Robotics Courseware Catalog
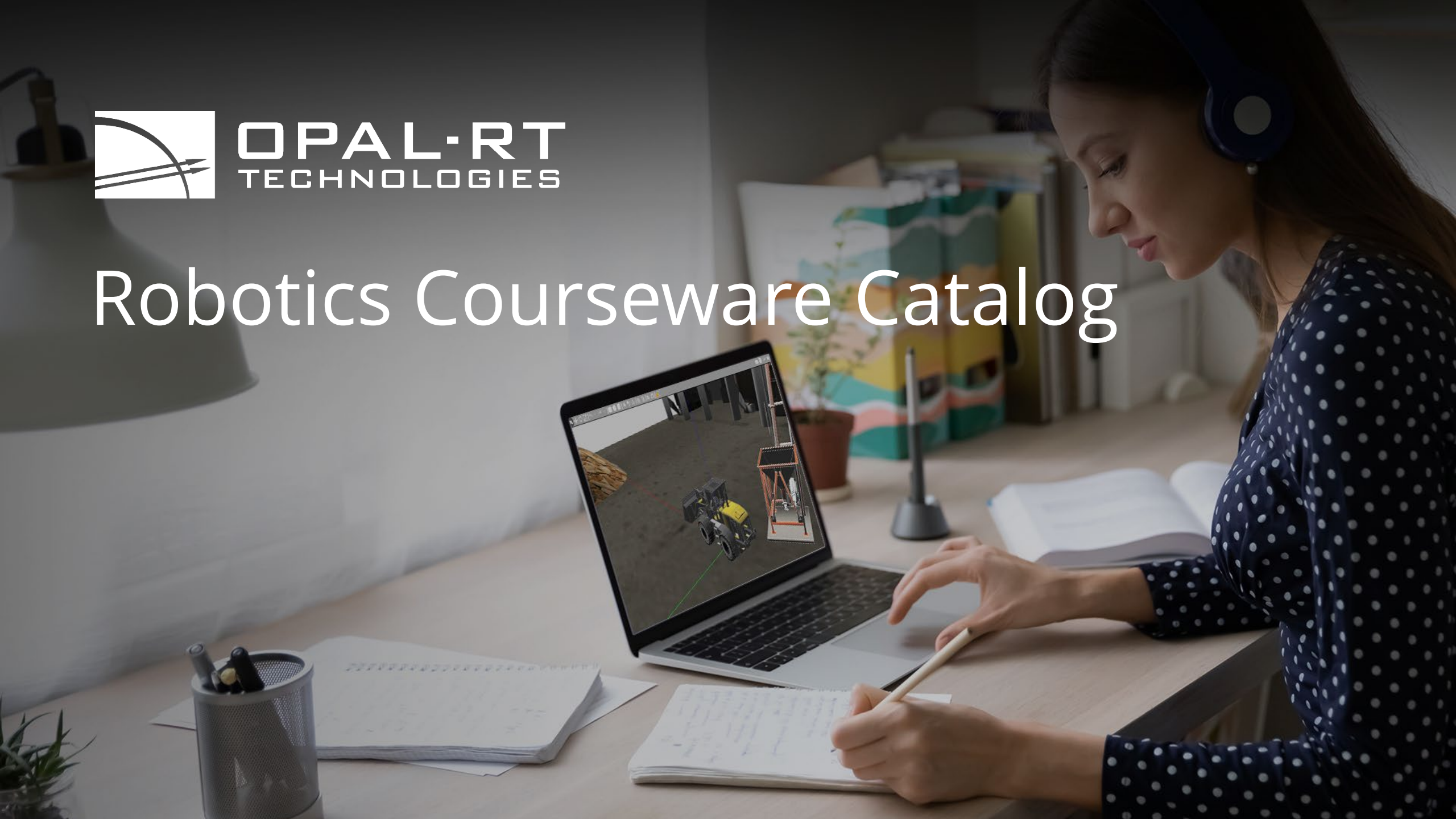
OPAL-RT TECHNOLOGIES

