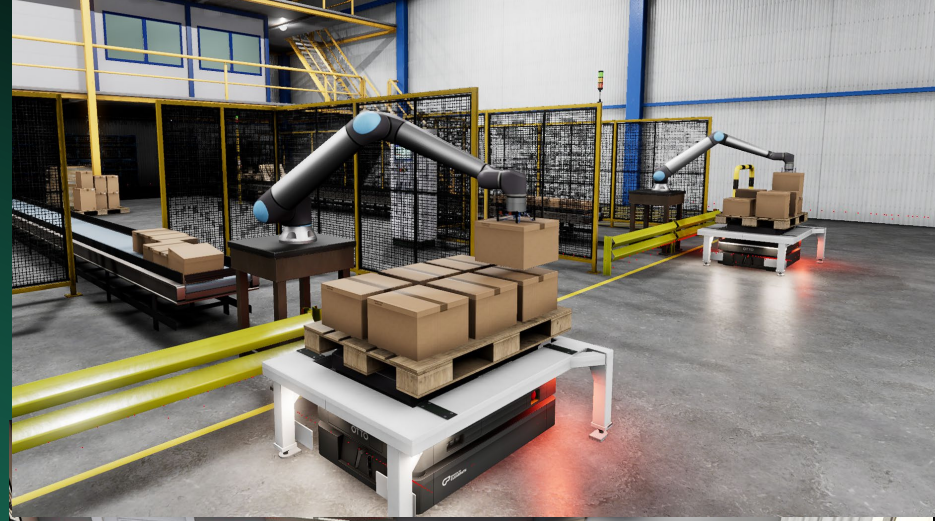
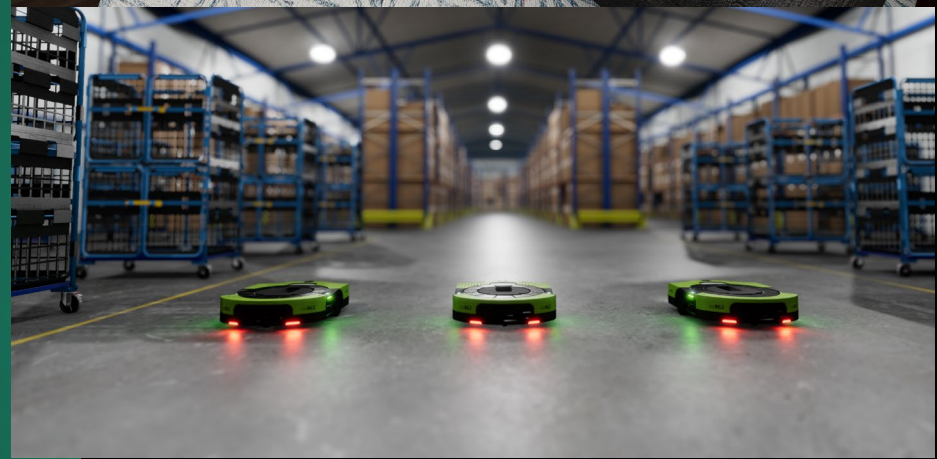
Simulate robots like never before with Open 3D Engine

Adam Dąbrowski (Robotec.ai)





The talk

Part 1: Finding your way in robotic simulators zoo.

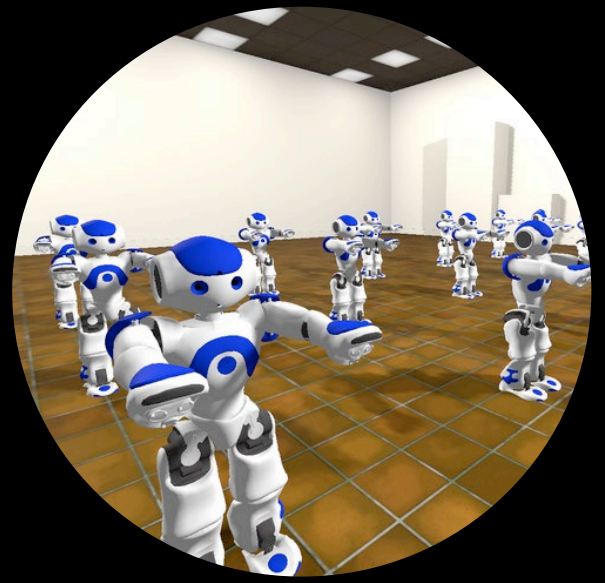
- Why are game engines included?
- What does my use-case match?
- **Demo: O3DE, scale, beauty and ROS.**

Part 2: Building simulations with O3DE.

- Getting ahead with project templates.
- Resources at hand: robots, assets, demos.
- What is unique about O3DE integration with ROS?
- **Demo: 3 minutes to simulate your robot!**

Part 3: Features, future and you.

