



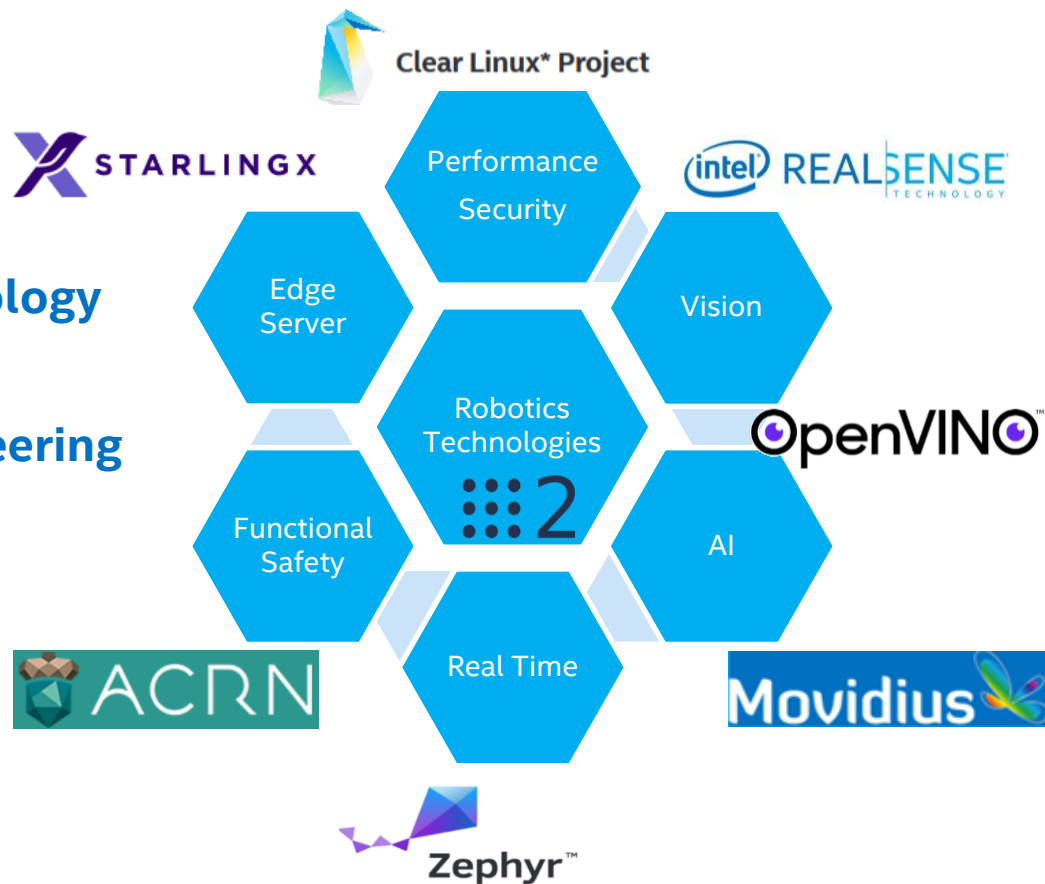
OpenVINO™ Acceleration for Intelligent Robots

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Nov. 1st 2019

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

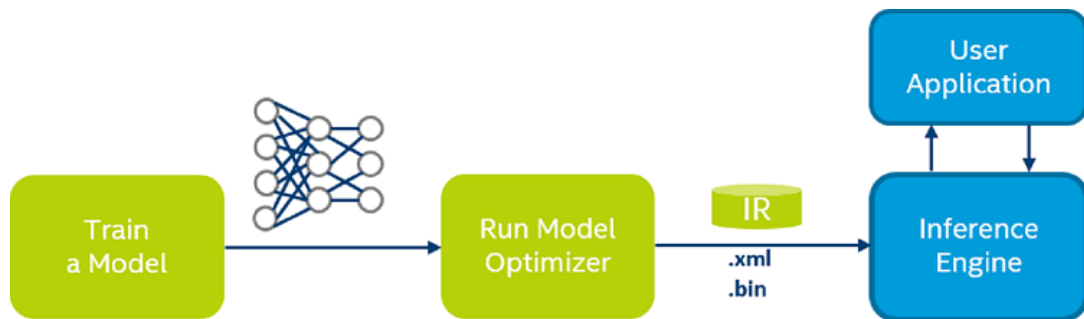
Github	Number of repos <small>by 09/2019</small>
CNN ROS	30
deep learning ROS	71
IEEE	Number of papers <small>by 09/2019</small>
CNN Robot	729
deep learning Robot	1788

