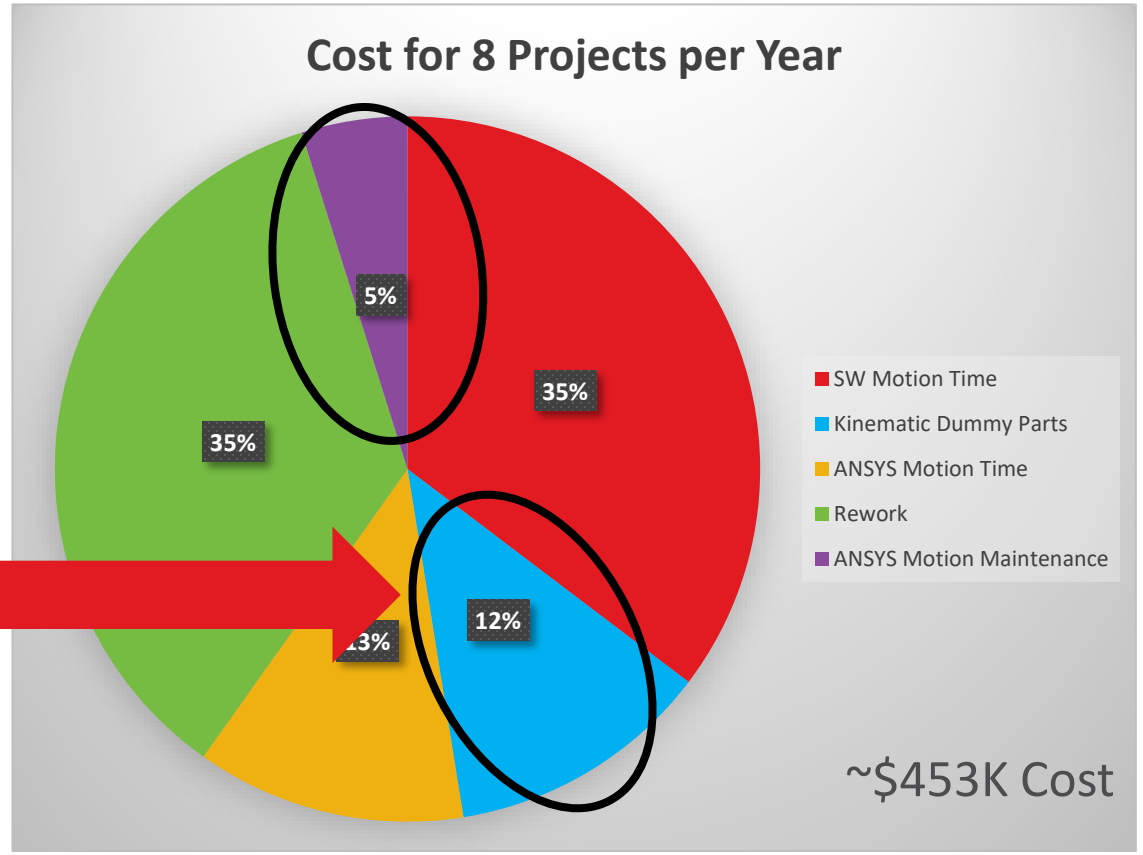


Business Case

Current State:



Future State:



