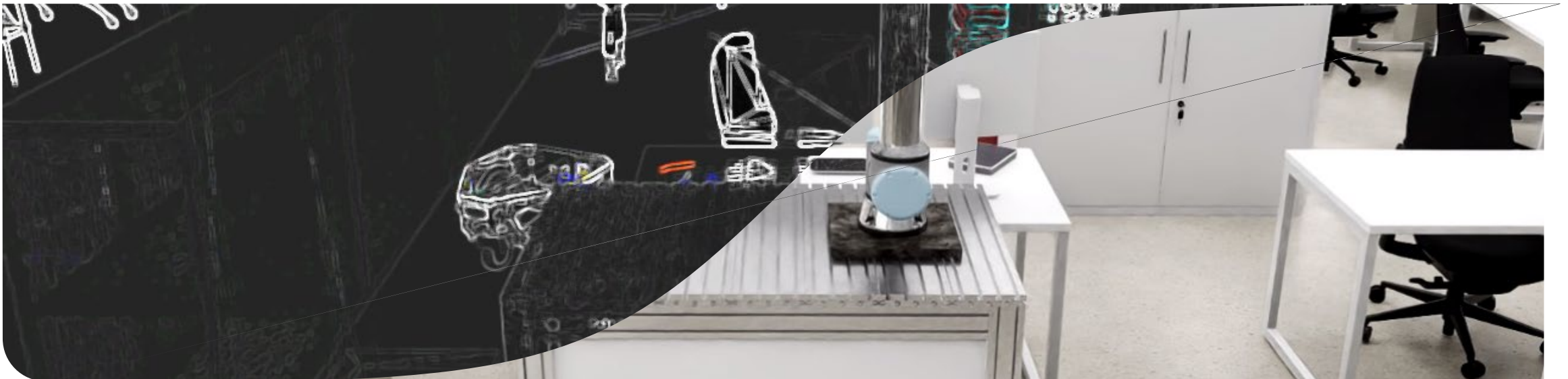
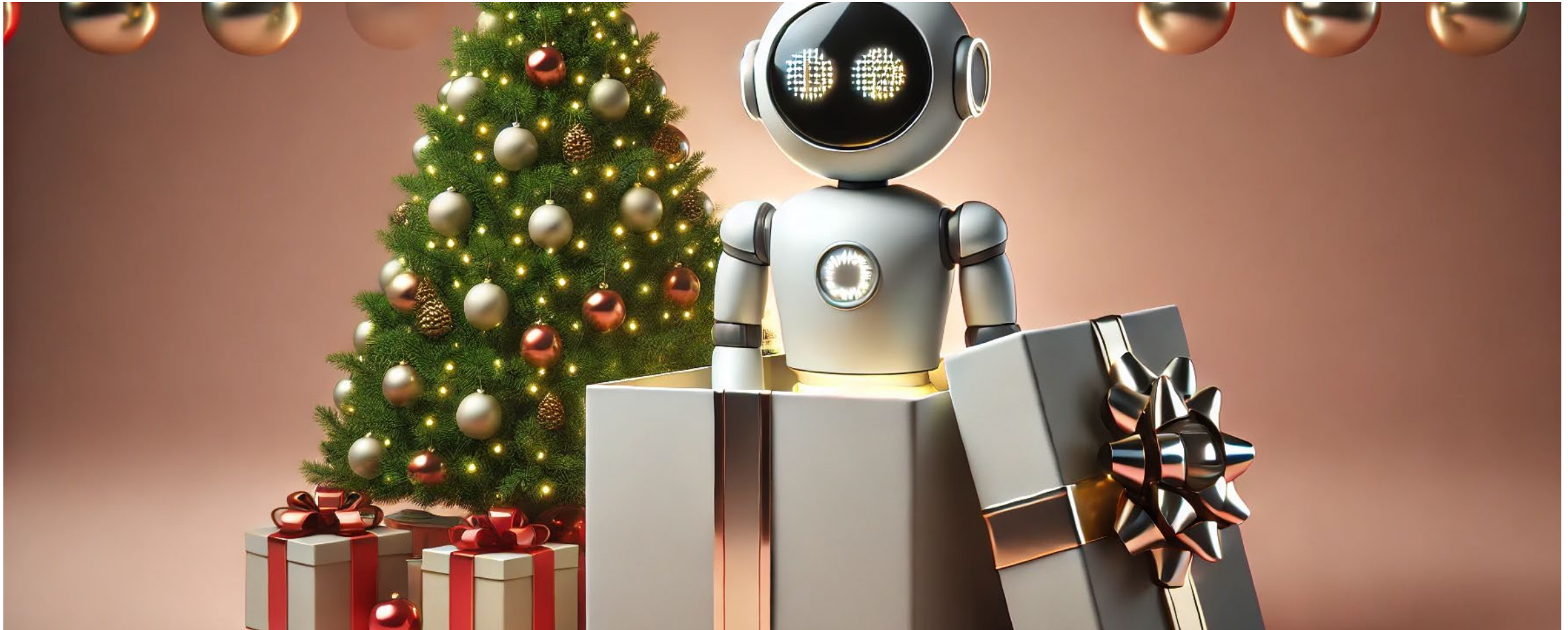


ROS2 Workflows in Omniverse Isaac Sim: Digital Twins & ros2_control.