- Serial Robotics Manipulators

- Wheeled Mobile Robots

- Autonomous Off-Road Vehicles

Serial Robotics Manipulators
Wheeled Mobile Robots
Autonomous Off-Road Vehicles

3dof Planar Robot
FANUC LRMate 200 iC
UR10e

SERIAL ROBOTICS MANIPULATORS

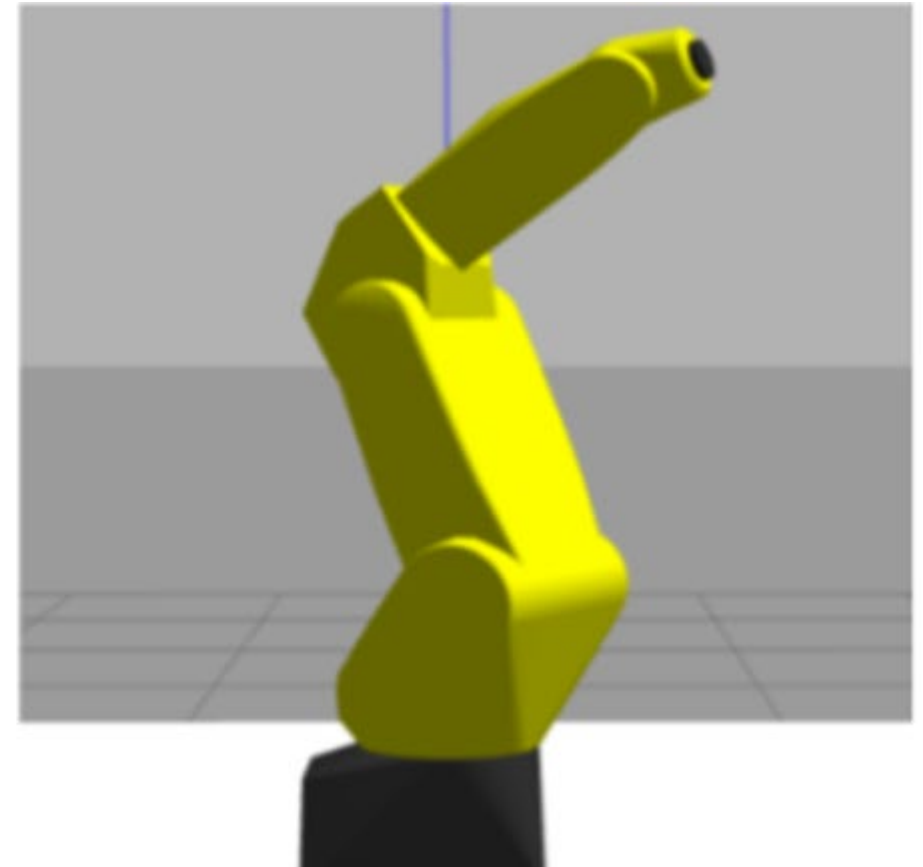| Topic	Suggested Lab Sessions
3-dof Planar Robot	DH-table & Homogeneous transformations
	Direct & Inverse Displacement Analysis
	Decoupled architecture (two positioning + one orientation)
	Kinetostatics & Jacobian analysis
	Position & speed joints control
	Trajectory generation with polynomial interpolation
	End-effector (EE) control for pick-and-place operation
FANUC LRMAte 200 iC	Same items as above
	6-dof spatial robot: 3D Rotation & Quaternion
	Decoupled architecture (three positioning + three orientation)
	Dynamics & gravity impact
	Joints & EE control (with gravity)
UR10e	Same items as above except with non-decoupled architecture
	EE Force-based control

