Connect to All

RECURDYN

Particleworks CFD DEM FEA MBD MFBD Control MBS-FE Coupling FMI CoLink Simulink SimulationX AMESim Simplorer EDEM

- **Welcome**
- **Multibody Dynamics Platform Vision**
- **What's New in RecurDyn V9R3**

Brant Ross

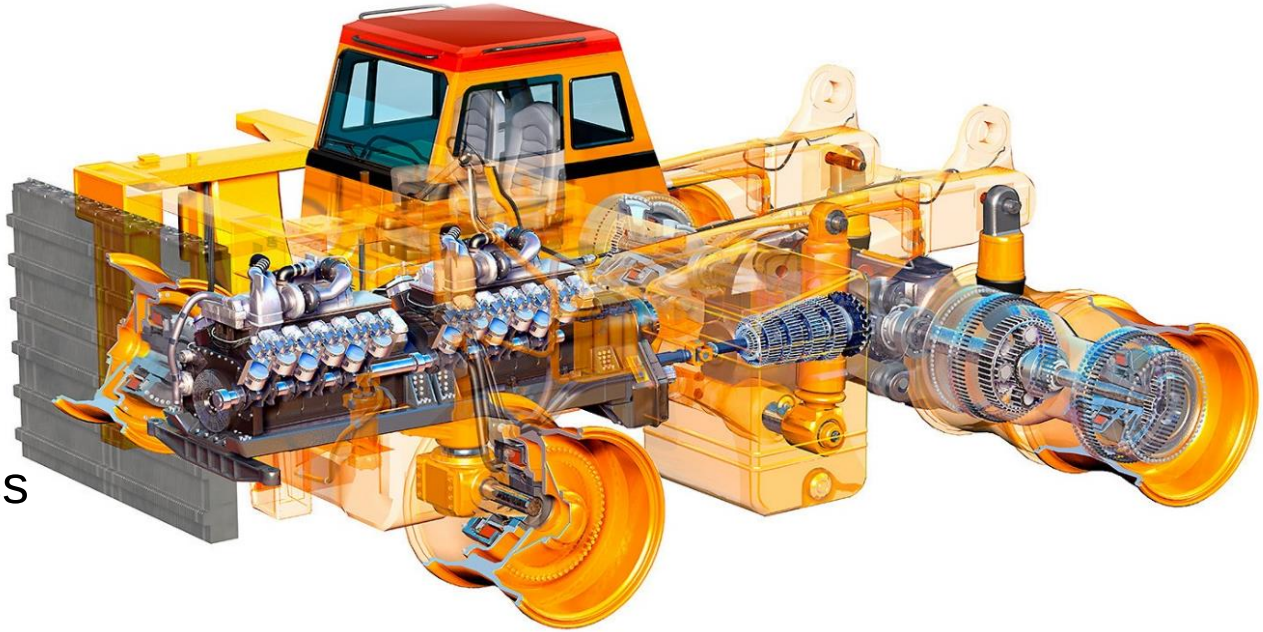
Business Manager

Wednesday, September 25th

10:00 am EDT (8:00 am MDT)	Welcome, Review of Schedule	Brant Ross
10:15 am EDT (8:15 am MDT)	RecurDyn as a multi-physics simulation platform, V9R3: RecurDyn/Professional and ProcessNet.	Brant Ross
12:00 pm EDT (10:00 am MDT)	Break	
1:00 pm EDT (11:00 am MDT)	V9R3: RecurDyn Toolkits, Controls, and Co-simulation Interfaces	Nelson Woo
2:00 pm EDT (12:00 pm MDT)	V9R3: RecurDyn/FFlex and Mesher.	Zach Smith
3:00 pm EDT (1:00 pm MDT)	Review of Logistics for the Thursday Tutorials	Brant Ross
3:15 pm EDT (1:15 pm MDT)	Adjourn	

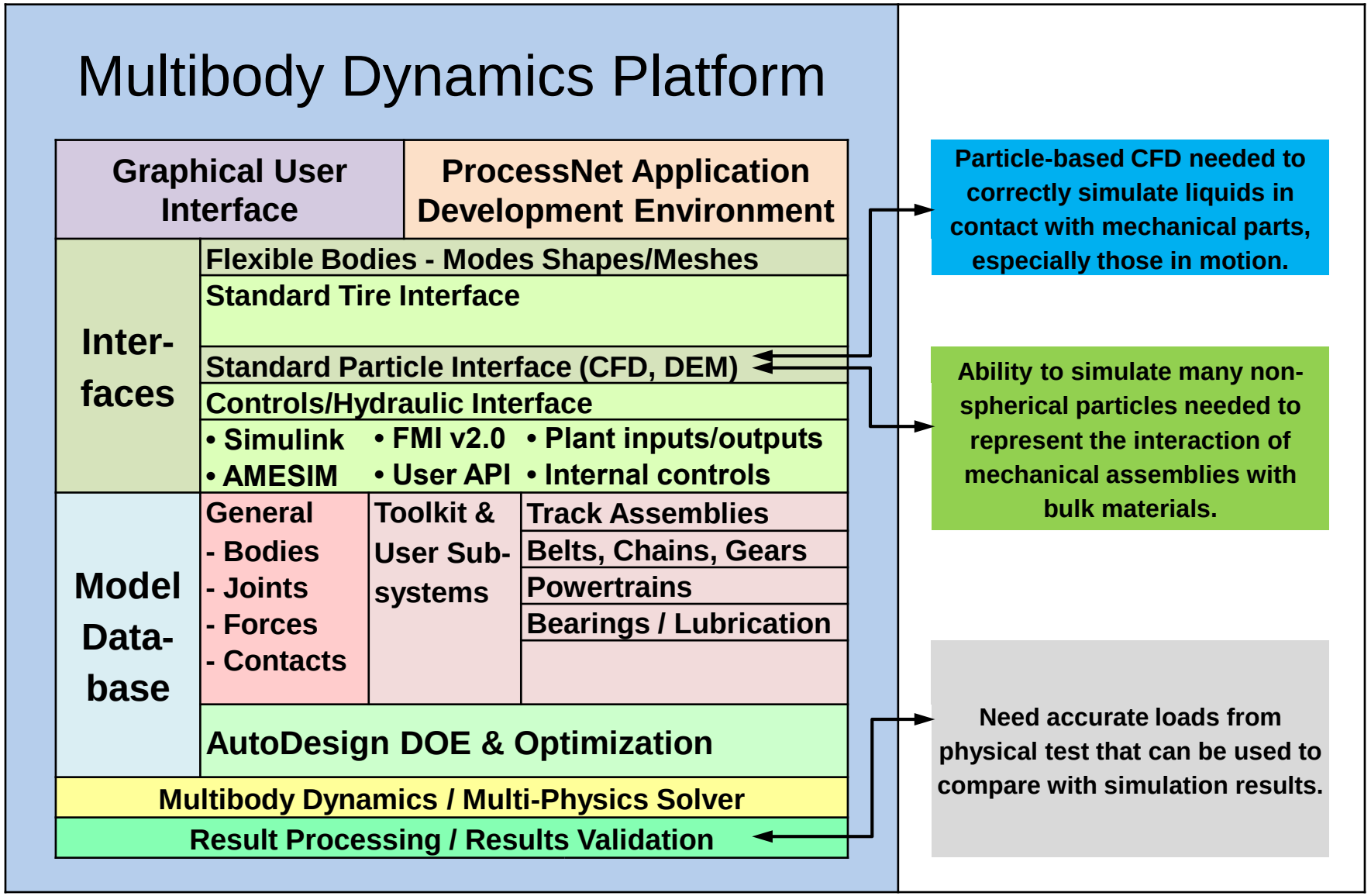
Capabilities Needed for System-Level Simulation