- Let's look at sensors, components and tooling for robotics.
- Where do I start and how can I contribute?



Finding your way in robotic simulators zoo.

Comparing simulators

Complete-package, general-purpose simulators. I excluded:

- Dead / stale projects.
- Domain-specific sims such as Automotive (AWSIM, CARLA).
- Physics engines alone (though they matter).

Fair comparison would be highly multidimensional and exhaust the talk limit.

Simulator, use-case, user skill, platform, version, plugins, (..)

Instead, let us look at some key insights.

Simulators, engines

Game & simulation engines

Why game engines?

- Large interactive worlds -> content creation, high performance sensor / physics simulation
- Telling good visual stories -> photorealism, generating synthetic data.
- **Automotive**: no great fit among robotic simulators -> driving automotive simulation towards game engines.

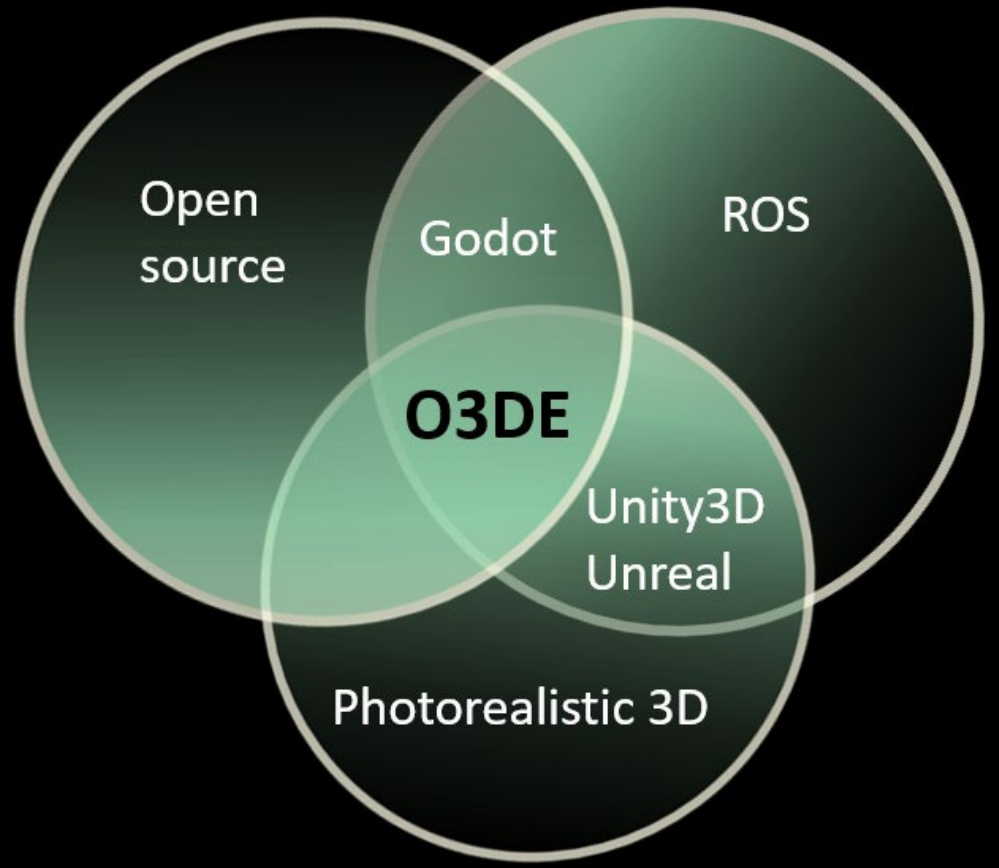
Game & simulation engines

These aspects are becoming more important in other branches of robotics, because:

- Multi-robot use / complexity of environments are growing.
- Fundamental problems are still being solved but focus on applications and productivity is increasing.

Game engines can excel at simulation of **integrated** robotic use-cases, especially where the focus is on **perception**, **behaviors**, **scenarios** and **productivity**.

Open 3D Engine

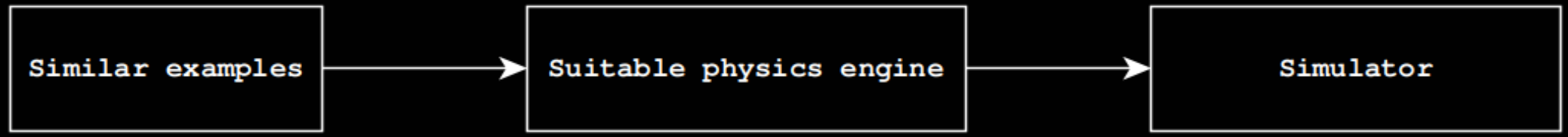


Great fit for ROS simulation:

- Open source and free.
- ROS 2 native:
  - C++ & CMake.
  - No bridges, write ROS code in O3DE!
  - Not just a connector: sensors, control, tooling.
- High modularity.
- Atom: a modern, photorealistic renderer.

