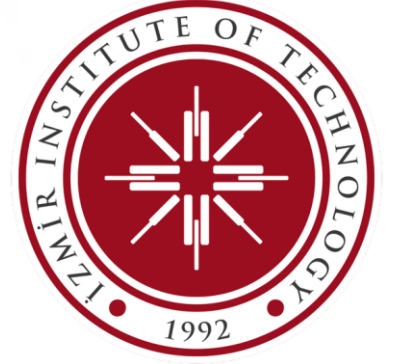# Simscape Multibody use
in
Robotics Courses

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Dynamic Modelling and Control of Robots
Course description and learning objectives

Undergraduate Level Course

4th Year Students

Technical Elective

Mechanical Engineering Cirriculum

Remote & Physical

Learning objective #1: Mechanism construction in CAD software

Learning objective #2: Dynamic modelling of robots

Learning objective #3: Task-oriented simulation of the robot

Learning objective #4: Creating the virtual reality representation of the robot

Learning objective #5: Controller design and tests in simulation environment

Dynamic Modelling and Control of Robots
Reason for adoption MATLAB and Simulink Tool

- It is a rapid way to **test and validate** the theory in simulation environment.

- **Open for improvements in the modeling** of robots, actuation system, etc.

- Can take it to the next levels in terms of **HIL and finally embedding** the optimized controllers to a µProcesor.
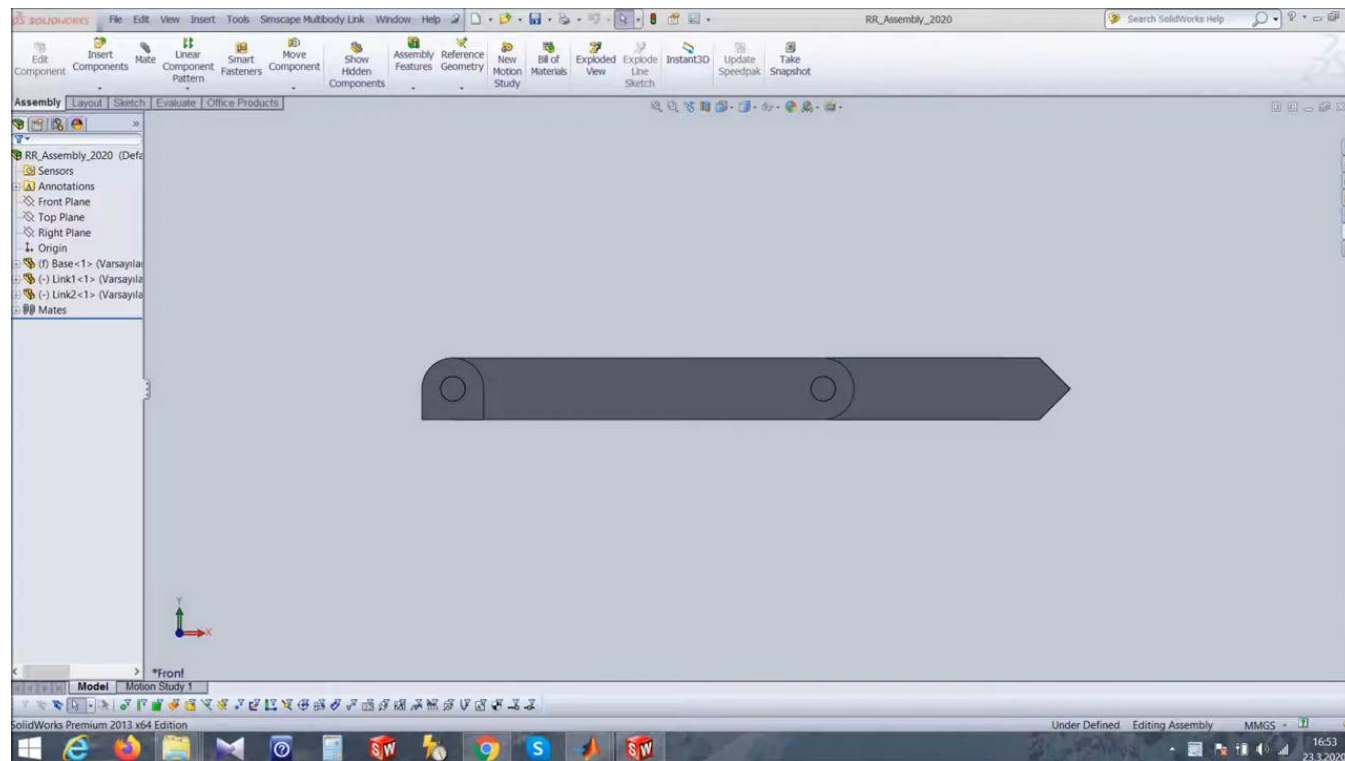
How MATLAB and Simulink were used in the course