- (80's) Multibody Dynamics (MBD) – Rigid Bodies
- (90's) MBD – Linear Flexible Bodies, Controls
- (00's) MBD – Process Automation, Nonlinear Flexible Bodies, Hydraulics,

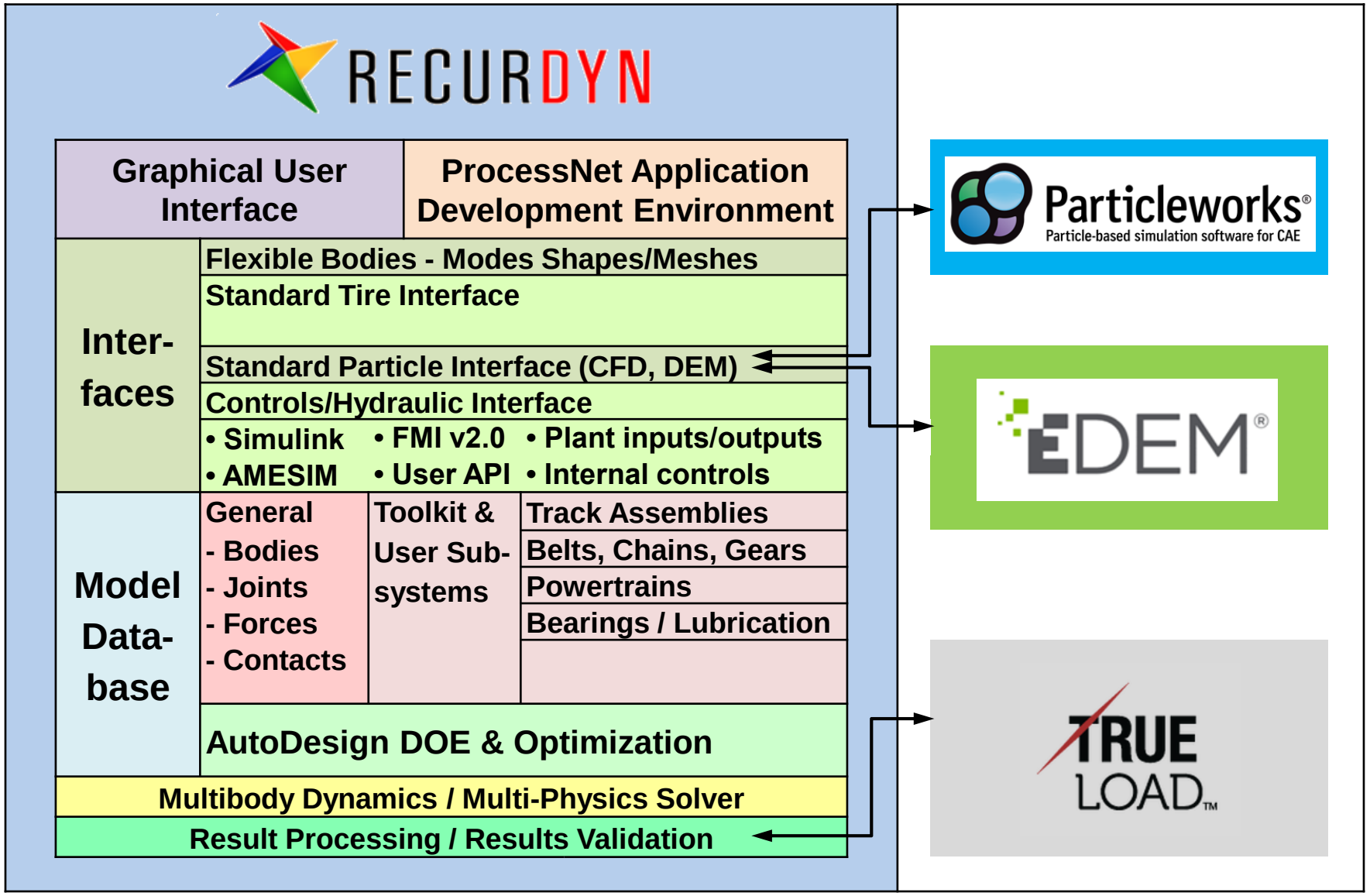


- (10's) Extended multi-physics simulation through co-simulation with CFD & DEM
- (20's) MBD is now Model-Based Design, emergence of Model-Based Engineering. Multibody dynamics is a key enabler of MBD and MBE for products that include assemblies in motion.