My need is..

.. to simulate a task which heavily relies on **accurate simulation of physics** of { *grasping of soft bodies, legged joint systems, hydrodynamics of submersible, deformable ground, …*}



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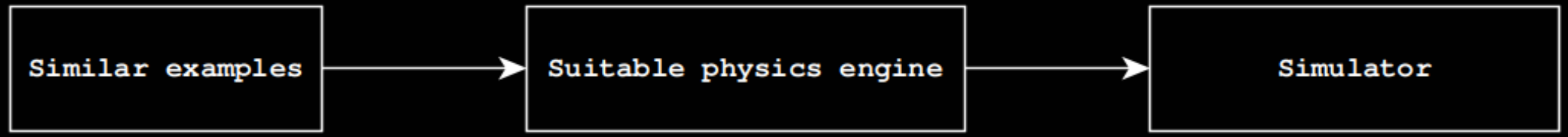

GAZEBO

Webots
robot simulation

CoppeliaSim

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.. quite simple, I want a wheeled robot in a relatively small indoor area for a quick research project.

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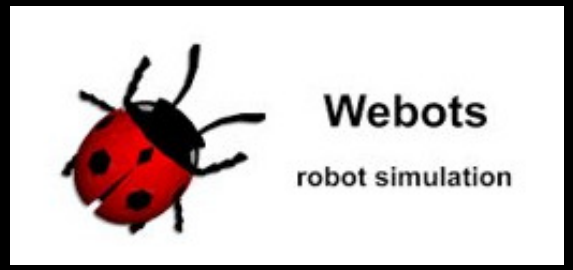
Most will do, consider:



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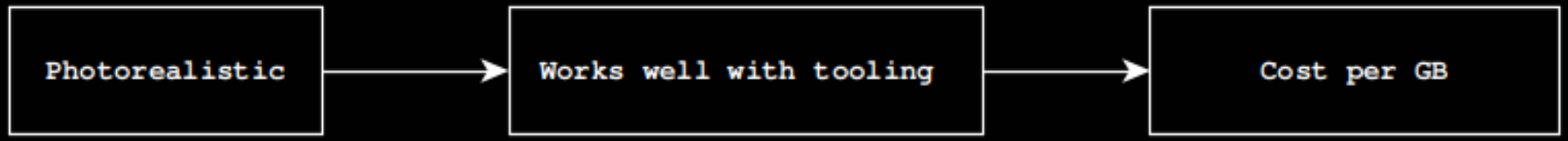
.. to produce large amounts of **high-quality synthetic sensor data** labelled with ground-truth to train my neural networks for { *detection, segmentation, tracking*, ...}



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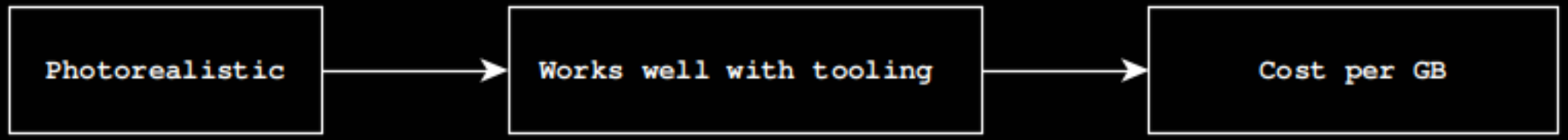
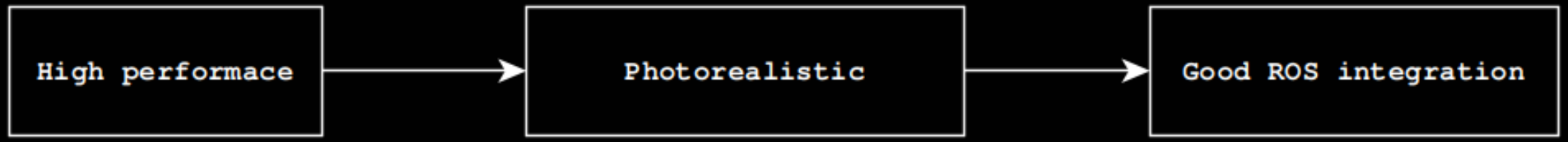


Game engines and NVIDIA Isaac Sim might be the best fit:

NVIDIA ISAAC | O3DE | UNREAL ENGINE | unity

My need is..

.. industrial simulation with ROS robotic arms and AMRs. Scene is quite large, and I want to see robot interactions in presence of humans and each other to achieve productivity goals. All simulation has to be physical and integrated with real system such as robot deliberation packages, providing them with realistic sensor data.