ROSCon DE 2024



Free* robots to everyone!



Outline

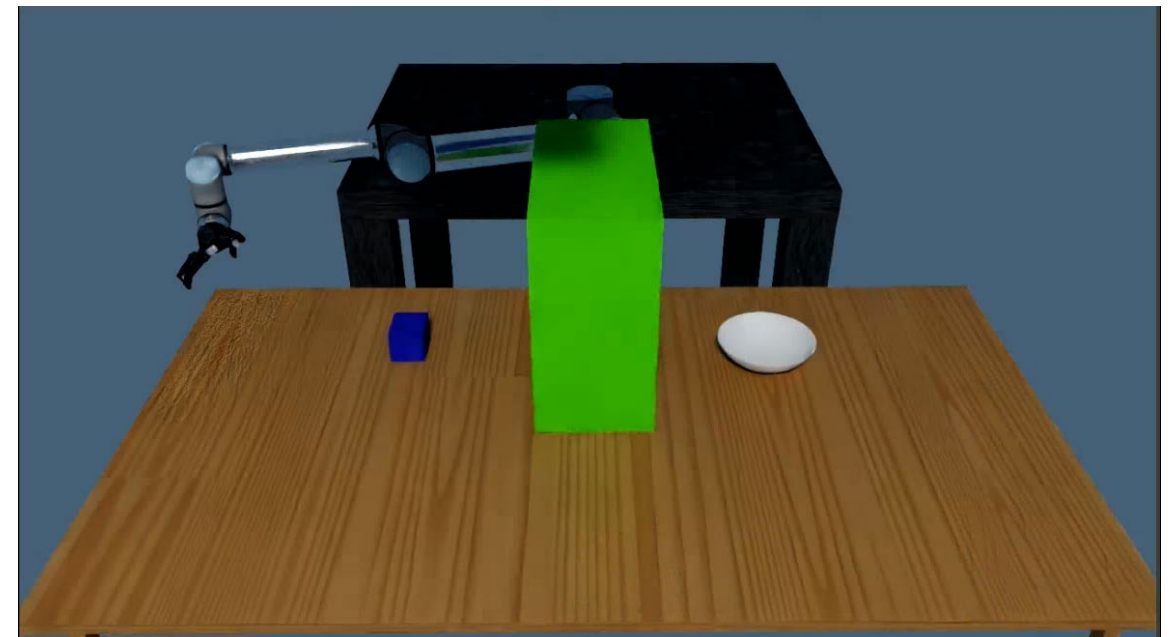
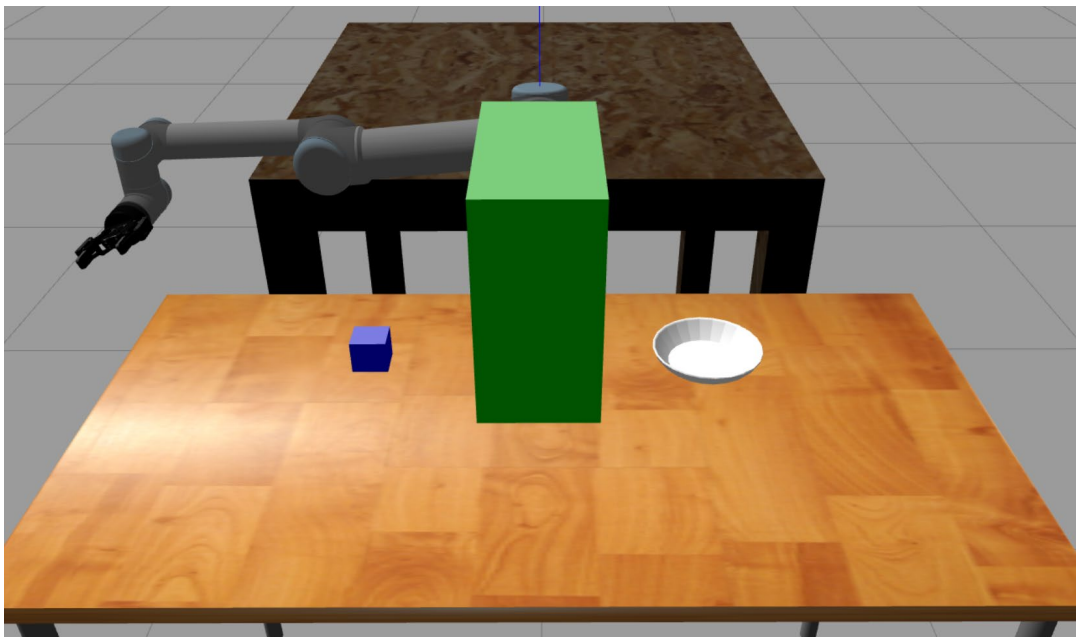