Multi-Physics Platform for Assemblies in Motion

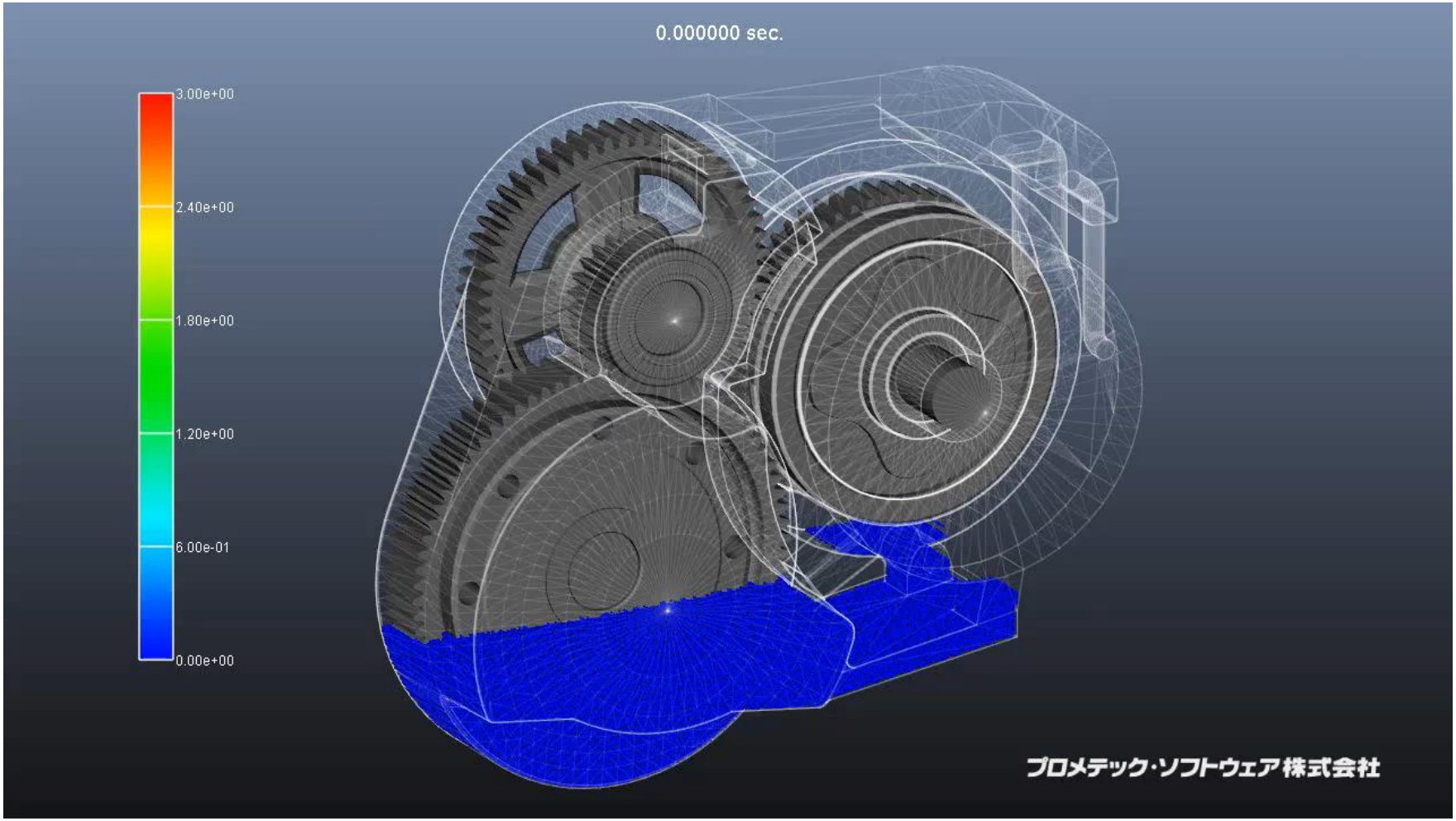


Multi-Physics Platform for Assemblies in Motion



Oil Sloshing Within a Transmission

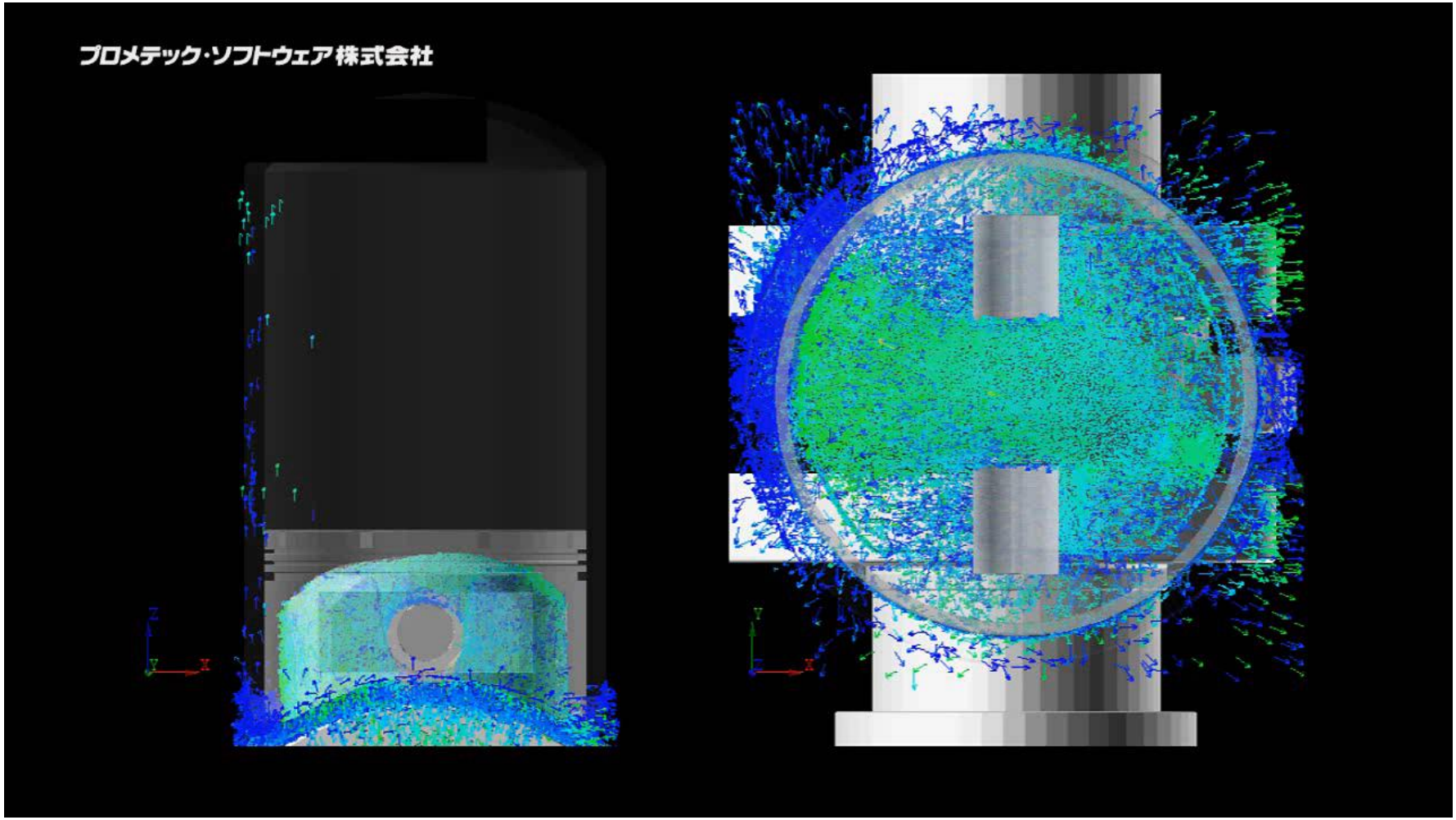
RECURDYN × Particleworks



RECURDYN × Particleworks

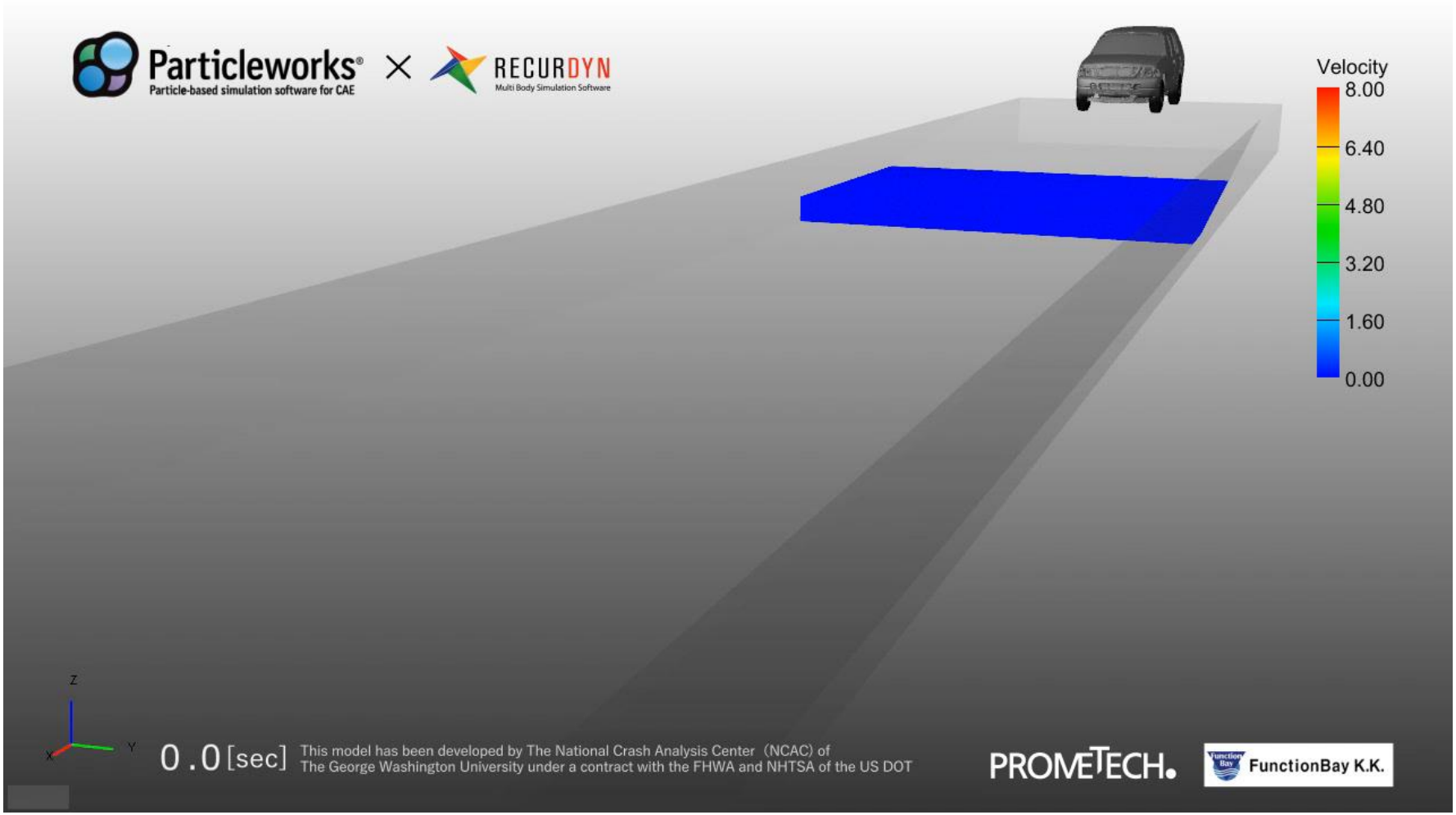