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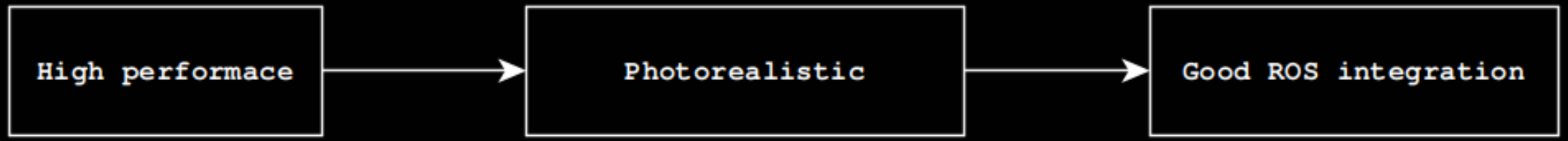


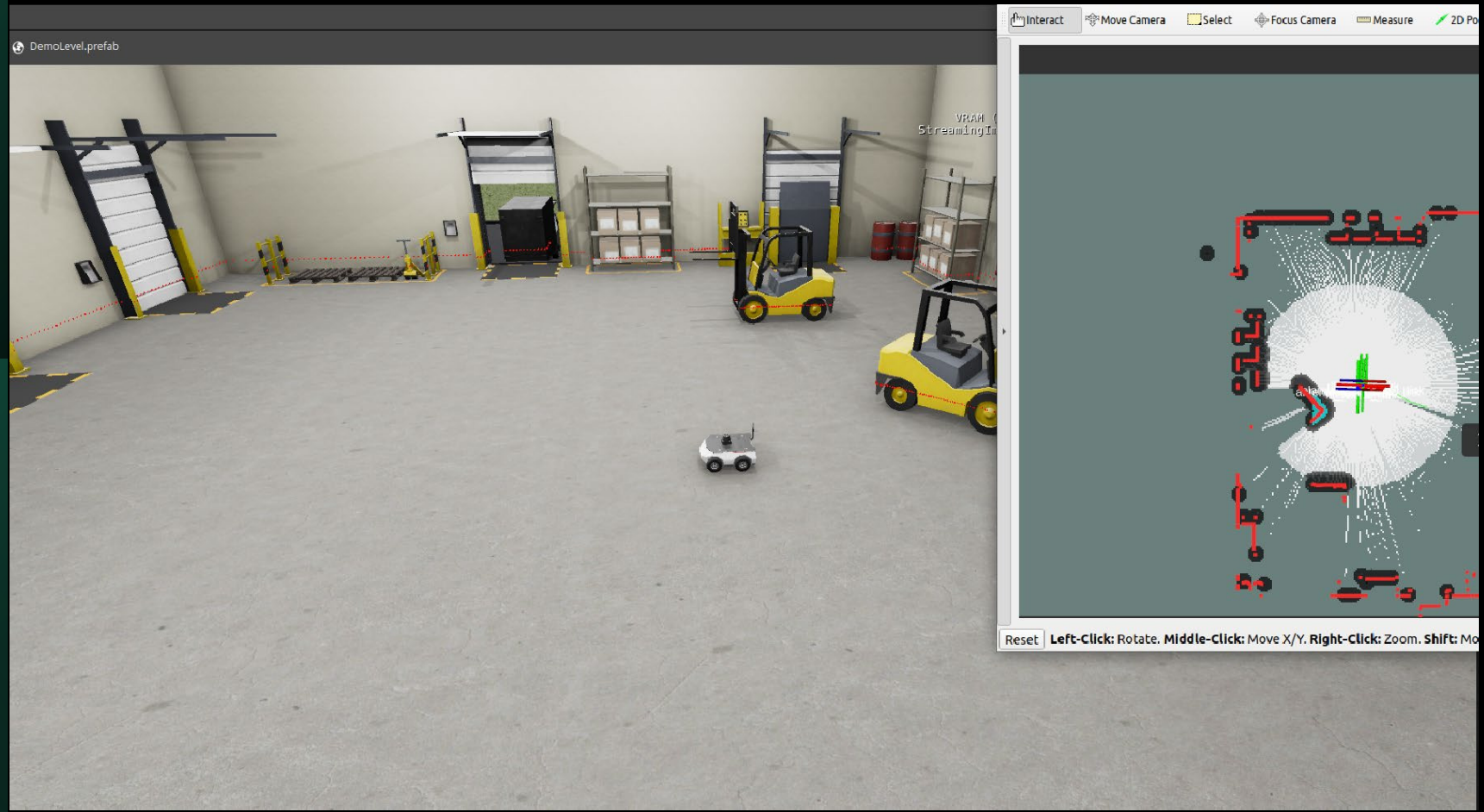
O3DE might be the best fit:

How to build with O3DE?