- **NVIDIA Omniverse Isaac Sim**
- **Bridging ROS2 and Omniverse**
- **Modeling a Robot with Isaac Sim and ROS2**
- **Modeling a Sensor with Isaac Sim and ROS2**
- **Omni-RobotLab @HKA**
- **Use-Cases:**
 - **Mobile Robots: Control and Navigation**
 - **Dual-Arm Manipulation**
- **Conclusion and Future Work**

NVIDIA Omniverse Isaac Sim

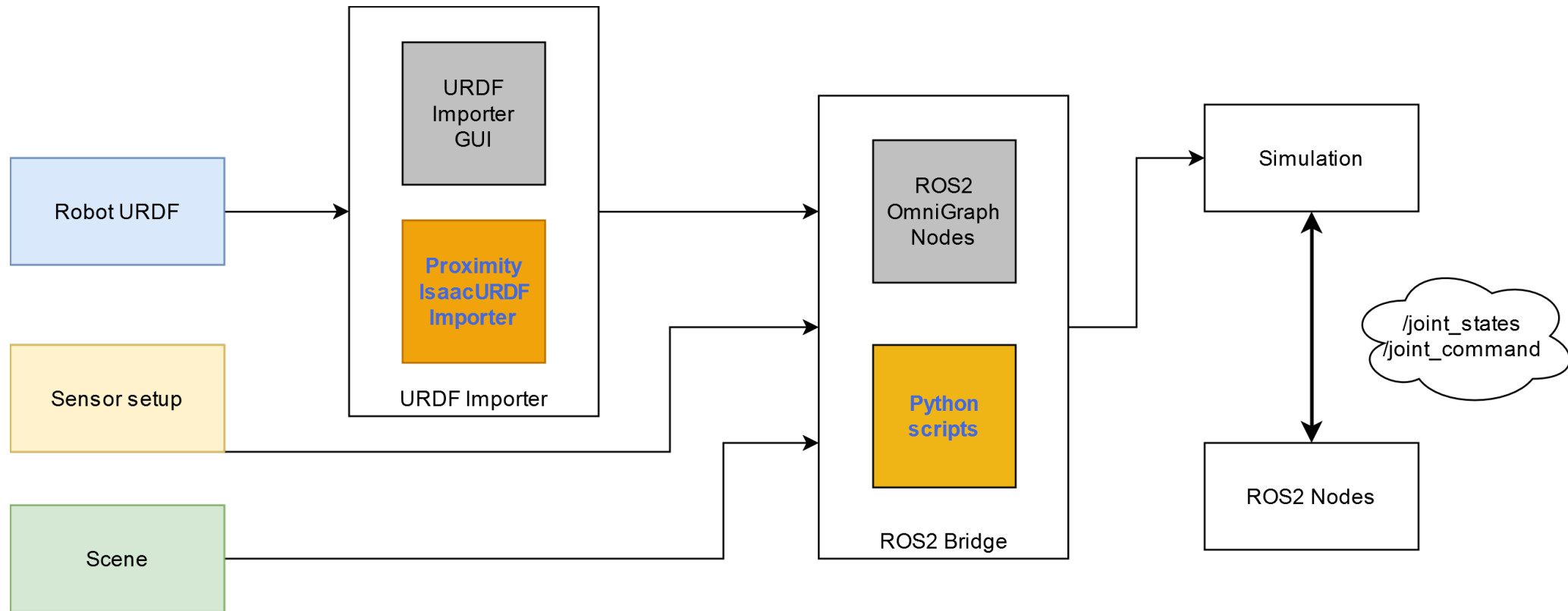


- Collaborative platform for 3D applications development based on OpenUSD
- NVIDIA RTX / CUDA
- PhysX physics engine



<https://roboticscasual.com/ros-tutorial-how-to-use-opencv-in-a-robot-pick-and-place-task-for-computer-vision/>

Bridging ROS2 and Omniverse



Modeling a Robot with Isaac Sim and ROS2



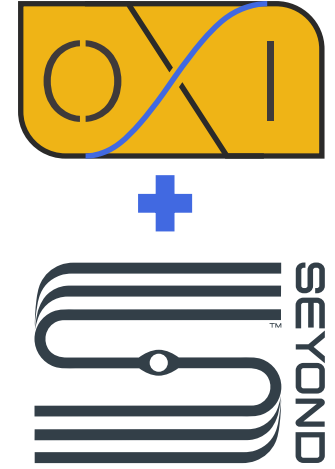
Standard Isaac Sim URDF Importer:

- GUI or via Python API
- Only URDF + STL
- Need to change **<ros_package_name>** refs to path
- Might need to change **Articulation Root API**
- Setup joint drive stiffness and damping (dynamics tag, no stiffness)
- Limited sensor parametrization in GUI

ProximityRobotics Isaac URDF Importer:

- Based on IsaacURDFImporter
- + xacro
- + <ros_package_name>
- Automatic Articulation Root API
- <isaac_drive_api> tag for joints (stiffness, damping, friction)
- <isaac> tag for custom LiDAR sensors, etc.

