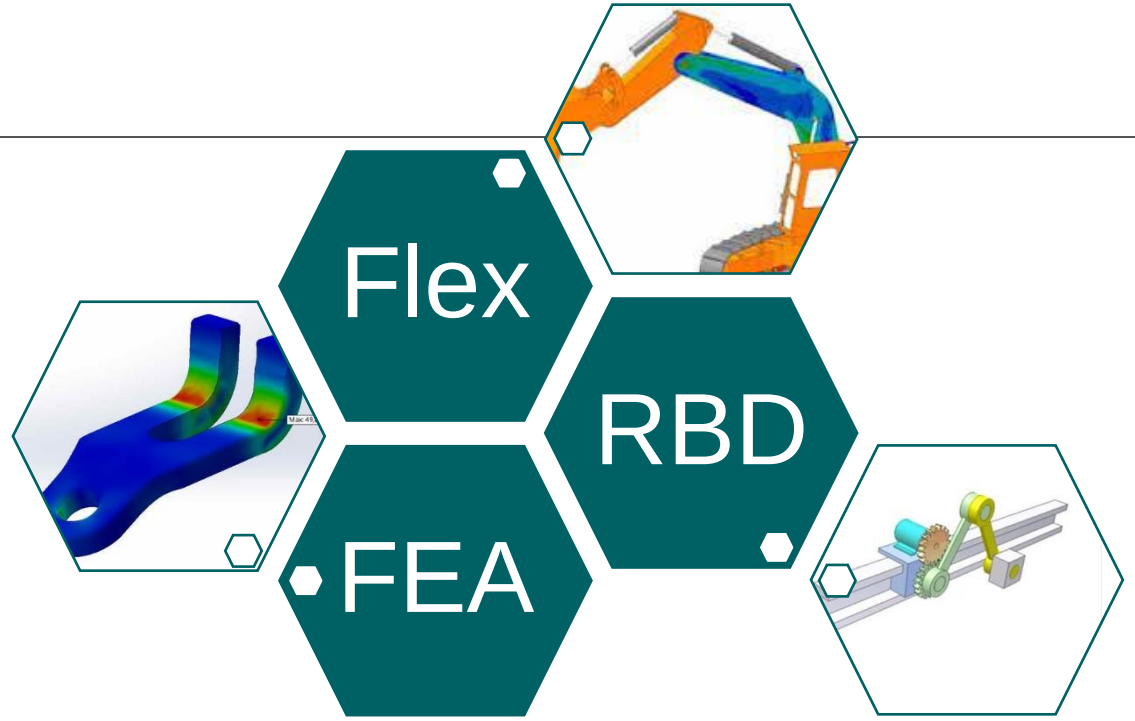

Thesis Progress Presentation

Direct Integration of Structural Simulation Results into Rigid Body Dynamics

Thesis progress presentation | 03.09.2024
Institut für Mensch-Maschine-Interaktion | www.mmi.rwth-aachen.de
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Institut für Mensch-Maschine-Interaktion