SERIAL ROBOTICS MANIPULATORS

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FANUC LRMate 200 iC
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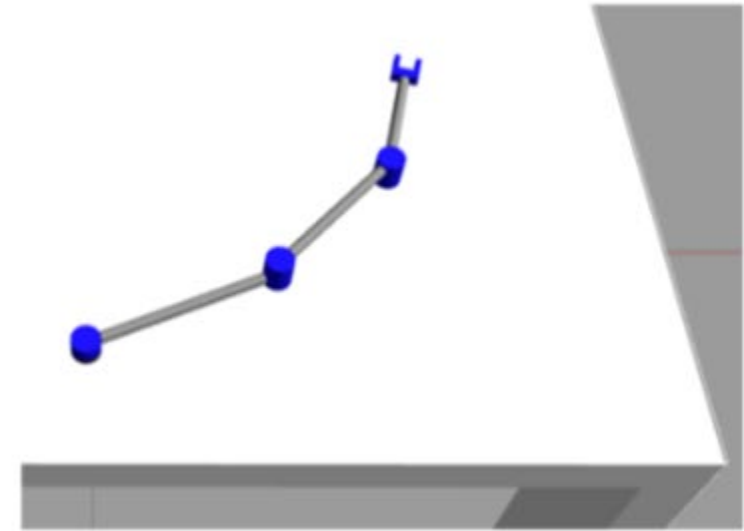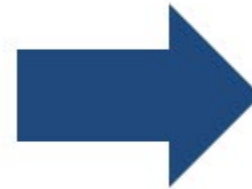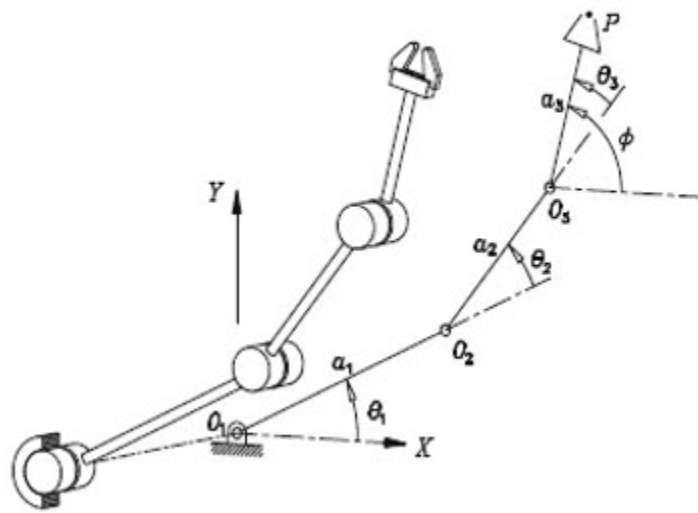
Courtesy of Prof. J. Angeles
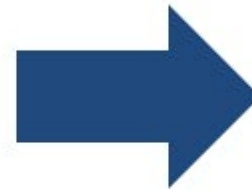Fundamental of Robotics Mechanical Systems

SERIAL ROBOTICS MANIPULATORS

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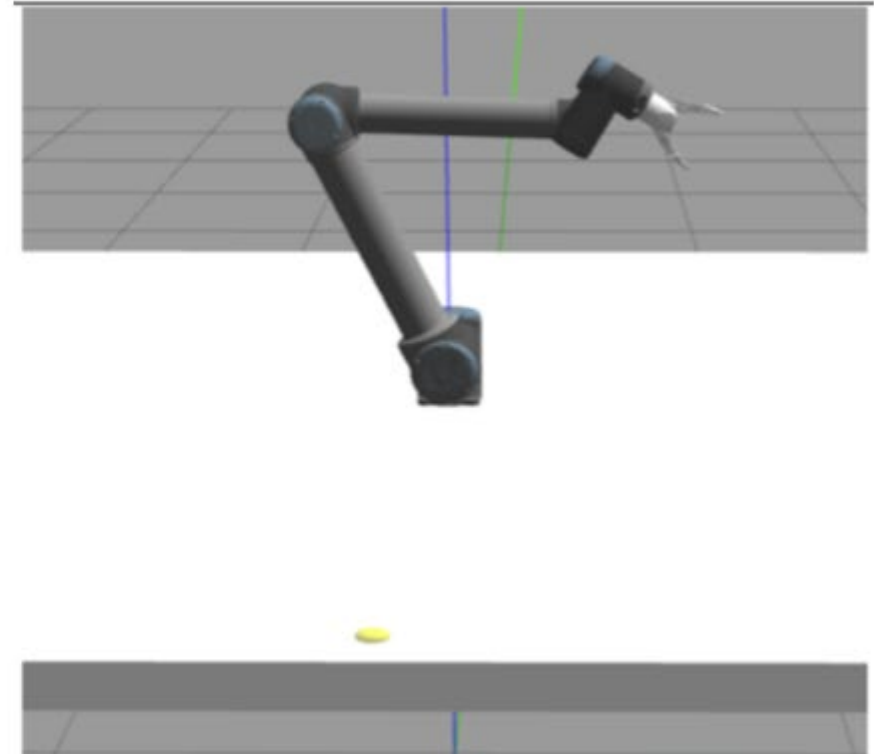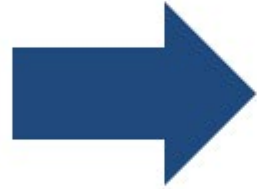**OPAL·RT**
TECHNOLOGIES