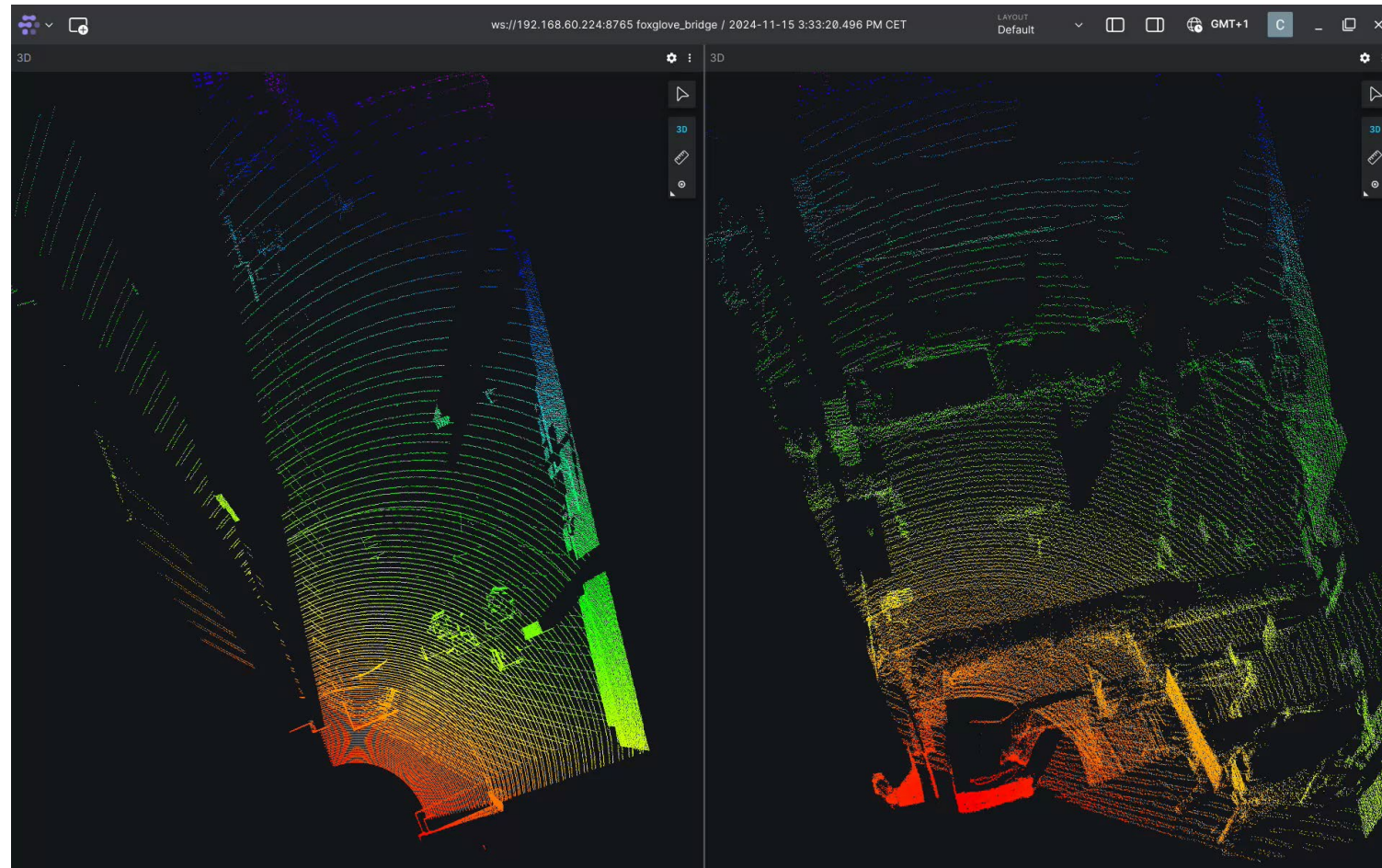
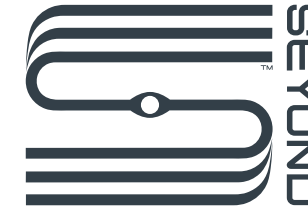
Modeling a Sensor with Isaac Sim and ROS2