Project Templates

Simple robotics project: *Ros2ProjectTemplate*

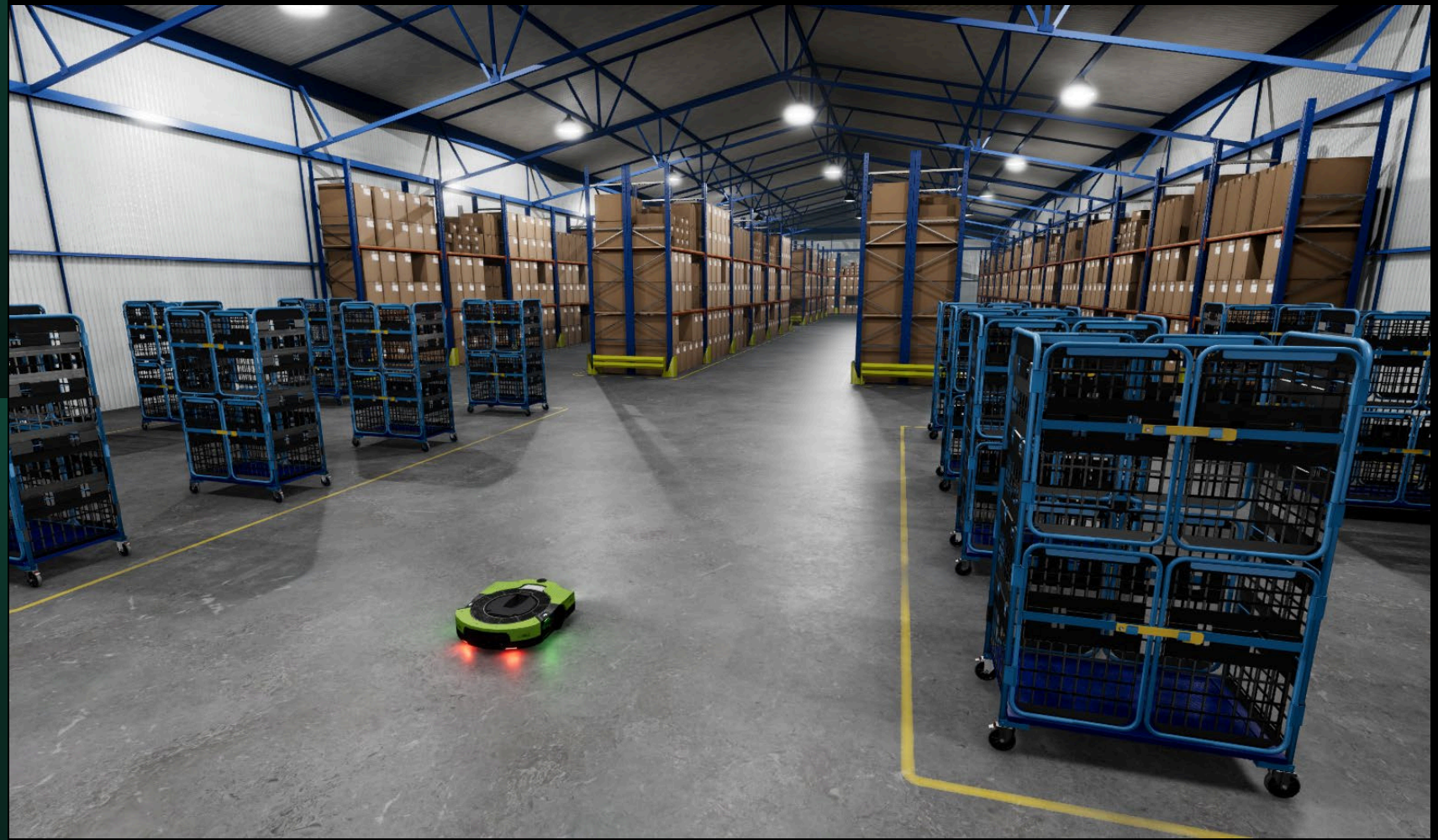
- Hello world with O3DE and nav2 stack.
- Husarion ROSBot XL in a Warehouse.
- Simple assets with smaller footprint.