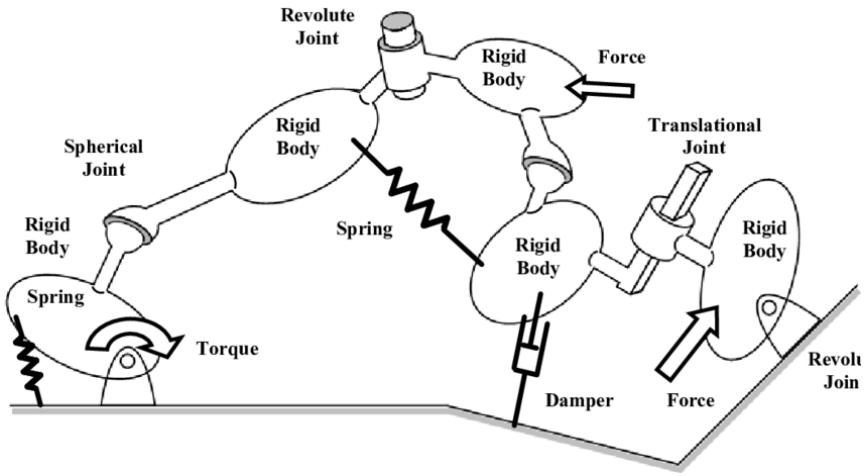
RWTH AACHEN UNIVERSITY

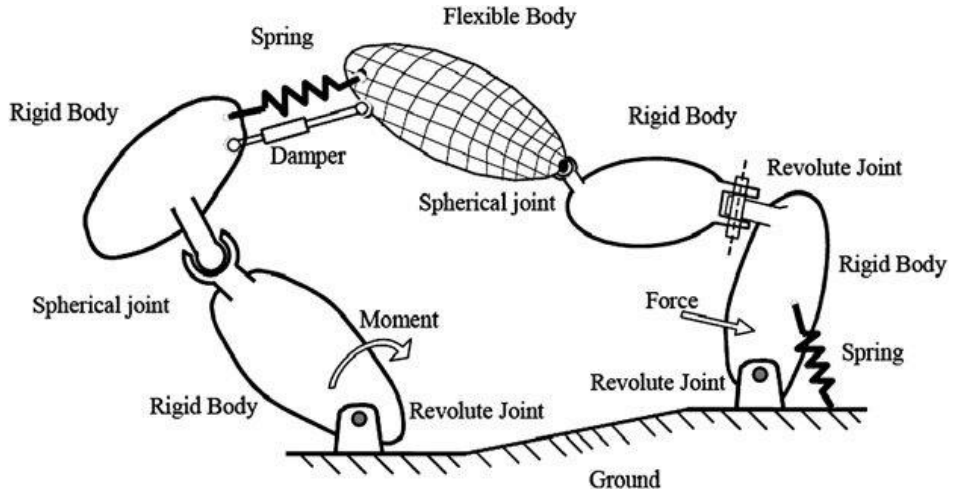
Organizational Info & Thesis Goal

Advisors : Dorit Kaufmann (MMI) , Jan-Lukas Archut (IGMR)
Time duration of the thesis : **22 Weeks**
Course : MSc CAME (Faculty 4 Mechanical Engineering)

Goal :

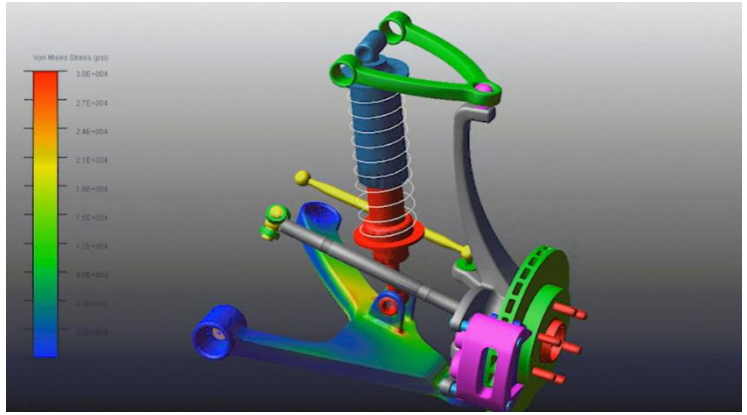
Test a simulation approach that can help in including a flexible body in a RBD simulation.



