Utkarsh Ashish Kulkarni

Mechanical System's Simulation Engineer

Aachen, Germany | +49 15758173397

utkarsh.kulkarni@rwth-aachen.de

LinkedIn | Xing

Portfolio of Projects

Who I Am

Mechanical Engineer passionate about research and development of simulation technologies used in virtual prototyping of mechanical systems. Highly motivated to understand and learn from first principles concepts pertaining to Physics and Mathematics, to solve challenging problems with logical reasoning.

Key Skills

FE Simulation
- Ansys
- Abaqus
- Ferrite.jl

MBD Simulation
- MSC Adams
- Project Chrono

Programming
- Python
- Julia
- C++

3D Modeling
- SolidWorks
- FreeCAD

Documentation
- Typst
- LaTeX
- MS Office

Languages
- English (C1)
- German (A2+)

Front Suspension & Guiding System Design

Category: Design

Tachyon Hyperloop (Student Initiative)

RWTH Aachen University | Oct 2022 - Jul 2023

Objectives

- To design and develop a suspension and guiding system for a Hyperloop prototype and complete at the European Hyperloop Week 2023.
- To integrate other subsystems namely powertrain, braking, thermal management into the chassis by coordinating with team members.
- To ensure manufacturability and assembly feasibility of the designed components.

Implementation & Methodology

- Iterated over various design concepts to optimize performance and manufacturability.
- Performed engineering calculations to determine loads and stresses on components.
- Selected appropriate mechanical components including bearings, dampers, and springs based on calculations and simulations

Learning Outcomes

- design for manufacturing and assembly (DFMA)
- Mechanical design
- Component selection based on engineering calculations
- dimensioning and tolerancing

Tools & Technologies

SolidWorks

Project Visuals

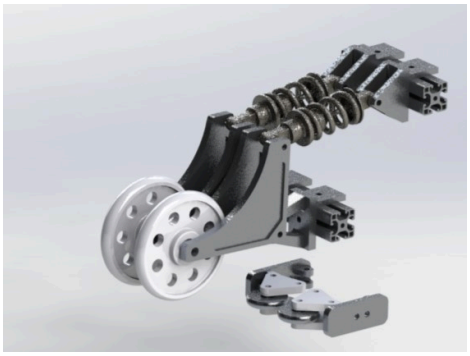

Figure 1: Suspension and guiding system

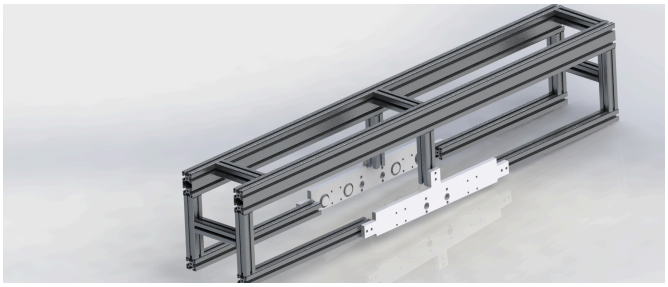

Figure 2: Chassis design

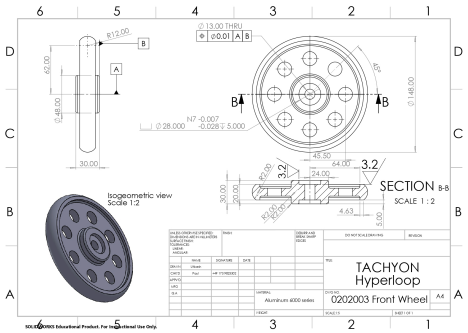

Figure 3: Detailed engineering drawing with dimensioning

Research on FE-MBD Coupled Simulation

Category: Research/Simulation

Man Machine Interaction (RWTH Institute)

RWTH Aachen University | Aug 2023 - Mar 2025

Objectives

- To research and implement a explicit co-simulation algorithm to couple FE simulations with Multi-body dynamic simulations.
- Focus on accuracy and robustness of the coupling algorithm.
- Document the research.

Implementation & Methodology

- Studied existing literature on FE-MBD coupling techniques.
- Developed an explicit coupling algorithm based on force and displacement exchange between FE and MBD solvers.
- Used custom code written in Julia for prototyping and testing.
- Used MSC Adams and Abaqus for production.

Learning Outcomes

- Total Lagrangian Formulation (nonlinear FE)
- Co-simulation techniques
- Newmark Time Integration to solve DAE's and ODE's from MBD and FE simulations