Seeyond Robin W LiDAR

- Range: 0.1m – 70m
- FoV (HxV): 120x70
- Points/s (@10Hz): 1.772.000

Modelling sensors using SensorRTX



Omni-RobotLab @HKA (1)

+HKA +



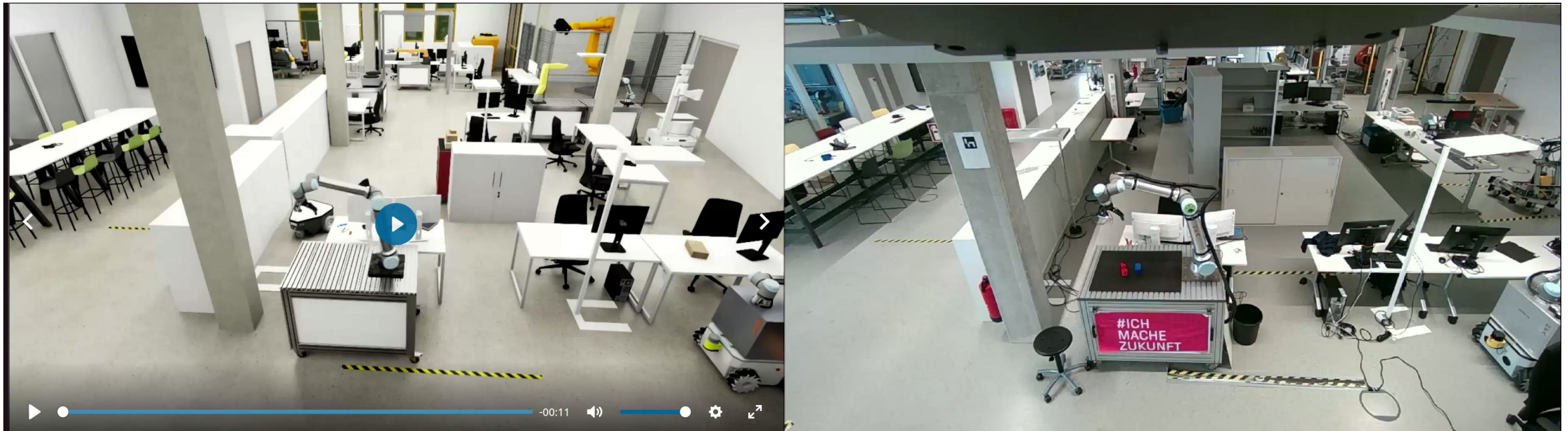
12 robot arms (KUKA, Franka, UR5, UR10...)

3 mobile robots (Neobotix MPO-500, ProximityRobotics-1200, BostonDynamics Spot)

Custom sensors (Seyond Robin-W LiDAR, realsense cameras, etc.)

Omni-RobotLab @HKA (2)

+IKA+



Mobile Robots: Control and Navigation (1)