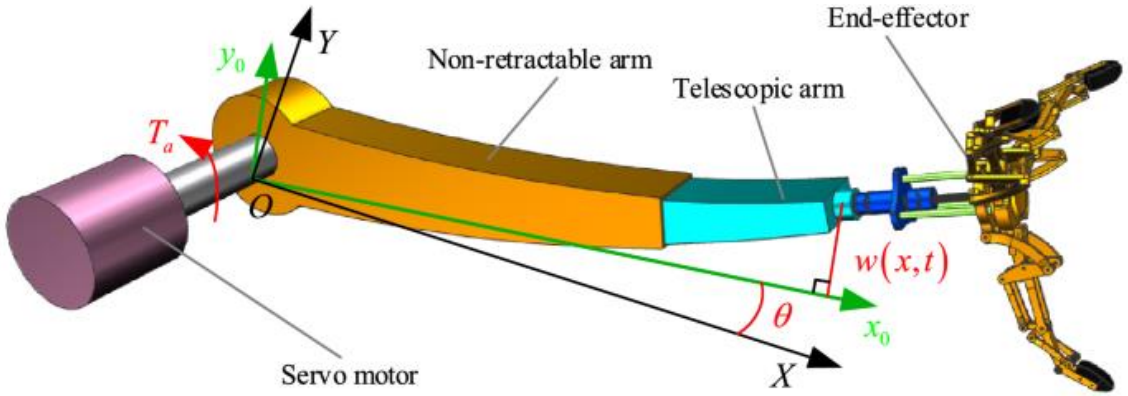


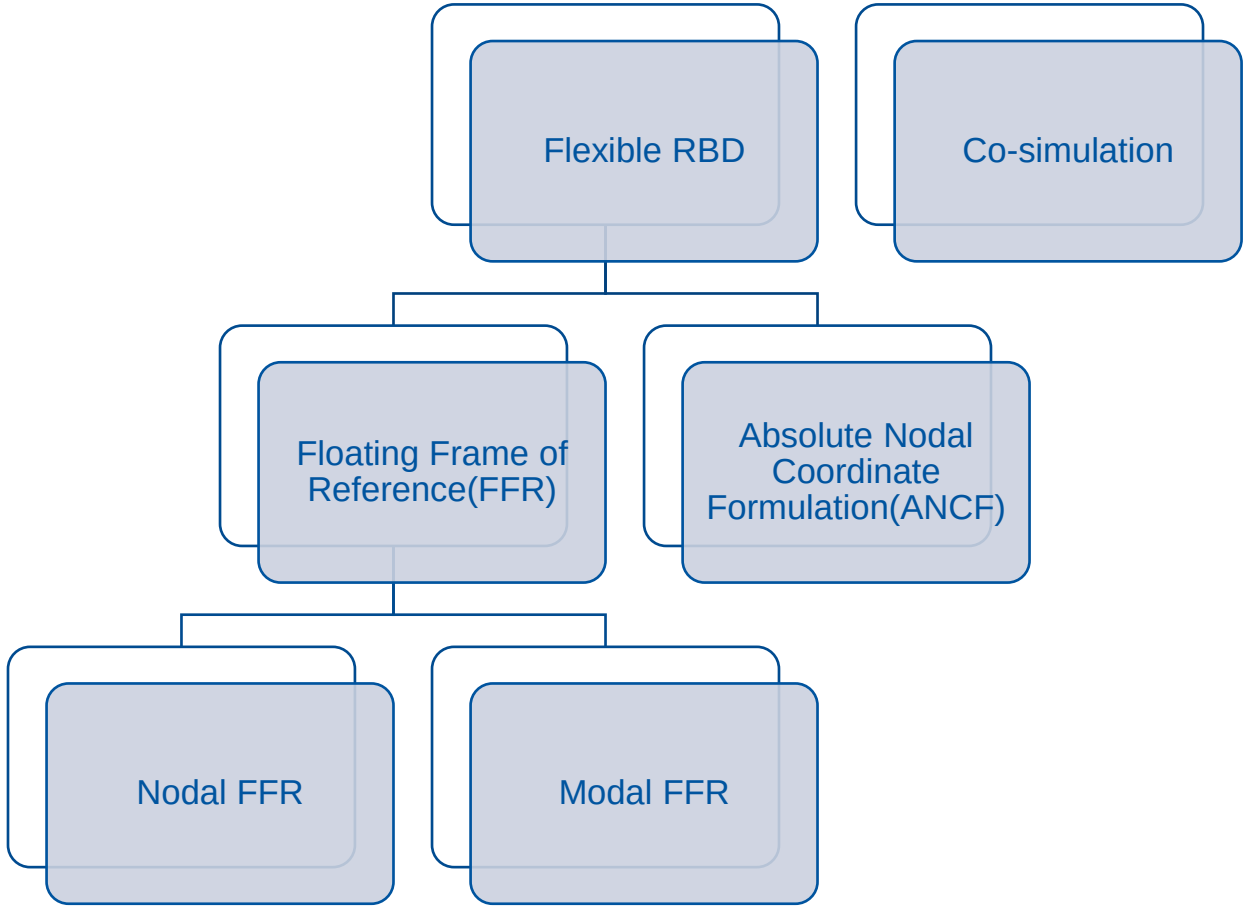
State of the art

Design Optimizations



Control of flexible parts





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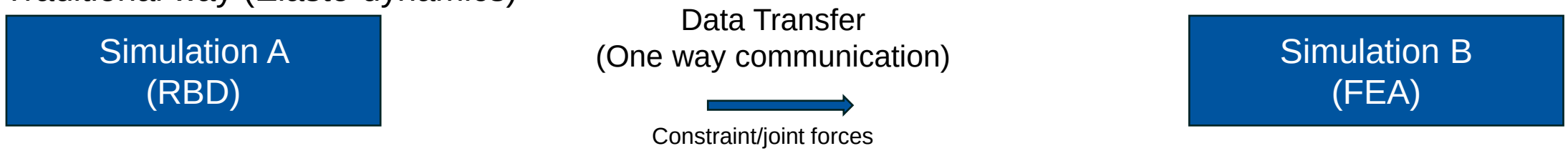
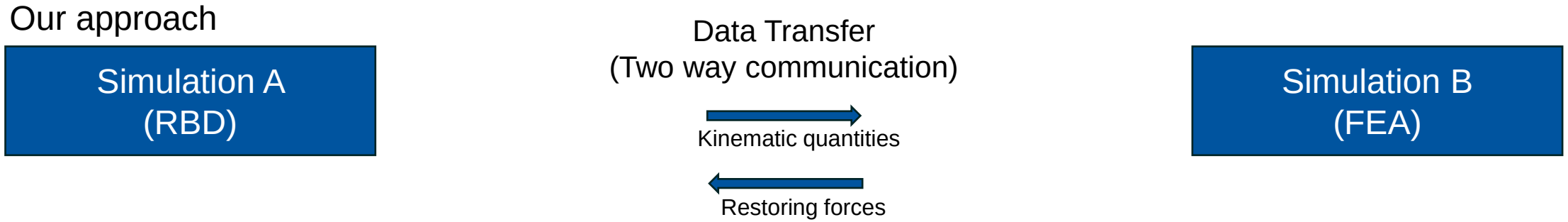
Co-simulation

Traditional way (Elasto-dynamics)



Our approach



Why Co-simulation :

- Pre-existing codes can be utilized avoiding starting from the ground up
- A code that transfers data between the two codes needs to be written

Methodology

Theory

The DAE equation of Motion in RBD :

$$M\ddot{q} - S(q, \dot{q}, t) - Q(q, t) + J(q, t)^T * \lambda = 0$$
$$C(q, t) = 0$$