Project Visuals

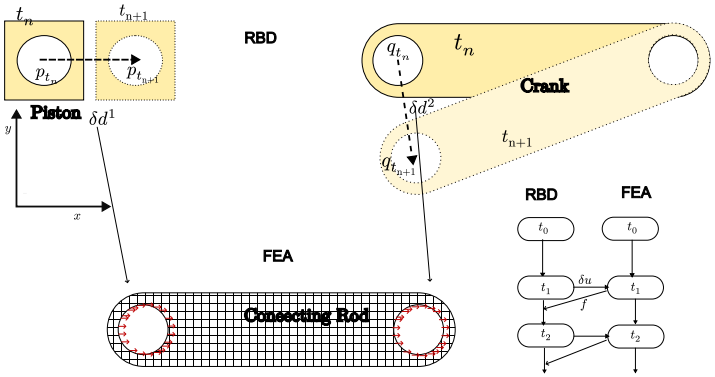

Figure 4: Co-simulation algorithm flowchart

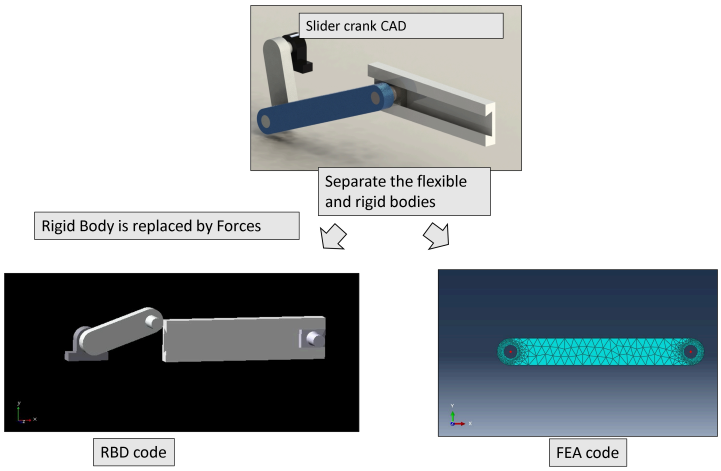

Figure 5: Simulation setup

,

Tools & Technologies

Ferrite.jl Julia

Simulation of a Forest Machinery

Category:Simulation

Man Machine Interaction (RWTH Institute)

RWTH Aachen University | Aug 2023 - Mar 2025

Objectives

- To analyze the deformation and vibrational performance of a forest harvester's frame under operational loads.
- Build a simulation in MSC Adams and Abaqus using CAD files provided by the vendor.
- Provide recommendations for design improvements based on simulation results.

Implementation & Methodology

- Built a MBD simulation in Adams and Abaqus.
- Used real world scenarios to generate loads on the harvester frame.
- Converted the critial part to a flexible body to analyze dynamic loads.
- Exported these loads to Abaqus for FE analysis.
- Evaluated the machine's vibrational behavior under operational loads and control inputs.

Learning Outcomes

- Using MSC Adams for rigid/flexible multi-body simulations.
- Using loads generated from multi-body simulations in FE software Abaqus.
- How modal frequencies affect vibrational characteristics of mechanical systems.

Project Visuals

Figure 6: Forest Harvester

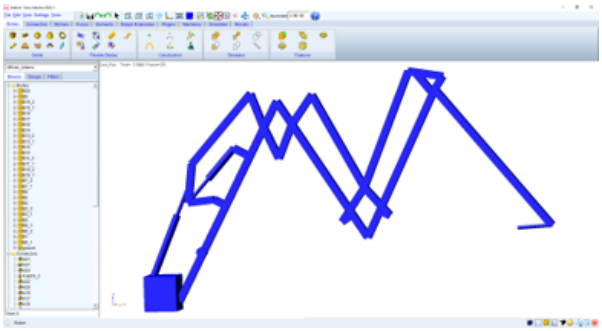

Figure 7: Simulation setup in MSC Adams

,

Tools & Technologies

MSC Adams Abaqus

Simulation of a Double Wishbone Suspension

Category:Simulation

IGMR(RWTH Institute)

RWTH Aachen University | May 2023 - Sept 2023

Task Description

- To simulate various load cases(**DLC2** & **DLC4**) on a double wishbone suspension system using a custom MATLAB/Simulink code.
- To perform the simulation for various time steps and time integrations schemes and quantify the results.
- To identify the best method for such highly oscillatory systems.

Implementation & Methodology

- Performed and evaluated simulations to a reference solution.
- Scored every time integration method on accuracy, stability.
- Documented the findings in a detailed report using LaTeX.

Learning Outcomes

- Understood the floating frame of reference formulation in MBD simulations.
- Learned various time integration schemes for solving ODE's in dynamic simulations.
- Gained experience in comparing numerical methods using a scientific approach.