- The **kinematic models** of the robot manipulator are derived.
- **A CAD model** is developed with the same kinematics in a CAD software that is compatible Simscape Multibody Link.
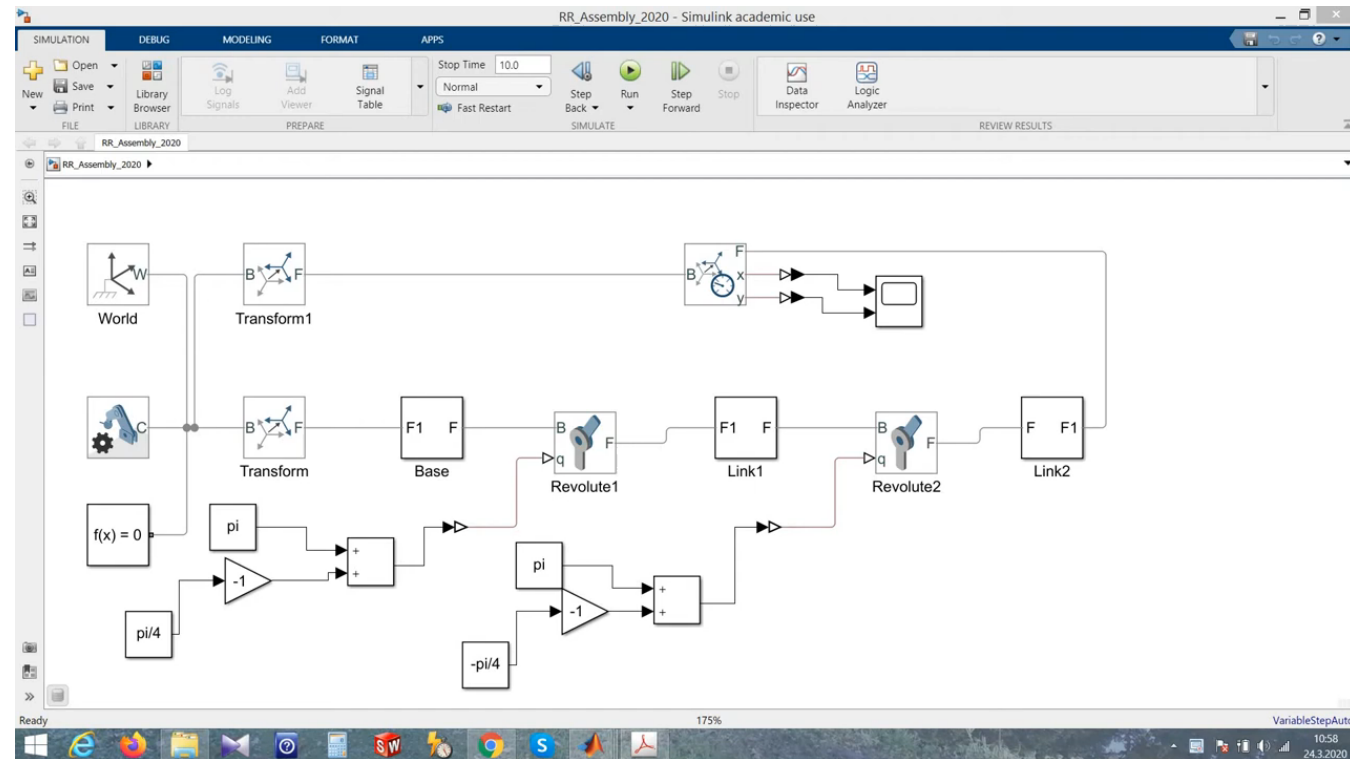
How MATLAB and Simulink were used in the course

- The CAD model is translated to **Simcape model** via Simscape Multibody Link.