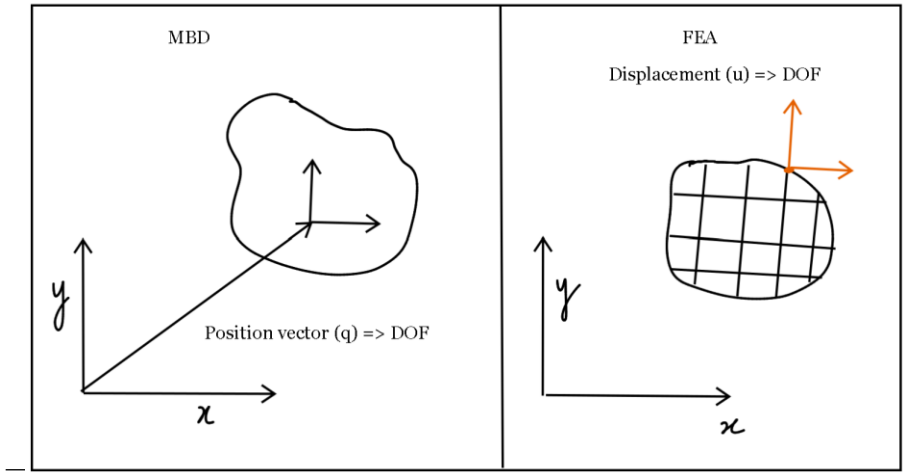
The EOMs of FEA are

Static case :

$$Ku = f$$

Dynamic case :

$$M\ddot{u} + C\dot{u} + Ku = f$$



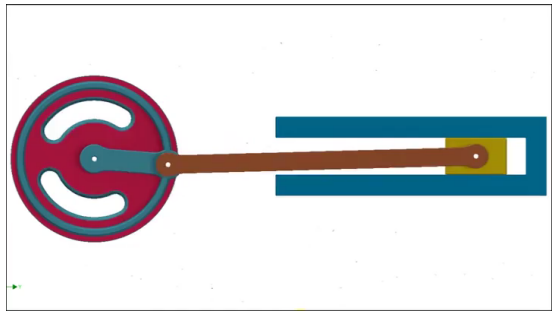
Implementation

The RBD was coded from scratch in Julia programming.

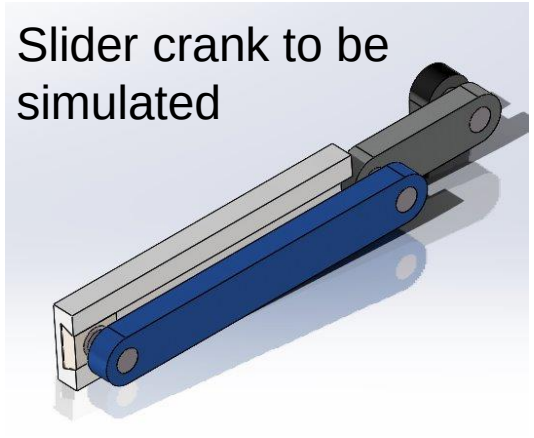
For the FEA part the two Matrices M , K were imported from Abaqus and solved in Julia

So almost everything was done in Julia.