Oil injection on a connecting rod

RECURDYN × Particleworks



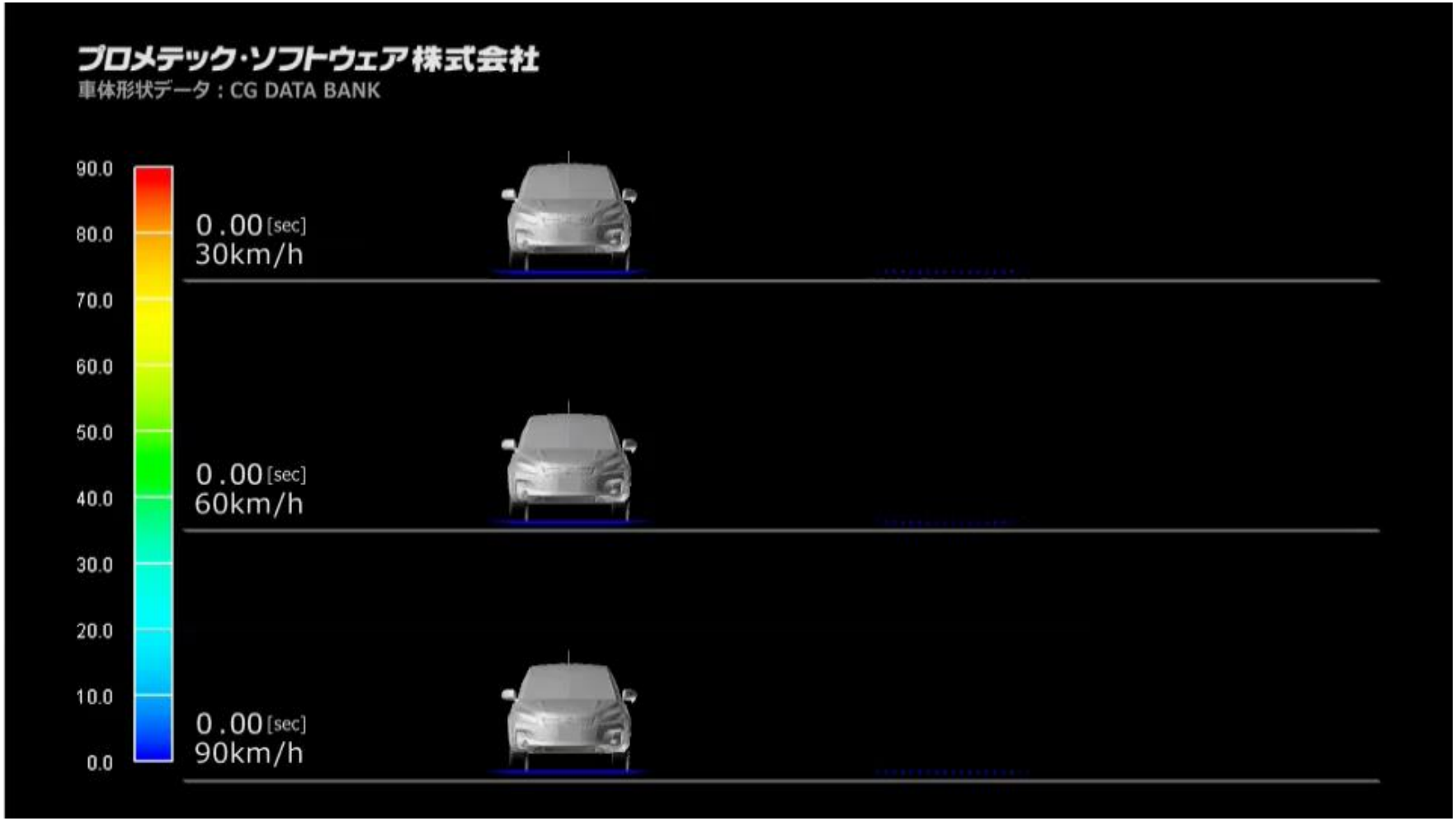
Vehicle on a flooded road

RECURDYN × Particleworks

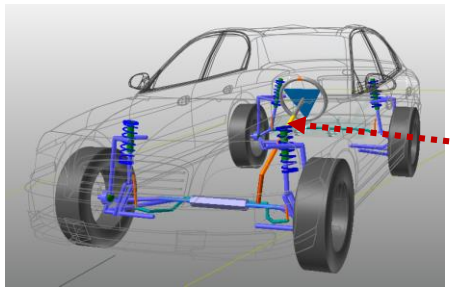


Car Water Splash vs. Velocity

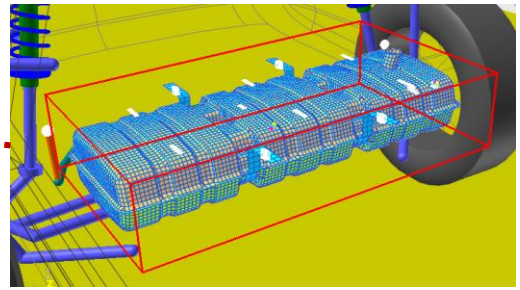
RECURDYN × Particleworks



Fuel Tank Sloshing (Flexible body)