How MATLAB and Simulink were used in the course

- **Kinematic models are validated** using the Simscape Model

How MATLAB and Simulink were used in the course

- The **dynamic model** of the robot manipulator is derived.
- **Dynamic model is validated** using the Simscape Model.
- **Controller designs** are made and implemented in the Simulink file containing the Simscape Model.
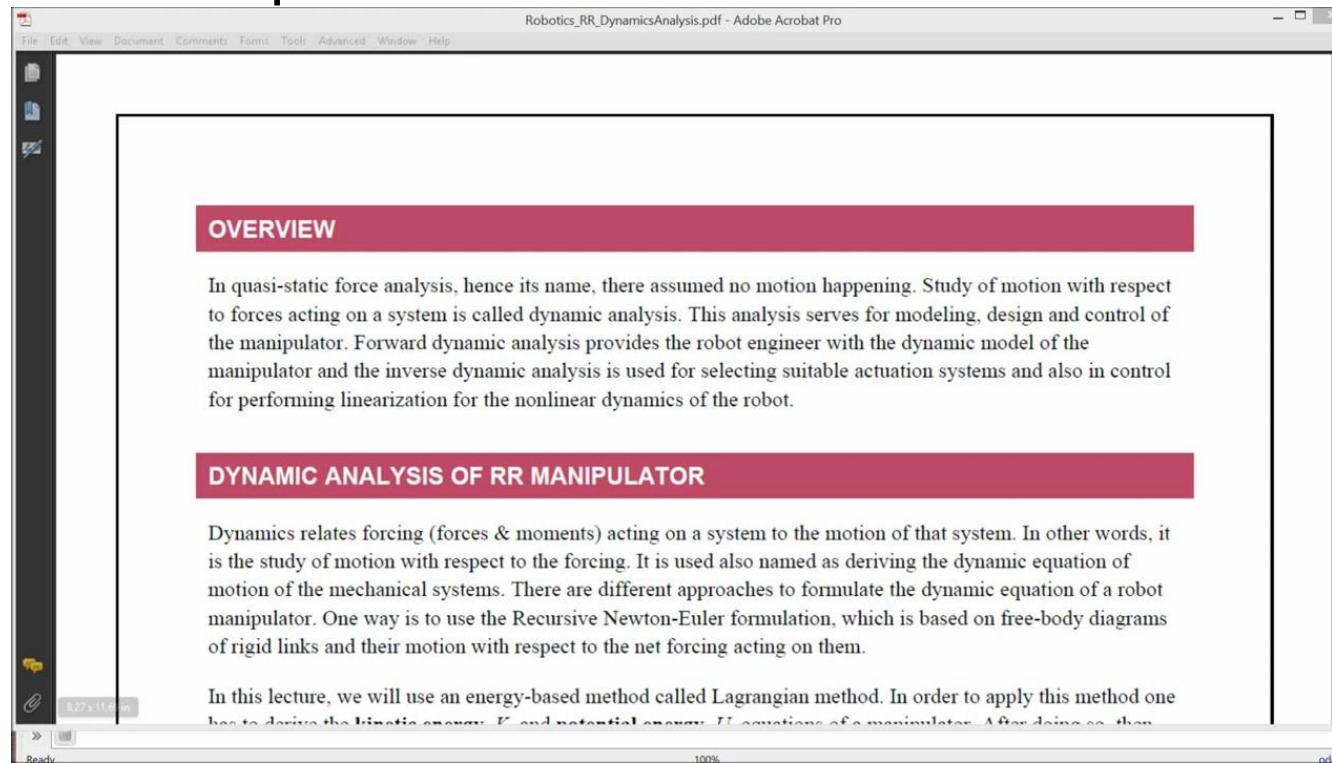
Benefits / added value of using MATLAB and Simulink

- Simscape model provides a virtual test setup for testing:
  - Kinematic models
  - Dynamic model
  - Controller designs
- A fast and relatively easy method to test the models when the CAD model of a robot mechanism is available.
- Possibility of the integration of actuation and sensor models as well as external effects through the use of other Simscape blocksets and Simulink blocks

Results obtained and personal considerations

- ## Students:
  - Enjoyed the course and implemented the methods for their own interests
  - Found jobs easily especially in ECU programming companies and companies developing their own controllers

- ## Robotics lab:
  - Ready to handle HIL tests running in the lab

- ## Personal considerations:
  - V-Realm support is discontinued ☹
  - Simscape Multibody Link does not support newer versions of some CAD software
  - Self-Paced Online Courses do not include Multibody

Future plans

- Use Multibody in graduate level courses:
    - Advanced Dynamics
    - Haptics and Teleoperation

Thank you

Q&A – 5min

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