The co-simulation algorithm

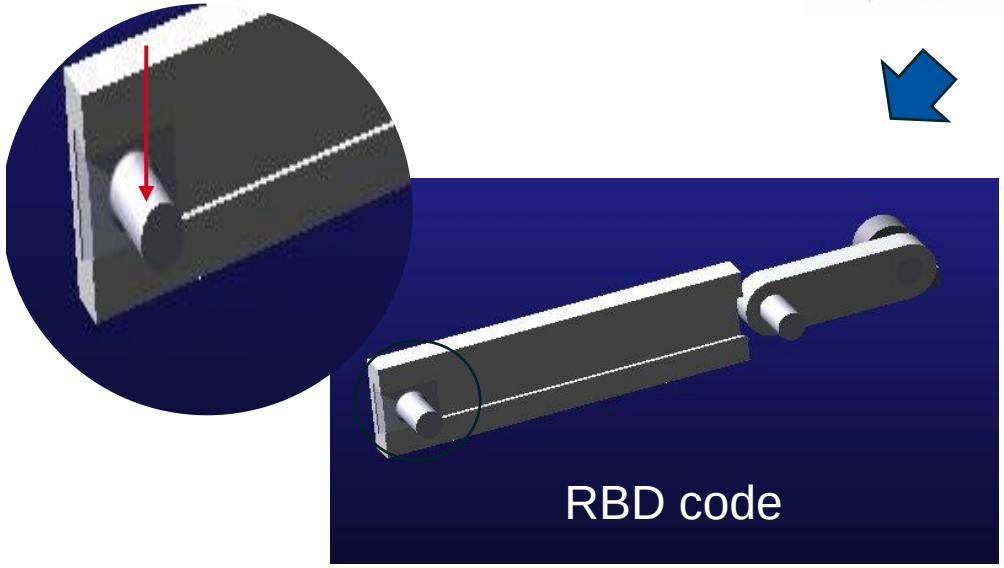


Slider crank to be simulated

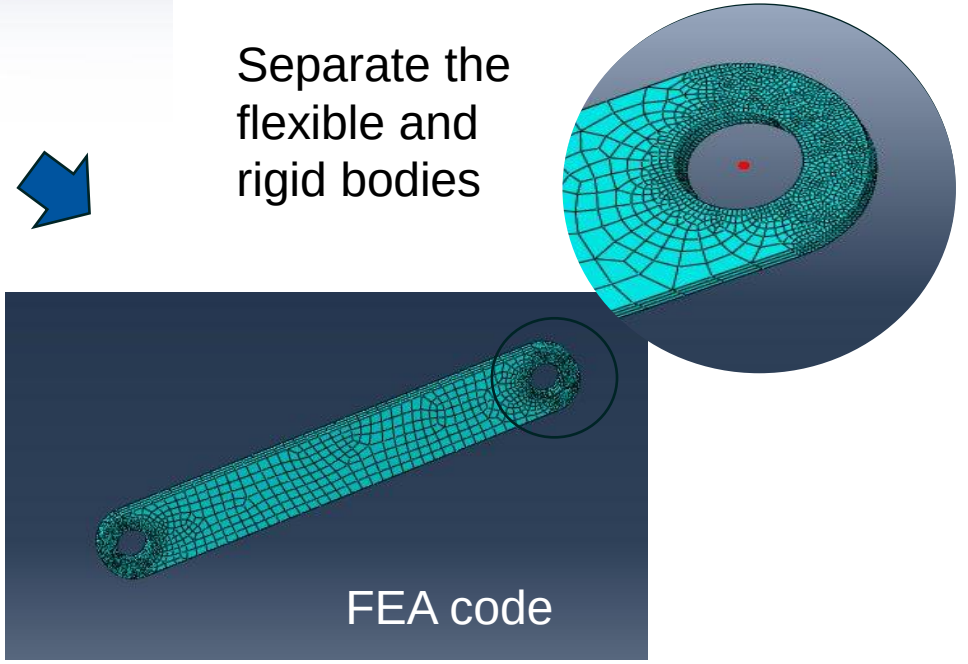


Interface node that receives Kinematic quantities from RBD

Interface node that recieves Force from FEA



Separate the flexible and rigid bodies



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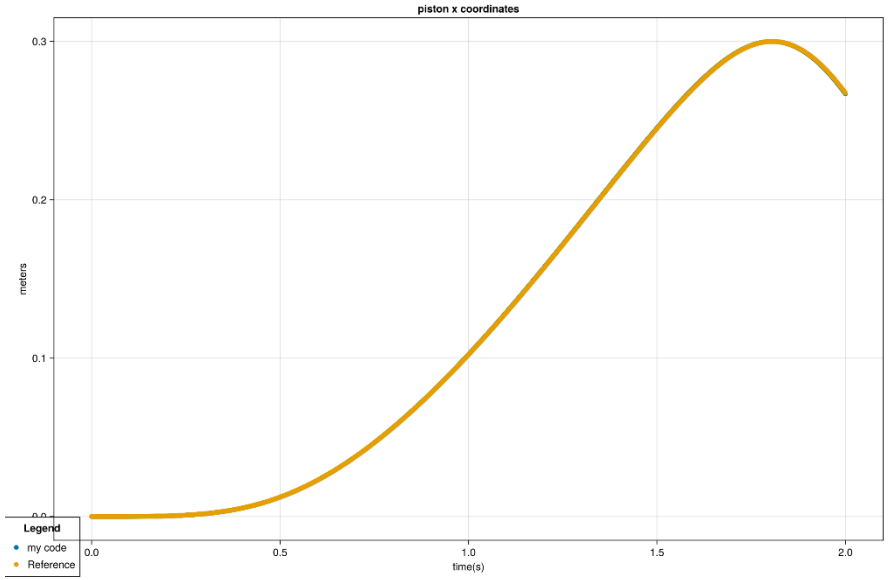
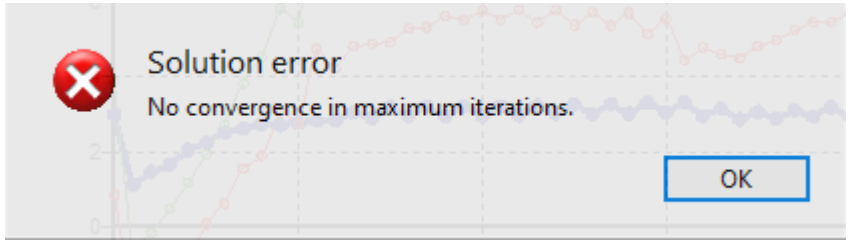
Progress and Findings

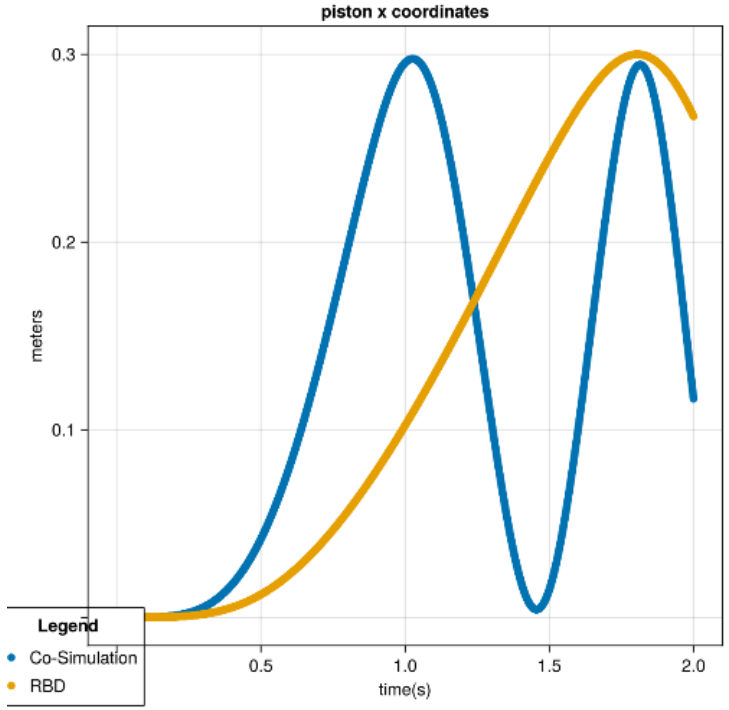
Validation of custom code to Adams RBD



RBD with Transient FEA
(includes inertia of the deformable body)



RBD with Static FEA
(doesn't include inertia of the deformable body)



Reasons that

- FEA is not known to be used for rigid body motion.
- Hard to find equilibrium at the interface nodes

Plan going forward

Thank you for your attention ☺

Utkarsh Kulkarni

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www.mmi.rwth-aachen.de
www.youtube.com/VEROSIMSimulation