Courtesy of FANUC

SERIAL ROBOTICS MANIPULATORS

Serial Robotics Manipulators
Wheeled Mobile Robots
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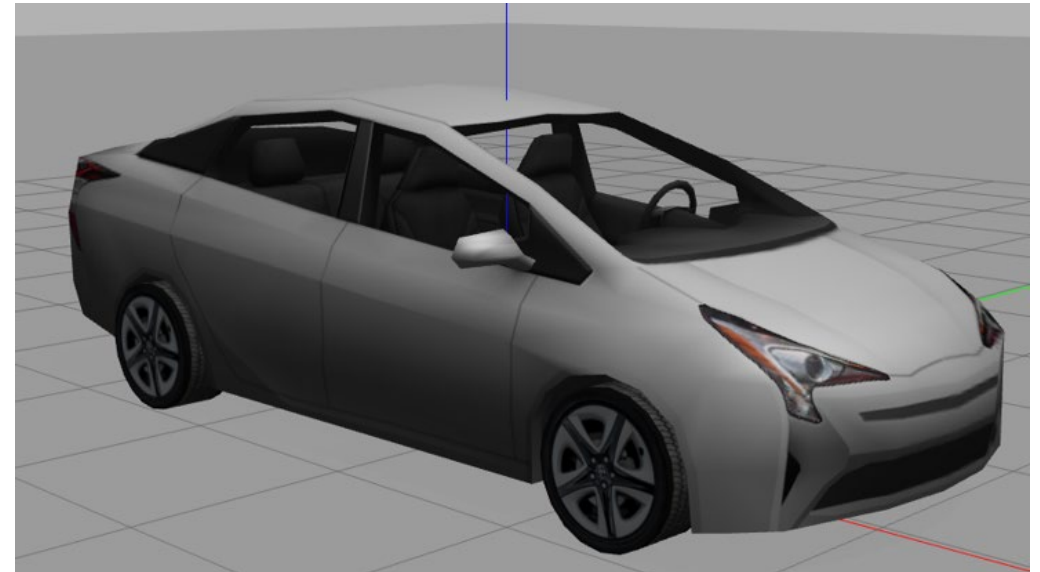3dof Planar Robot
FANUC LRMate 200 iC
UR10e

Courtesy of UR10e

WHEELED MOBILE ROBOTS

Serial Robotics Manipulators
Wheeled Mobile Robots
Autonomous Off-Road Vehicles

Ackermann-based steering
Articulated-based steering
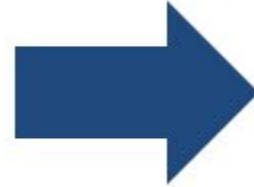Differential Drive robot
Mobile wheeled Pendulum

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Topic	Suggested Lab Sessions
Ackermann-based steering	Nonholonomic constraints & Kinematics model
	Dynamics model in Gazebo
	Nonlinear change of coordinates: One-chained system form
	Trajectory generation for point-to-point motion
	Navigation & Control
Articulated-based steering	Nonholonomic constraints & Kinematics
	Dynamics model in Gazebo
	Navigation & Control
Differential Drive Robot	Same items as above
	Lyapunov function for navigation with sliding mode control
Mobile Wheeled Pendulum	Same items as DDR
	Input-Output Linearization & Unstable zero-dynamics

WHEELED MOBILE ROBOTS

Serial Robotics Manipulators | **Ackermann-based steering**
Wheeled Mobile Robots | Articulated-based steering
Autonomous Off-Road Vehicles | Differential Drive robot
Mobile wheeled Pendulum