Project Templates

Fleet of indoor robots: *Ros2RobotFleetTemplate*

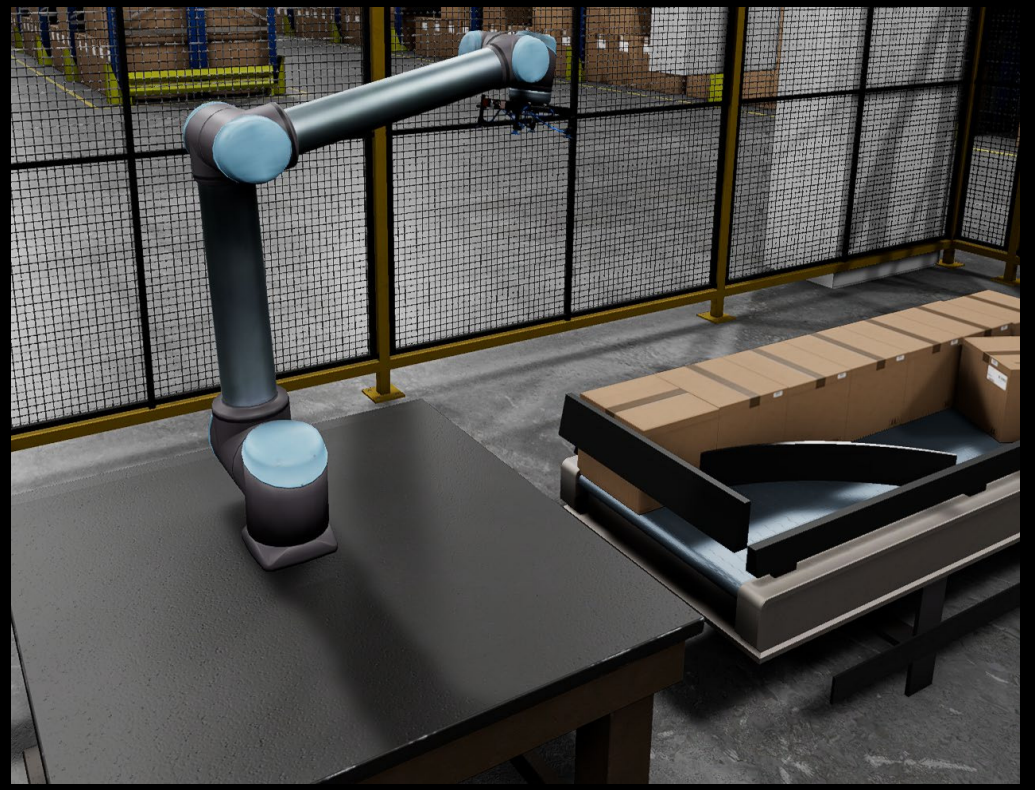
- Start with a fleet of AMRs in a warehouse, guided by nav2.
- Learn how to build and customize environment.
- Amazon Proteus robot model.



Project Templates

Robotic arms: Ros2ManipulationTemplate

- Panda Franka and UR10 arms.
- First scene is meant for vision and grasping R&D.
- Second scene includes conveyor belt and palletizing.

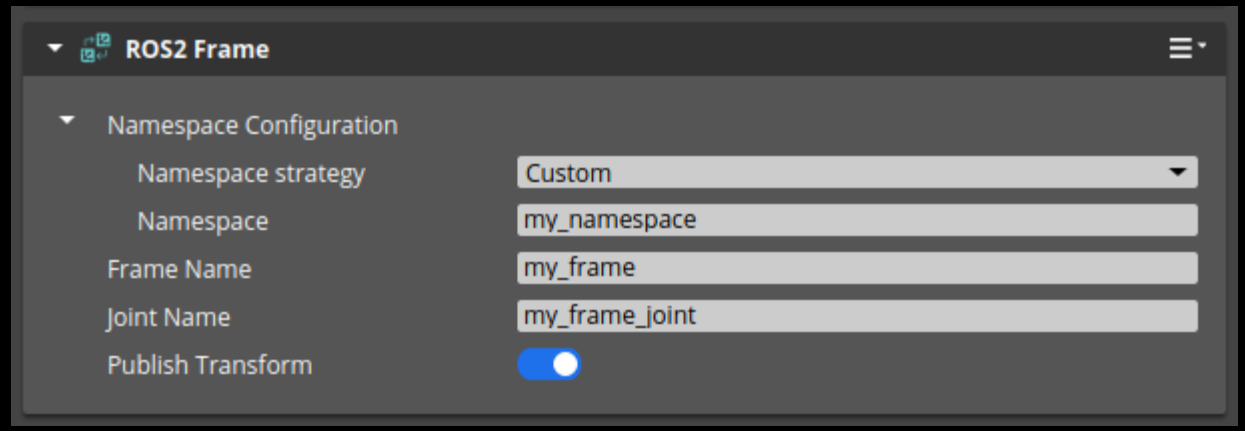


Build with O3DE

Custom messages? Build & source workspace, add one line:

```
target_depends_on_ros2_package(${MyTarget} my_msgs REQUIRED)
```

Designed with ROS 2 developers in mind, reflects concepts such as namespaces, frames and transforms.