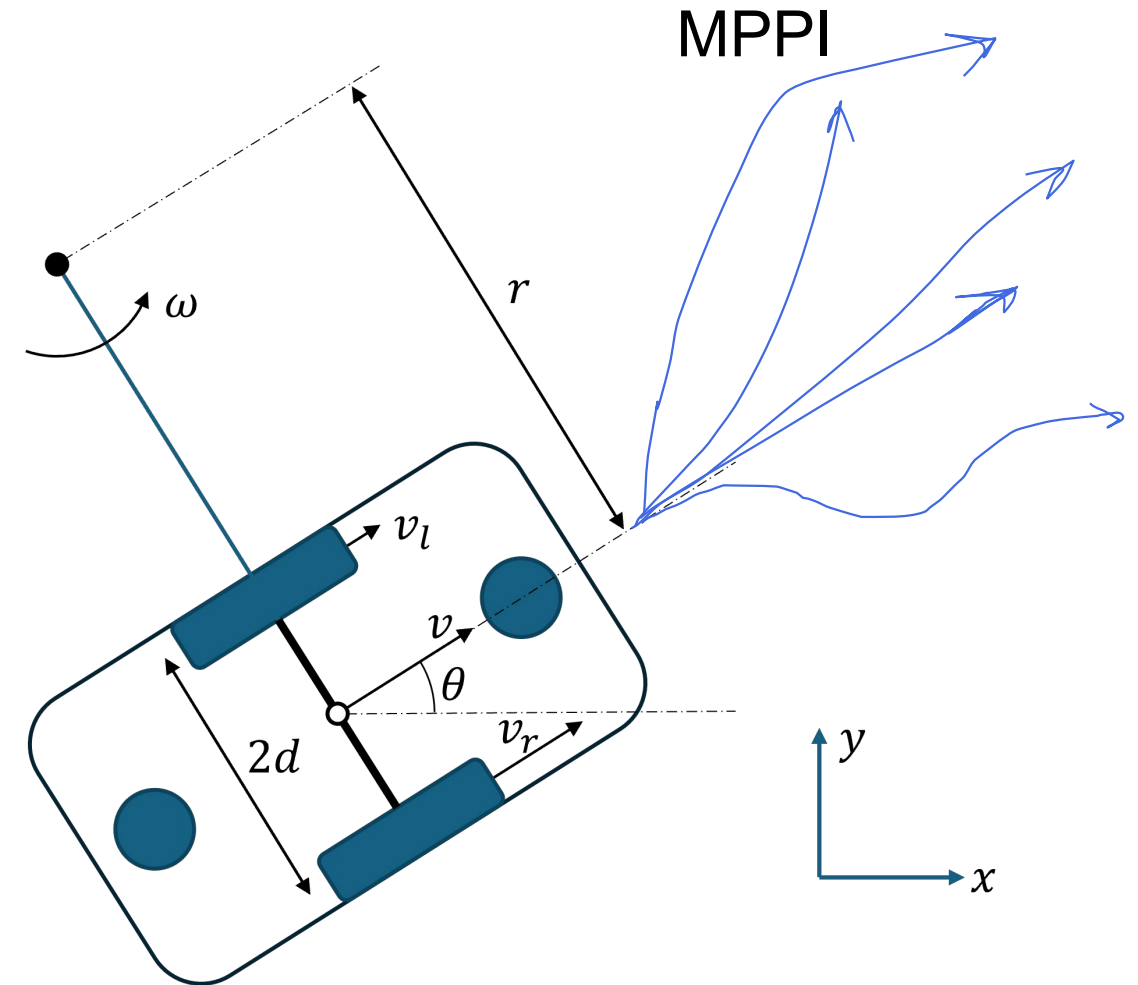


Problem:

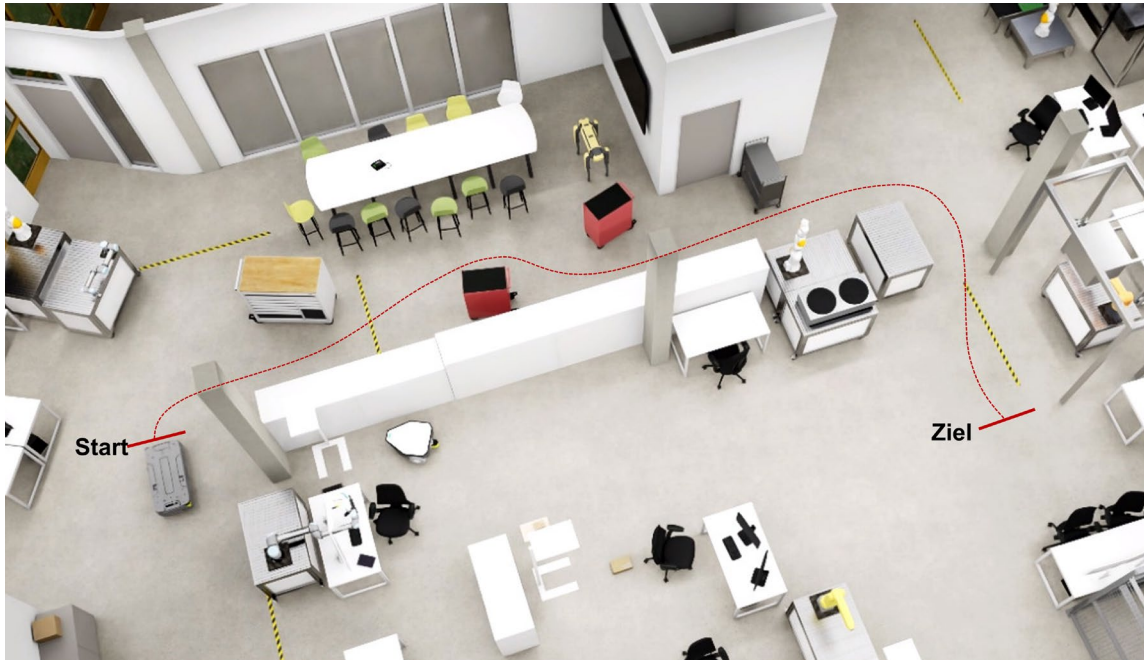
- New MPPI-based controller for a diff-drive robot:
 - 15 parameters
 - robot is not fully assembled

Solution:

Digital Twin Prototype in Isaac Sim!