Tools & Technologies

MATLAB/Simulink MS Office

Project Visuals

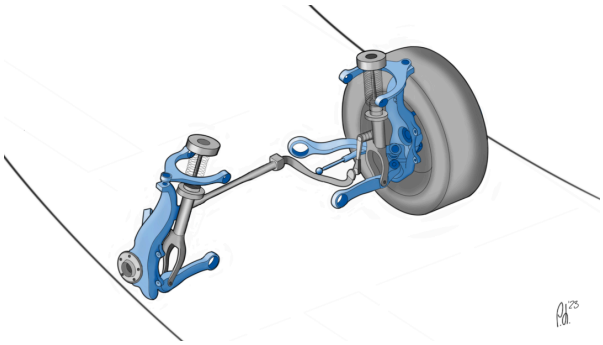

Figure 8: Suspension system CAD model

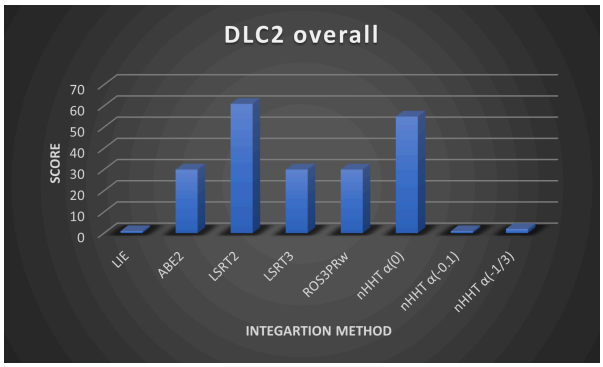

Figure 9: Performace for the loadcase DLC2

,

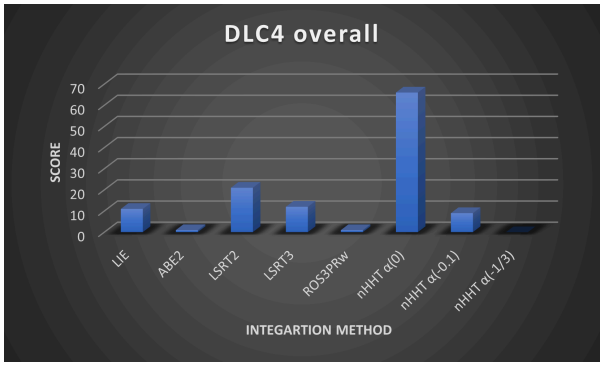

Figure 10: Performace for the loadcase DLC4

Pre-Processor for a MBD simulations

Category: Programming

Objectives

- To develop a tool with GUI to act as a pre-processor to create joints , forces , frames for simulation of multi-body systems.
- The tool would be able to export the model data like visualization mesh , joint, force, frame, body data as a json file that can be parser by any open-source MBD solver.
- The tool should be able to import CAD files in STEP format and visualize them.

Learning Outcomes

- Understood the principles of OOP in python.
- Gained first hand experience in using LLMs to build a useful application.

Implementation & Methodology

- By using PySide6 for GUI development and PythonOCC for CAD file handling and visualization I was able to ***vibe code*** a user-friendly pre-processor tool.
- This tool streamlines the workflow by importing STEP files and automatically calculating mass and inertia. Using the GUI, users can define joints, frames, forces, torques, and motors.

Tools & Technologies

PythonOCC, PySide6 , Github Copilot

Demo Video Here

Project Visuals

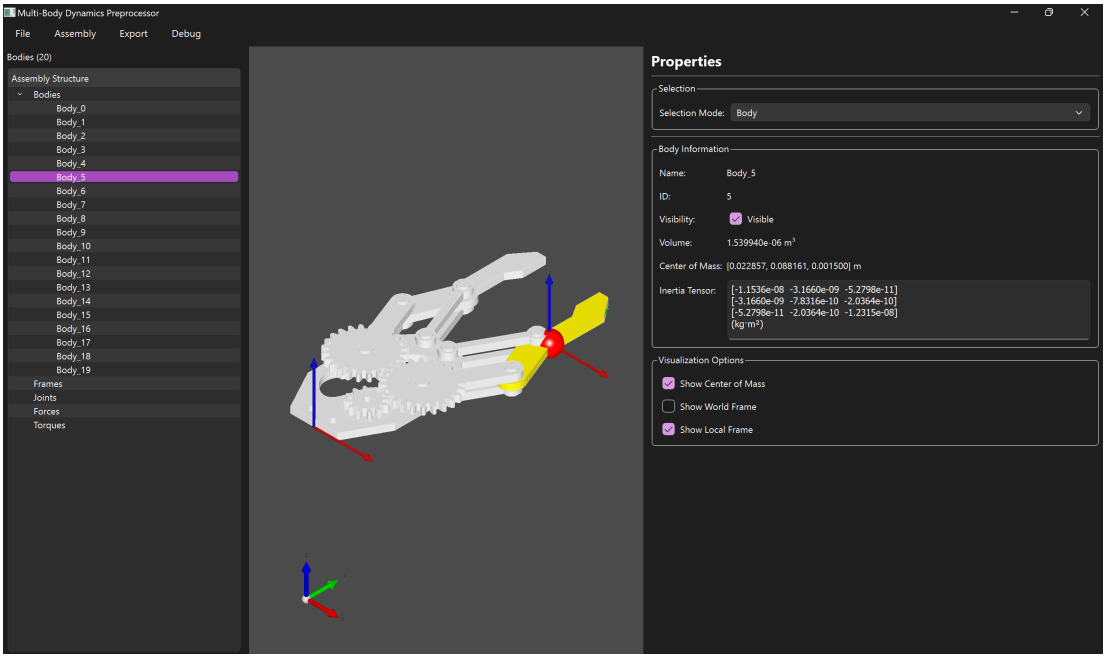

Figure 11: MBD Pre-processor GUI screenshot