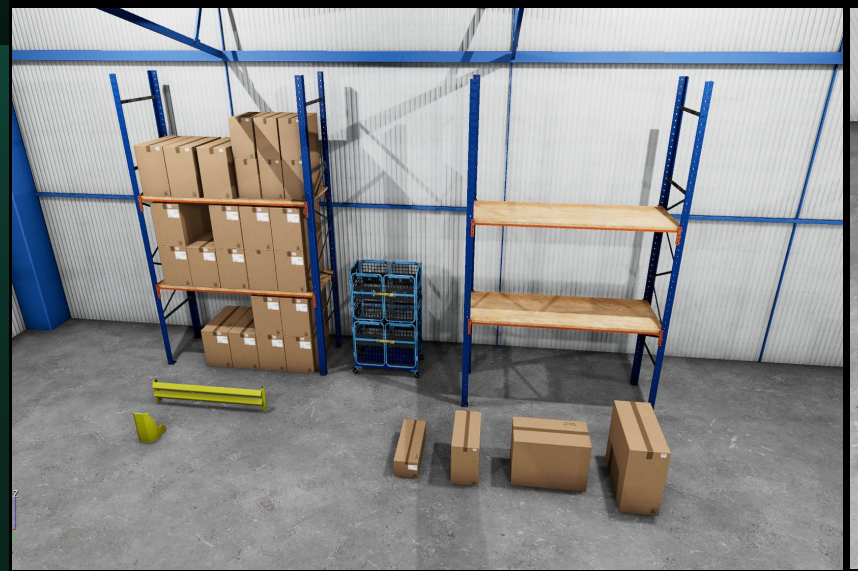


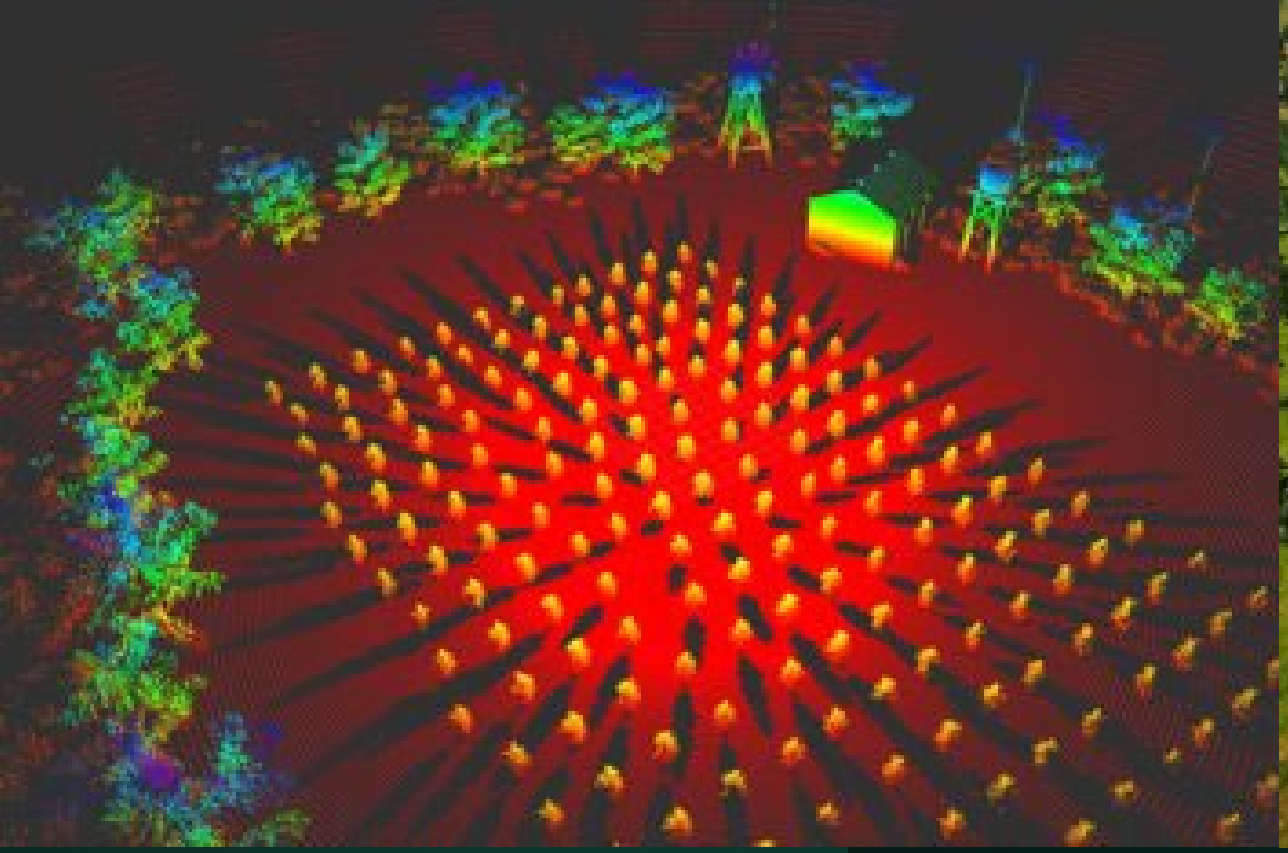
You can import your robot from URDF or SDFormat.