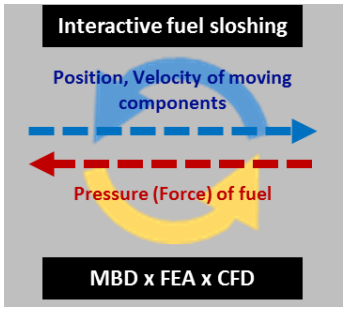


Vehicle Dynamics (RecurDyn)

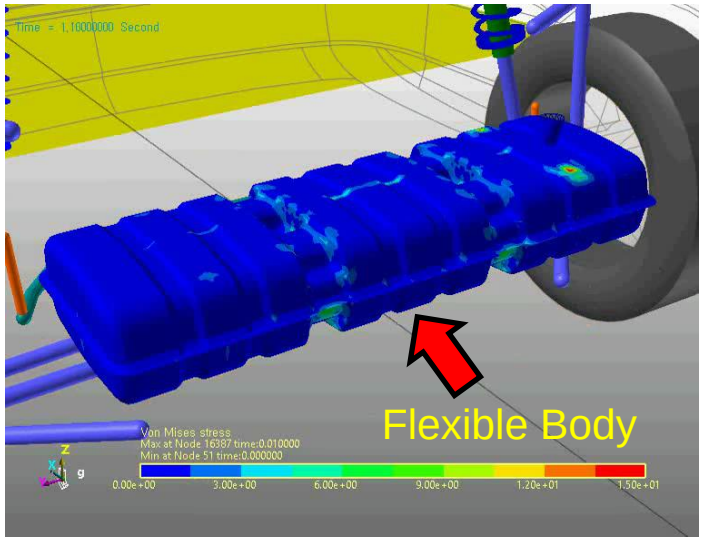


Fuel Tank (RecurDyn / Nonlinear Flex)

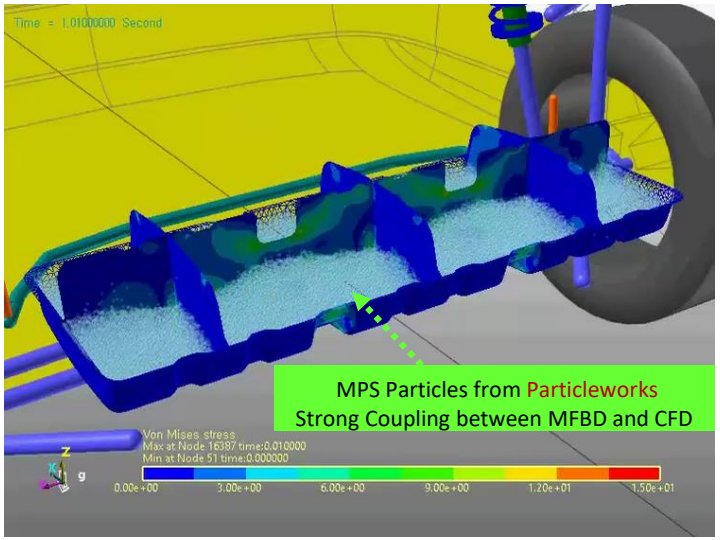
Rigid Bodies + Flexible Bodies



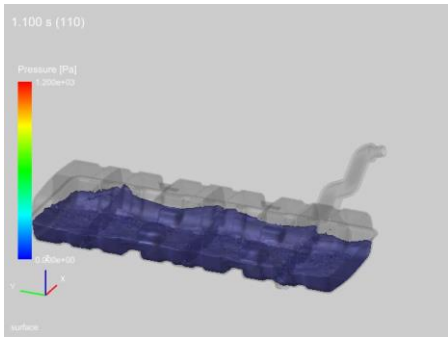
Incompressible Fluid Particles



Outside View (Double Lane Change)