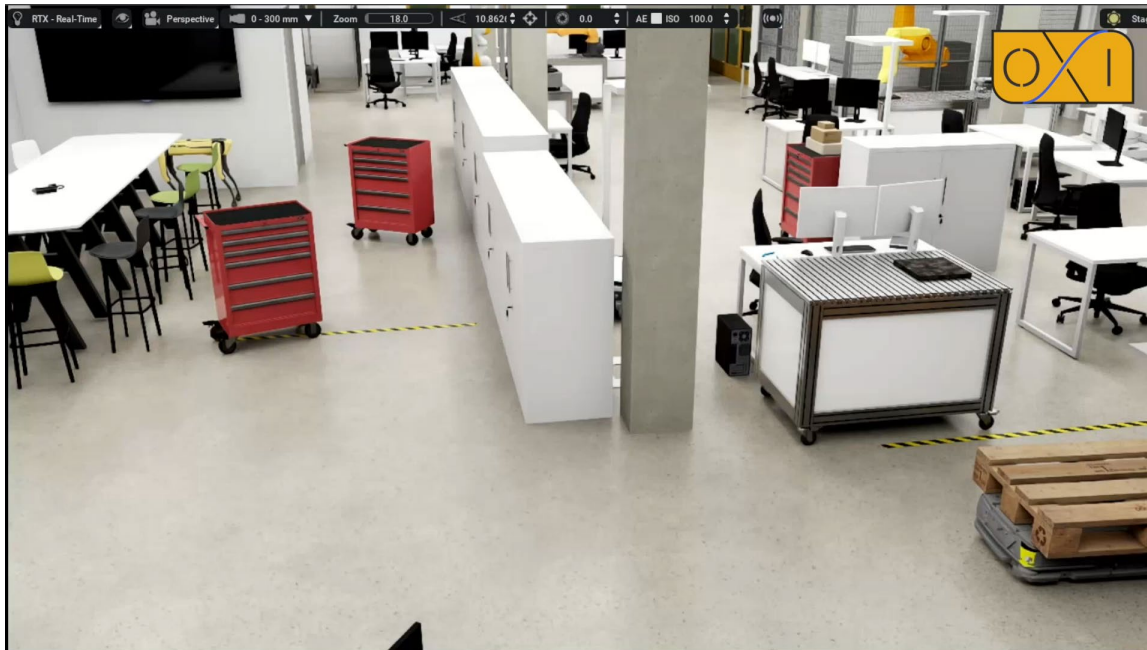


Mobile Robots: Control and Navigation (2)



- Simulation first!
- Parametrization
- Test planners, sensors, dynamic obstacles, etc.
- Validate on the real hardware

Mobile Robots: Control and Navigation (3)





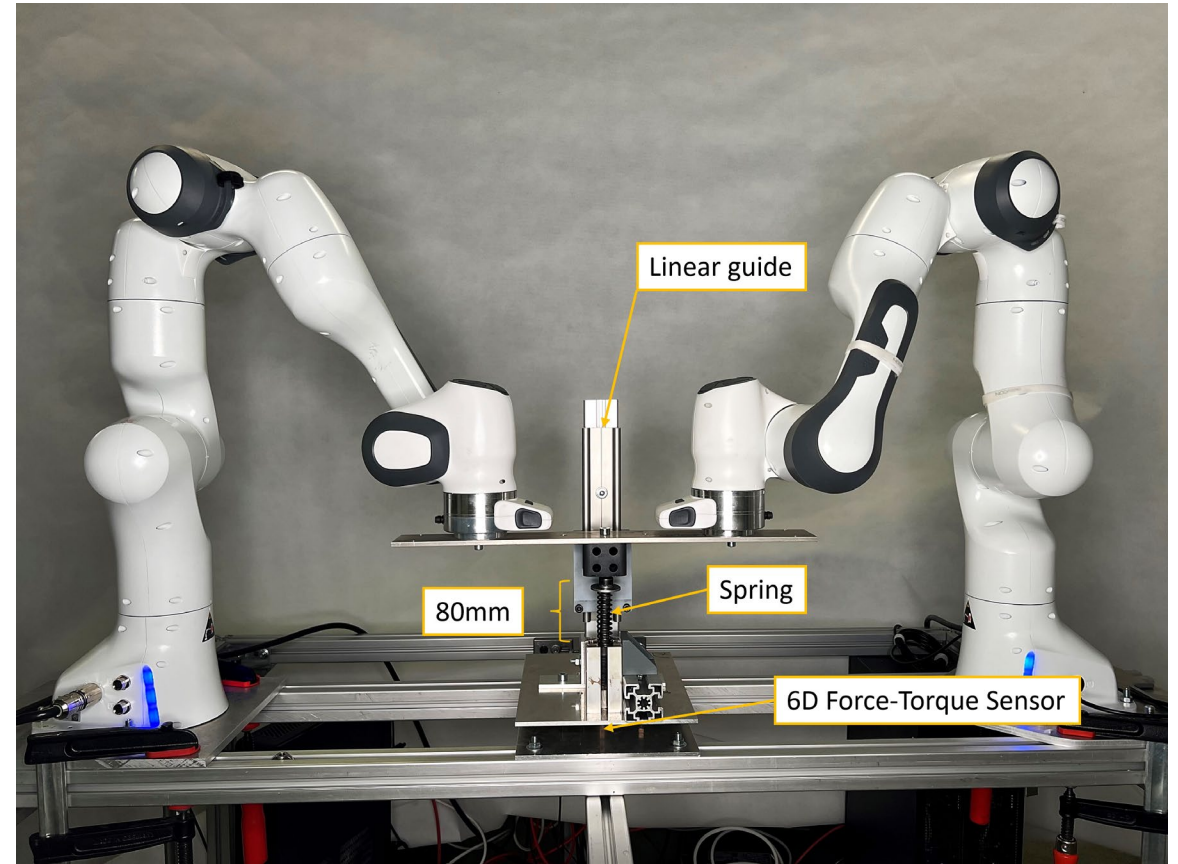
Dual-Arm Manipulation (1)