SDFormat

URDF

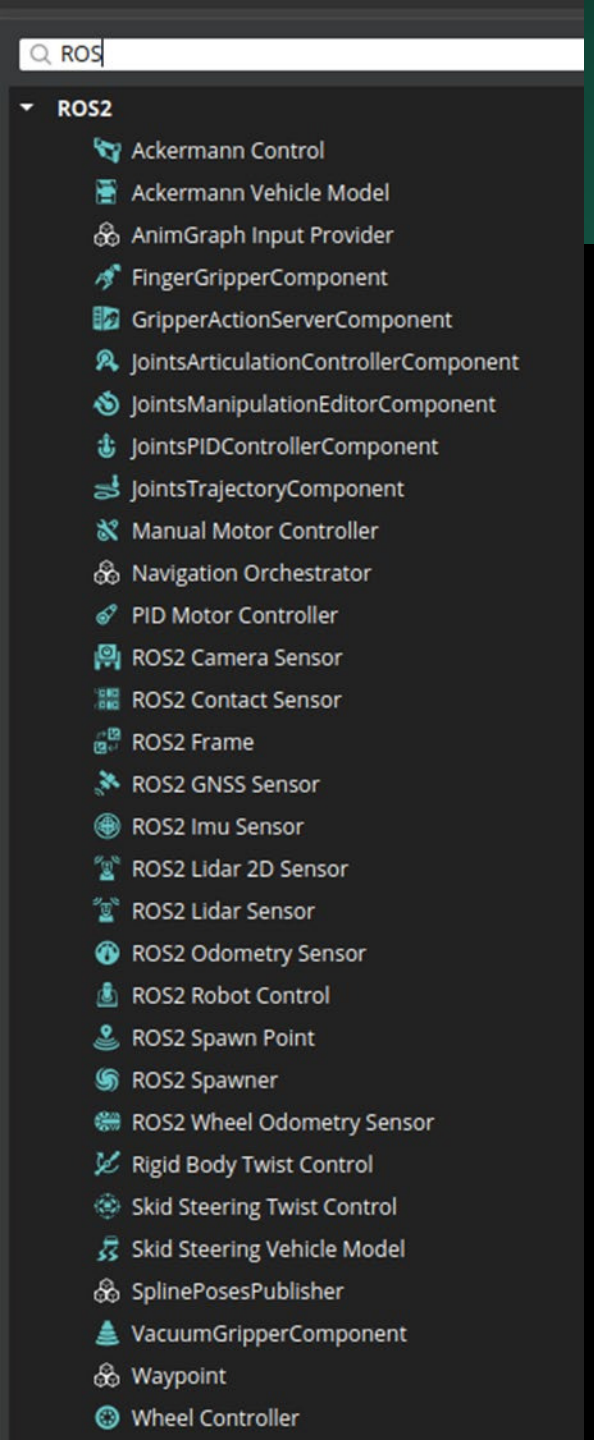
Resources



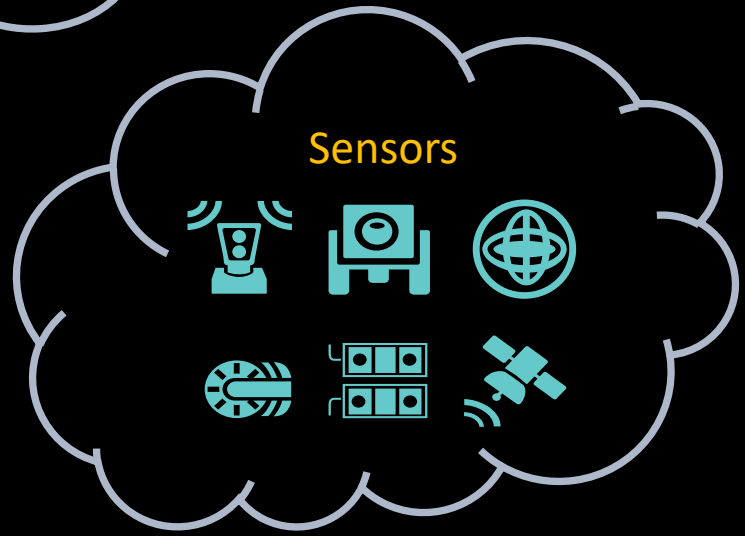


Features, the future and you

Summary of Features



O3DE supports all ROS interfaces:
topics, services, actions.



Learning and contributing

Learn through:

- Documentation, starting with setup and build, including API reference for ROS 2 Gem.
- Short tutorials for each template (with nav2 / MoveIt2)
- Running one of three demos.

Joining the community:

- Contribute to the engine or the ROS 2 Gem project.
- Build and share Gems with your sensors and robots.
- Develop a new use-case or demo and tell us about it!
- Say hello on O3DE Discord.

Visit Robotec.ai booth to ask me anything, import your robot or run the demo!

Questions?

Thank you!

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