~$363K/yr Savings

Software – User Experience

Feedback

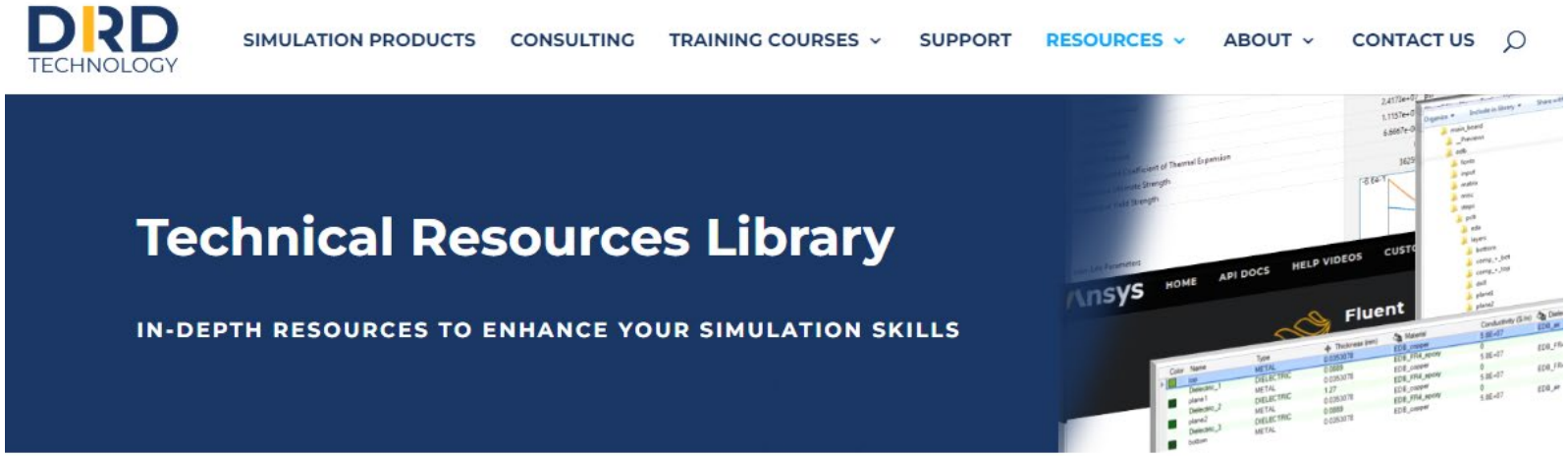
Conclusion

Takeaway:

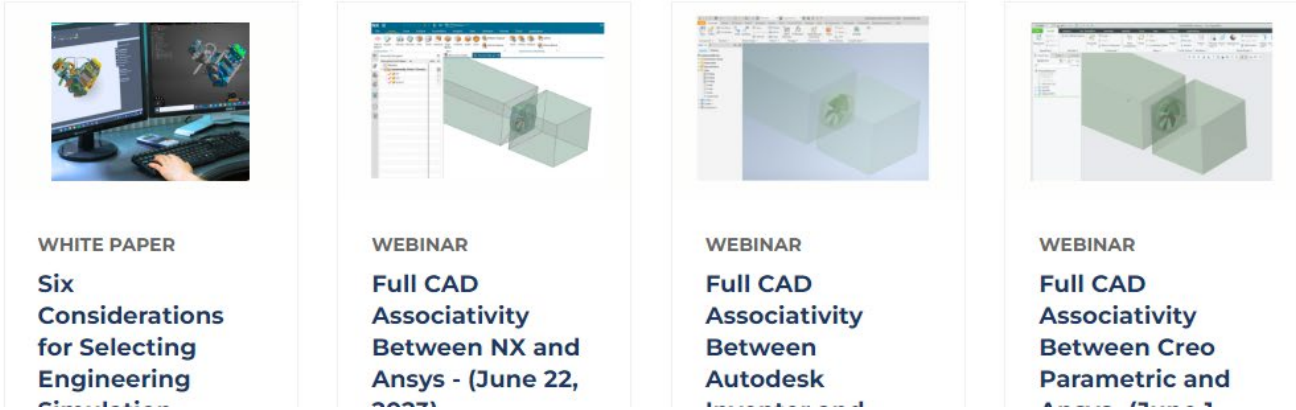
- ANSYS Motion expected to be a net cost savings vs traditional motion + testing
- TDW was able to simulate interactions through Motion that were also seen in physical testing
- Minor learning curve for those already versed with other ANSYS based simulation
- ANSYS Motion solver is exceptionally efficient for solving complicated dynamic problems
- Coupling Motion with traditional Mechanical results in extremely powerful simulation tool

Wrap Up

The recording and slides for this webinar are in our Technical Resources Library.



If you are not on our mailing list, or are unsure if you are, please let us know at support@drd.com and we can add you!



Wrap Up

Whether you're onboarding with the Ansys platform or looking to take your simulation proficiency to the next level, we have a training course carefully designed to fit your needs. With frequent introductory and advanced courses conducted live virtually and in-person or on-demand, we offer many opportunities for you to get the training experience that best suits your needs. Additionally, since our trainings are conducted by our in-house engineering and physics experts, we have the unique opportunity to carefully listen to your requirements and further refine our custom training materials to help you continually meet your goals.

Explore our training center below.

Wrap Up

Thank you for your attention!

May I address any questions?

DRD TECHNOLOGY

Design. Simulate. Succeed.