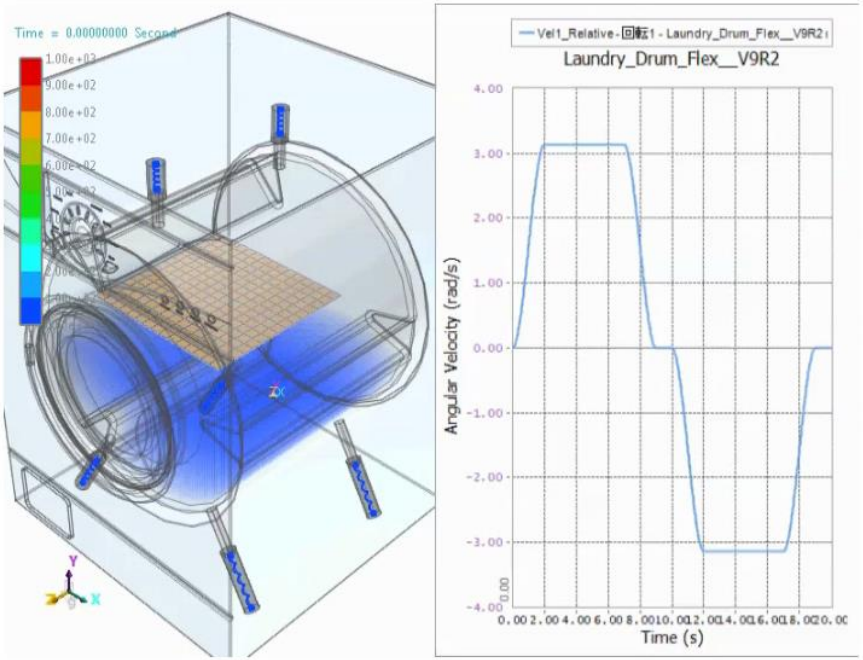
Transparent View (Double Lane Change)

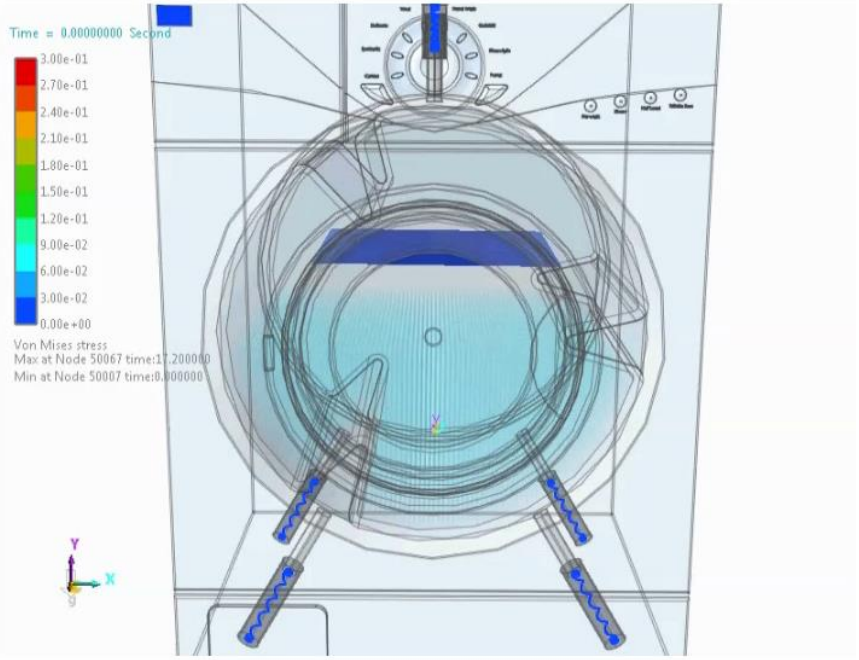


Surface Rendering of the Particles

Washing Machine (Front loading)

RECURDYN × Particleworks





Washing Machine (Front Loading Type) – Coupled simulation with MPS (Particleworks) and Shell element (RecurDyn)

Simulation by FunctionBay K. K.

Why include the impact of bulk materials?

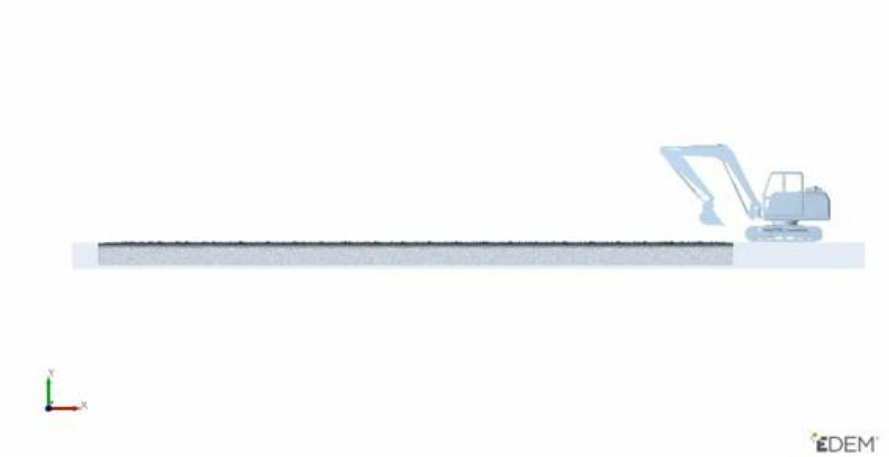
- Material type and behavior imparts loading on equipment
- Material loads affect the mechanical systems and machine performance

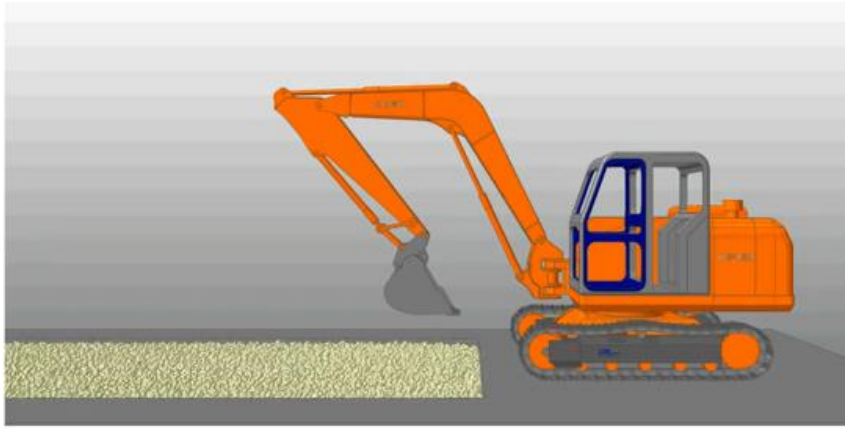
- Bulk materials have complex behavior.
- Predicting the effect of material on equipment is challenging
- Assumptions can lead to expensive mistakes