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TECHNOLOGIES

Courtesy of TOYOTA

WHEELED MOBILE ROBOTS

Serial Robotics Manipulators
Wheeled Mobile Robots
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Ackermann-based steering
Articulated-based steering
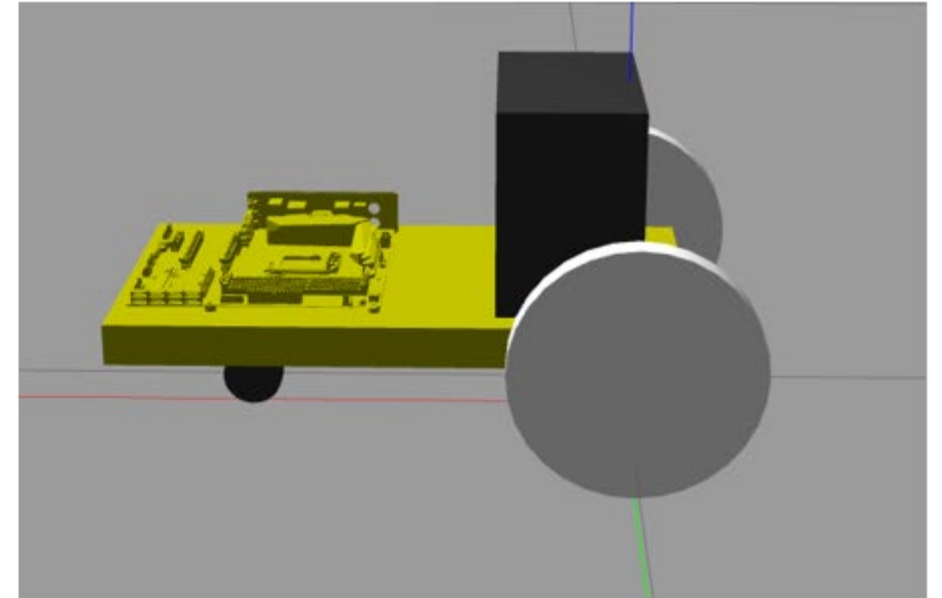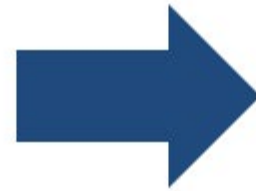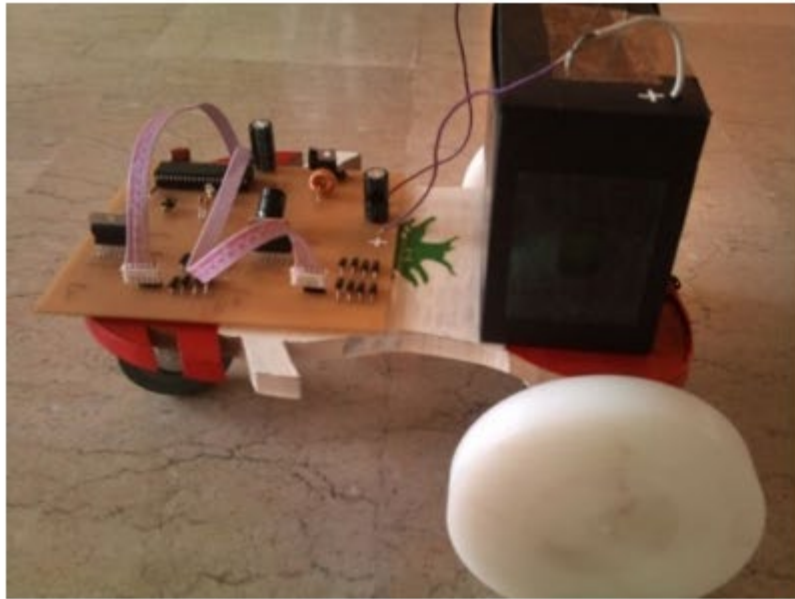Differential Drive robot
Mobile wheeled Pendulum

