OpenVINO™ Acceleration for Intelligent Robots

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Who We Are

- The Intel **Open source Technology Center** (OTC, https://01.org)
- The **Robotics Software Engineering Team** delivers ROS2 packages optimized on IA platforms
Why Do We Need Acceleration for Robotics?

- CNN* based AI methods become popular in robotics systems

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<th>Github</th>
<th>Number of repos (by 09/2019)</th>
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<td>CNN ROS</td>
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<td>deep learning ROS</td>
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- CNN inference
  - Computational complexity
  - Latency
  - CPU loads
  - Time critical requirements from robotic applications

CNN: Convolutional Neural Network
OpenVINO™ (Intel® Open Visual Inference & Neural network Optimization toolkit)

- 100+ open source and public pre-trained models
- Various inputs subject to the CNN model itself
- Common API across multiple Intel® platforms

Our works to connect OpenVINO™ with Robotics
ROS2 OpenVINO™ Toolkit

- Deliver ROS2 topics and services
- Support OpenVINO™ accelerated open models
  - People: face, emotion, age, gender, head pose, person reidentification
  - Objects: detection, segmentation
- Execute on CPU, GPU, or Movidius VPU
OpenVINO™ Grasp Pose Detection

1. Prepare a deployment model
   Grasp Pose Detection developed in NEU

2. Run Model Optimizer to convert the model
   ```
   python3 mo_caffe.py
   --input_model <path_to_.caffemodel>
   --input_proto <path_to_.prototxt>
   --output_dir ./fp32
   --data_type FP32 --log_level DEBUG
   ```

3. Use Inference Engine API to create classifier
   OpenVINO™ classifier

Useful resources

- Model optimization FAQ, inference application examples, OpenVINO™ Toolkit documentations
ROS2 Grasp Library

Subscribed Topics

- RGB image from sensor (sensor_msgs::msg::Image)
- PointCloud2 topic from RGBD sensor (sensor_msgs::msg::PointCloud2)
- Segmented object topic (people_msgs::msg::ObjectsInMasks)

Delivered Services

- plan_grasps (moveit_msgs::srv::GraspPlanning)
ROS2 Grasp Library

- Grasp applications (random picking, recognition picking)
- Plan Grasps (obj_name = "")
- Grasp Poses
- Pick, Place
  - camera-robot TF
  - Robot state
- Robot Interface
  - Robot driver
  - Gripper driver

- Grasp Planning
  - OpenVINO™ Grasp Detection
- Hand-Eye Calibration
Intelligent Visual Manipulation Applications

Random picking
OpenVINO™ Grasp Detection @GPU + MoveIt
https://www.youtube.com/playlist?list=PLxCMGJeilgoxq3uqcCVSYnSJ9iQk1L9yP

Recognition & picking
OpenVINO™ Object Segmentation + OpenVINO™ Grasp Detection + Hand-Eye calibration and transformation
Summary

• CNN based AI methods become popular in intelligent robots
• OpenVINO™ toolkit optimize and deploy deep learning solutions across multiple Intel® platforms
  • 4 deep learning frameworks, 100+ pre-trained models, one API for all devices
• Use converted open models – ROS2 OpenVINO™ Toolkit
• Convert your own models – like what we did in the industrial robot
  • OpenVINO™ Grasp Detection model and classifier
  • ROS2 Grasp Library connect OpenVINO™ and the MoveIt framework
• Intelligent visual manipulation applications running on real robot
Resource Links and Contacts

- https://github.com/intel/ros2_grasp_library
- https://github.com/intel/ros2_opencvino_toolkit
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