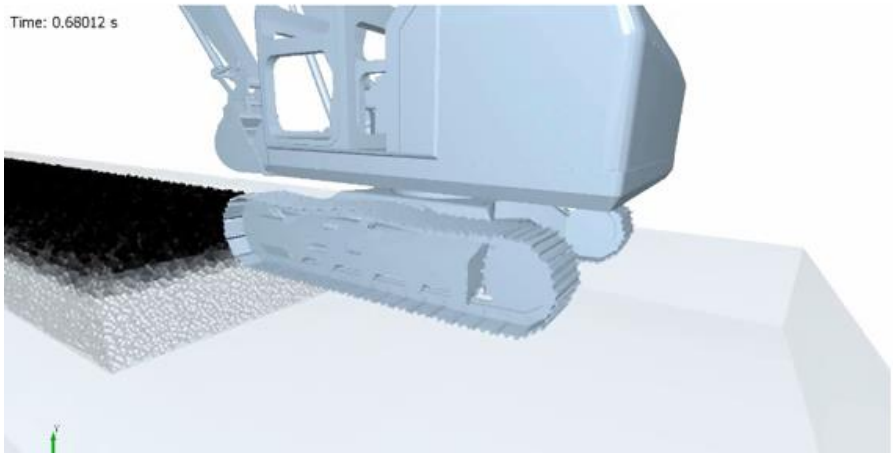
EDEM™

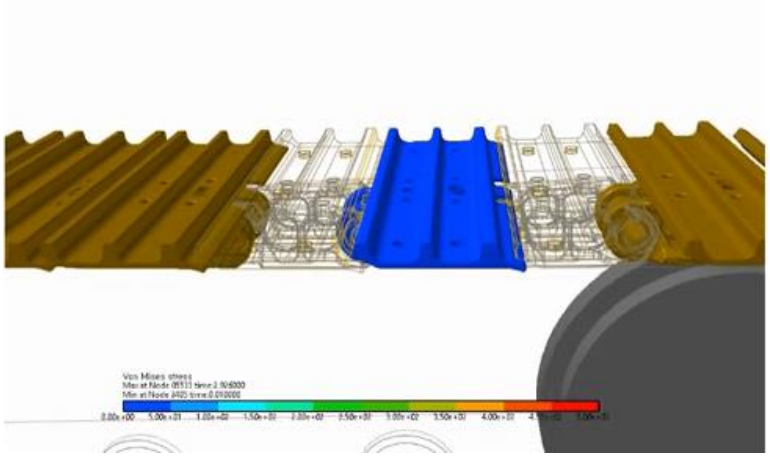
Off-Road Transit of Excavator

RECURDYN × EDEM™









4-Wheel Drive Loader

Wolf Star Products

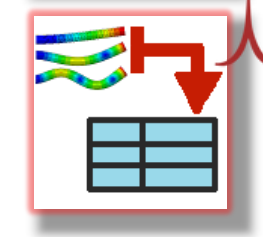
True-Load

TRUE LOAD™

Turns Components into load transducers

TRUE QSE™ ***Q**uasi-**S**tatic **E**vents*

Linearly Superimpose results via user defined functions



TRUE LDE™ ***L**inear **D**ynamic **E**vents*

Post-Process linear dynamic solutions

Time, Frequency, PSD Domain

FEA Fatigue Software

FEA based fatigue

Motivation

Wolf Star Technologies
True-Load

1. What's the load?
2. True-Load provides
   - Strain correlated loading
   - Full field knowledge from a handful of strain gauges
   - Easy interface to FEA Durability SW
3. First to market solution

Products and Loading

Wolf Star Technologies

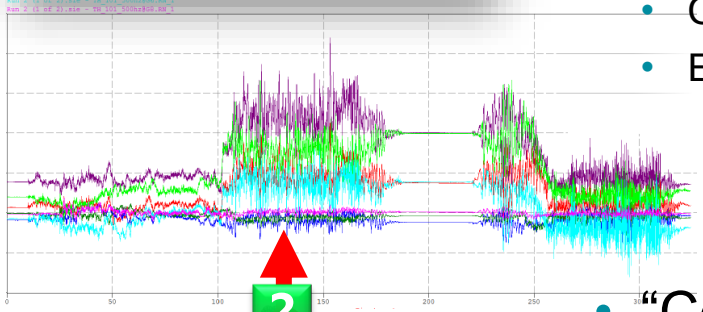
True-Load

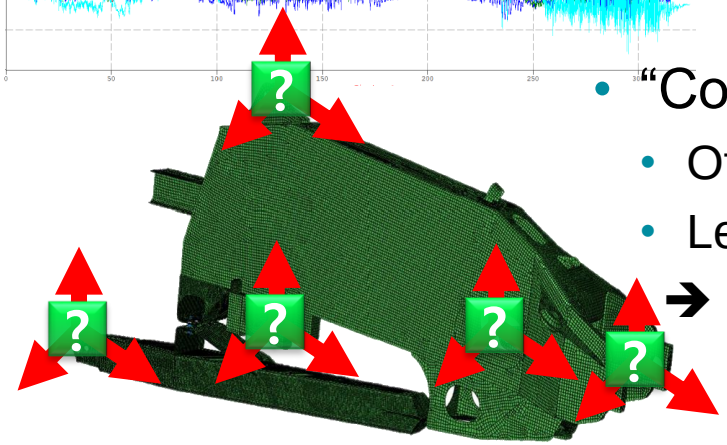
Historical Concerns with Loading

- Loading profile is biggest unknown in analysis (GIGO)
- Poor loading drives extra iteration cycles ➔ $$$
- Traditional load measurement:
  - Is expensive ➔ Load transducers can cost $10,000+
  - Is expensive ➔ Requires modifications to mount transducers
  - Is inaccurate ➔ Changing structure changes loads & load paths
  - Not aligned with analysis ➔ Needs to 're-work' data & FEA

Historical Concerns with Strain Measurement

True-Load





- Strain gauge placement from heuristic knowledge
- Simulation (FEA) does not match test data
  - Many hours spent post-test to “adjust” loading
  - Only one or two points / channels of data are targeted
  - Entire event is not well understood
- “Correlated” load cases used for future designs
  - Often missing key elements of loading influence
  - Leads to wasted iterations in hardware

➔ Wasted Time, Wasted $$$

Connect to All RECURDYN

MOTION PORT

What's Wrong?