Problem:

- Two robot arm scenario: spraying, wiping...
- Relative motion
- Constraints: continuity, manipulability, self-collision...

Solution:

- Relaxed IK: +relative TCP pose, + stiffness, +joint distance, single seed
- cuRobo (NVIDIA): CUDA accelerated, multi seed, multi-robot setup. Jacobian and Hessian not implemented (no stiffness optimization)



Dual-Arm Manipulation (2)



Conclusion



Pros:

- High-fidelity physics
- High-quality graphics
- CUDA accelerated
- ML support (Isaac Lab)
- Plays nice with ROS2
- Isaac Sim is free to use
- Minimal Sim2Real gap
- Create your own assets
- Community and NVIDIA support(?)

Cons:

- Development platform -> bugs
- Need of RTX hardware
- Proprietary software



Future work



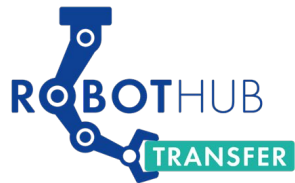
- <https://github.com/ProximityRobotics>
- kubernetes.io + proximity containers = automatic deployment

Your robot/process in Omniverse?



- Special offer for SMEs:

robot-hub.eu/transfer/

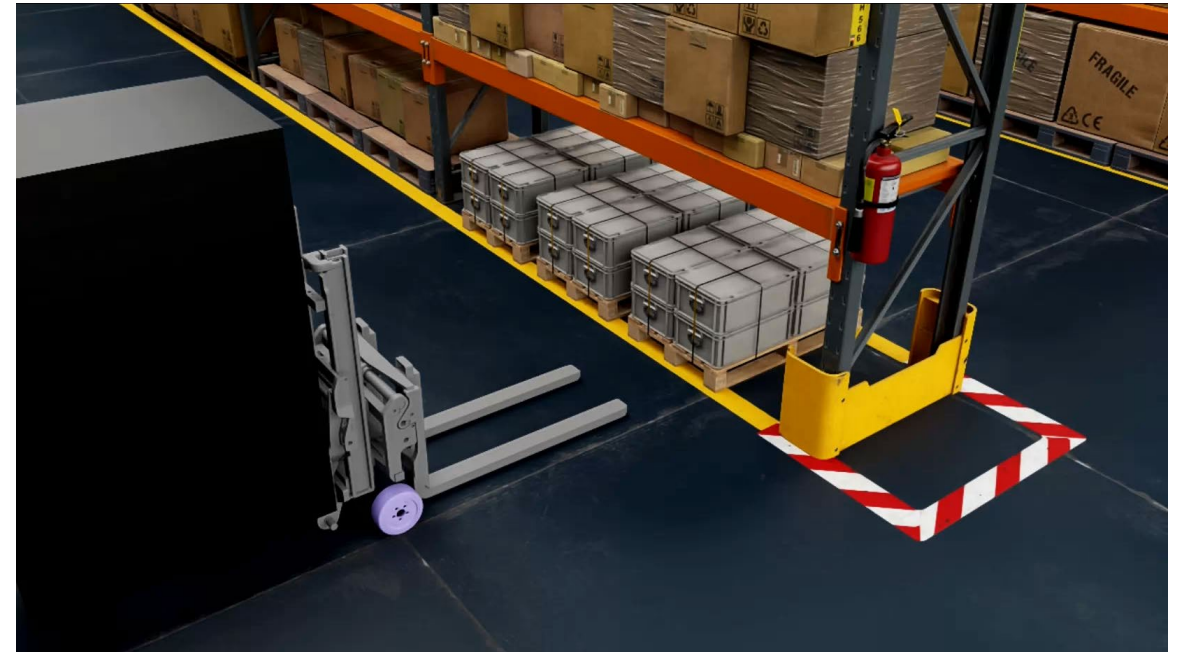


Interreg



Kofinanziert von
der Europäischen Union
Cofinancé par
l'Union Européenne

Oberrhein | Rhin Supérieur



Thank you for your attention!



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- Proximity Robotics team members who contributed to this presentation:



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Ilshat



Kathrin



Max