Courtesy of VOLVO

WHEELED MOBILE ROBOTS

Serial Robotics Manipulators
Wheeled Mobile Robots
Autonomous Off-Road Vehicles

Ackermann-based steering
Articulated-based steering
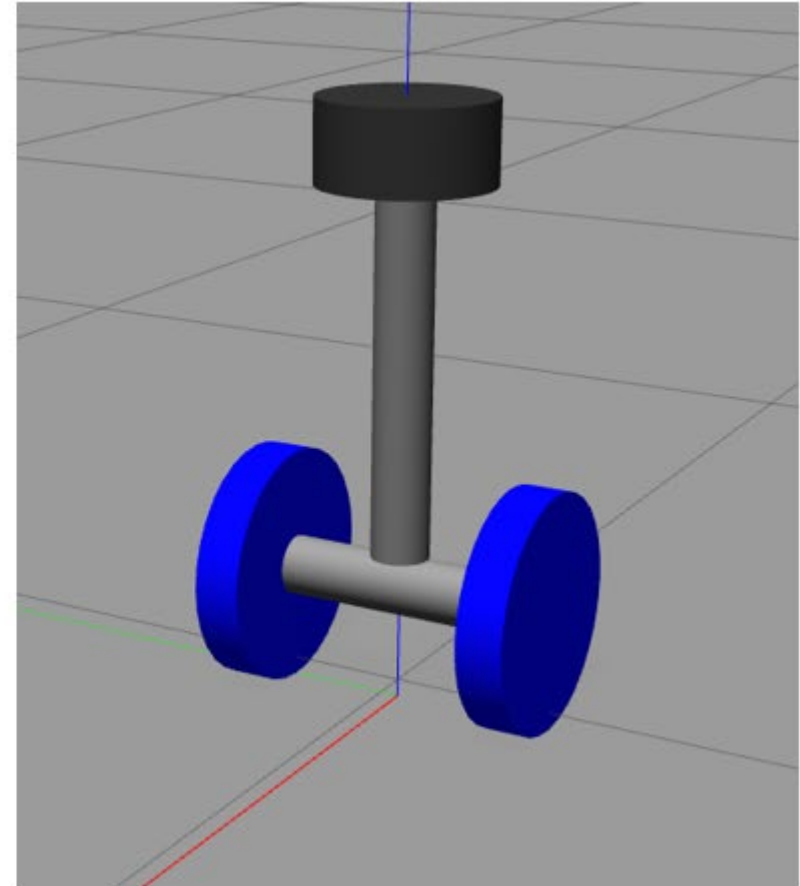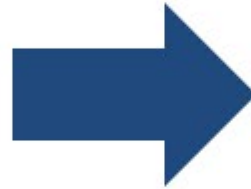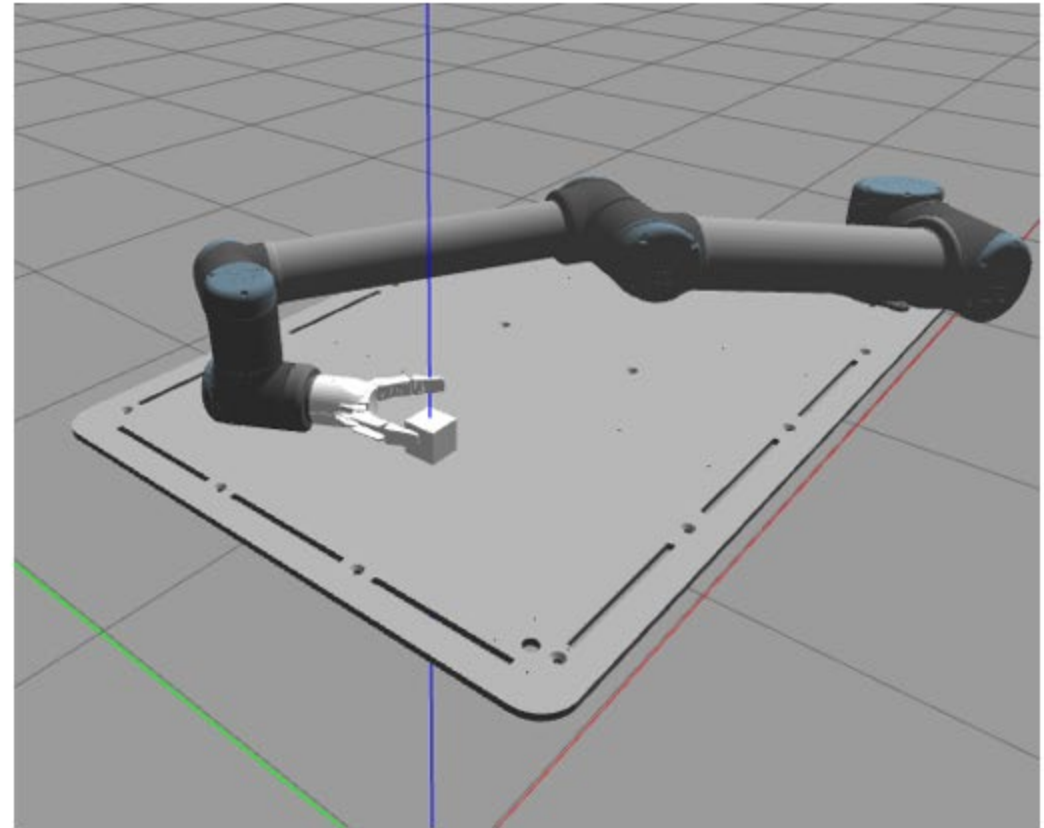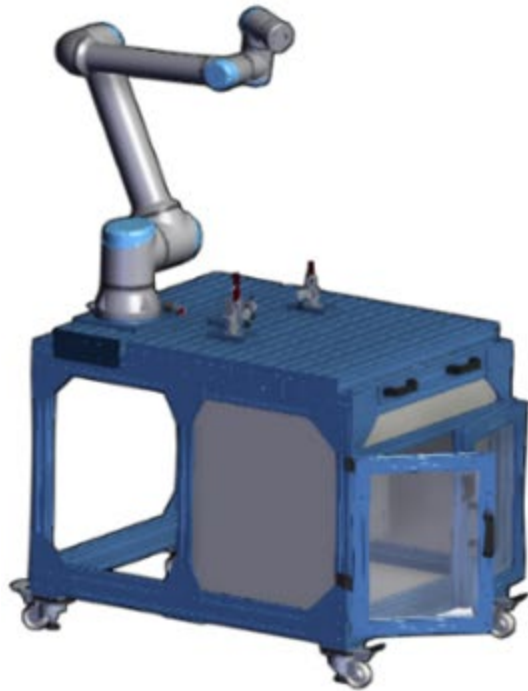**Differential Drive robot**
Mobile wheeled Pendulum