True-Load

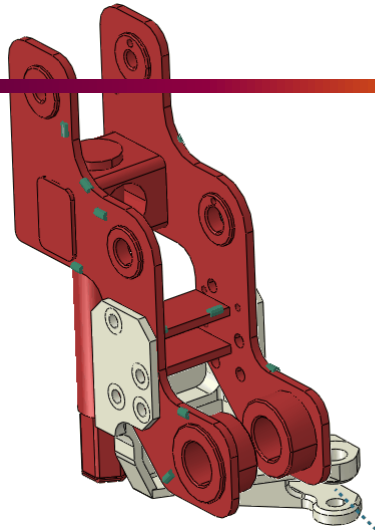
- ✓ High Fidelity Models
  - ✓ Skilled FE Analysts
  - ✓ World Class FEA Software
- ✓ High Fidelity Testing
  - ✓ Instrumentation
  - ✓ Equipment
  - ✓ Data Processing
- ✓ High Fidelity Fatigue
  - ✓ fe-safe®
  - ✓ Design Life
  - ✓ Safe Design

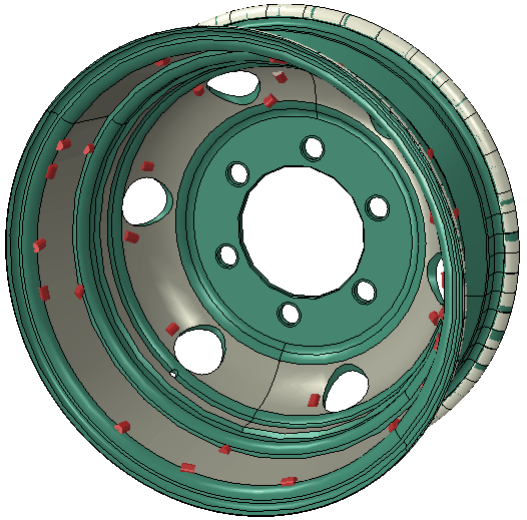
- ✘ Too many variables to manage
  - ✘ Gauge Locations
  - ✘ Load Cases
  - ✘ Quantity of Data
  - ✘ Unique loading for each data point
- ✘ Impossible to perform manually

Poor loading knowledge causes extra design iterations = $$$$

The Solution – True-Load™

Wolf Star Technologies
True-Load

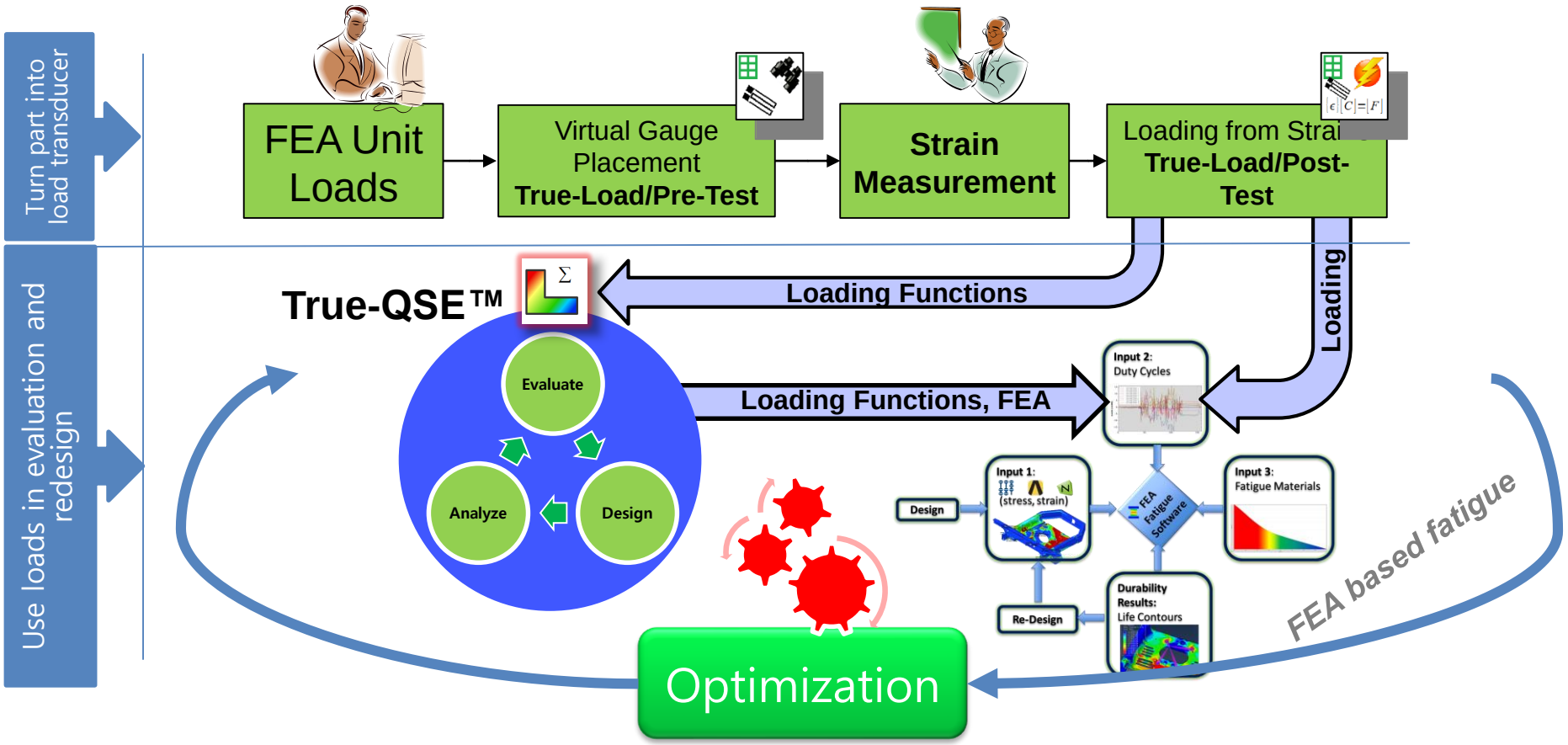




- In-situ load measurement
- Turns complex components into multi-channel load cells
- Leverages FEA Model and Test Data
- Works with all FEA
- Optimal placement of Strain Gauges
- Direct interface to FEA-based fatigue

The True-Load™ Workflow

Wolf Star Technologies
True-Load



Connect to All RECURDYN

MOTION PORT

Multi-Physics Platform for Assemblies in Motion