Courtesy of É.S.I.B

WHEELED MOBILE ROBOTS

Courtesy of É.T.S

AUTONOMOUS OFF-ROAD VEHICLES

Serial Robotics Manipulators
Wheeled Mobile Robots
Autonomous Off-Road Vehicles

DDR Platform & UR10e
Tractor & Mower Arm
Articulated Wheeled Loader

Topic	Suggested Lab Sessions
DDR Platform & UR10e	Navigation and control of the platform in a warehouse
	PPO for UR10e with grasping
Tractor & Mower arm	Navigation and control of the tractor
	Force-based control of the mower arm
Articulated Wheeled Loader	Navigation and control of the tractor
	Loading and unloading of the arm

AUTONOMOUS OFF-ROAD VEHICLES

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DDR Platform & UR10e
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OPAL·RT
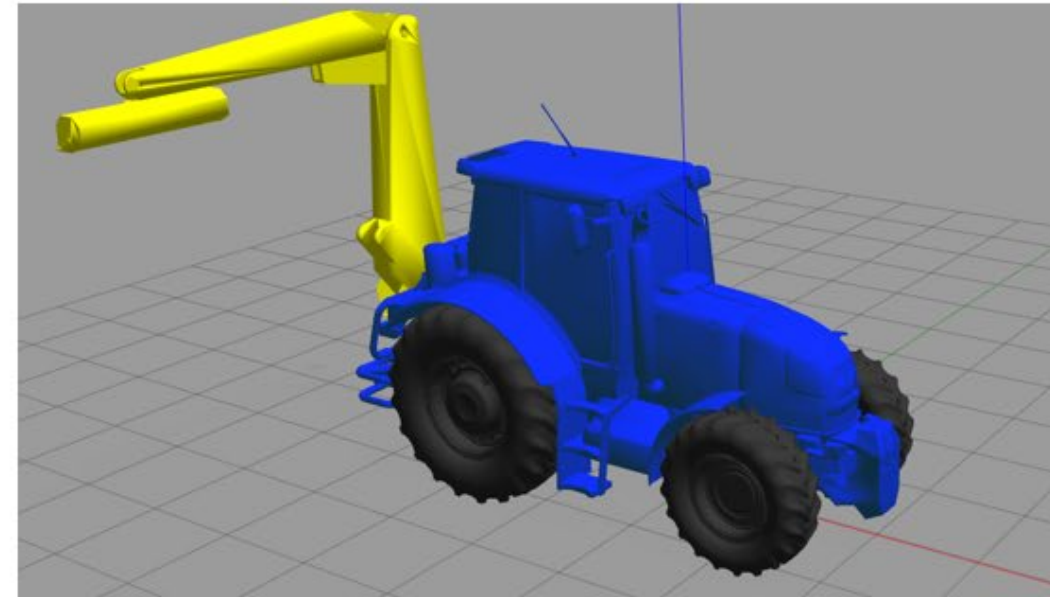TECHNOLOGIES

Courtesy of UR10e

AUTONOMOUS OFF-ROAD VEHICLES

Serial Robotics Manipulators
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DDR Platform & UR10e
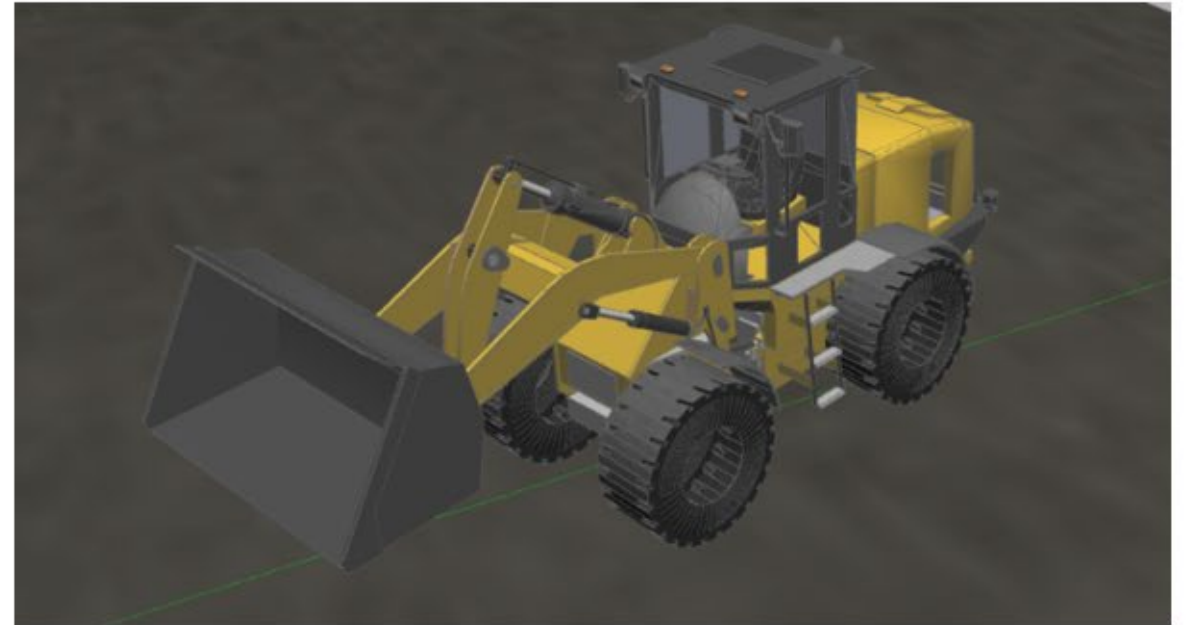**Tractor & Mower Arm**
Differential Drive robot

Courtesy of CNH Tractor

AUTONOMOUS OFF-ROAD VEHICLES

Serial Robotics Manipulators
Wheeled Mobile Robots
Autonomous Off-Road Vehicles

DDR Platform & UR10e
Tractor & Mower Arm
Articulated Wheeled Loader

Courtesy of VOLVO