- CNN inference
 - Computational complexity
 - Latency
 - CPU loads
- Time critical requirements from robotic applications



<https://www.shutterstock.com/image-photo/agriculture-technology-artificial-intelligence-concepts-farmer-734412016>

OpenVINO™ (Intel® Open Visual Inference & Neural network Optimization toolkit)



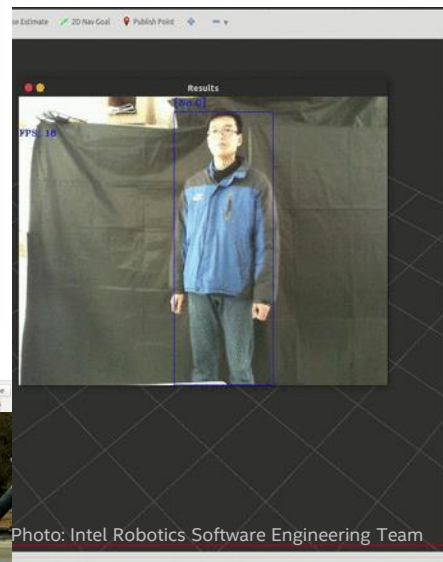
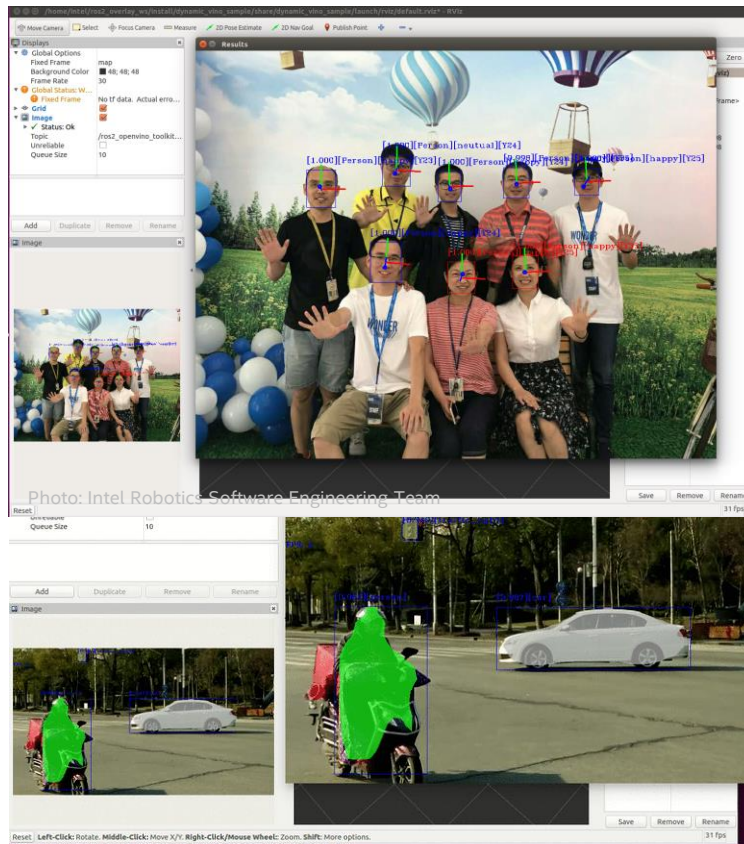
https://docs.openvino toolkit.org/latest/_docs_MO_DG_Deep_Learning_Model_Optimizer_DevGuide.html

- **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

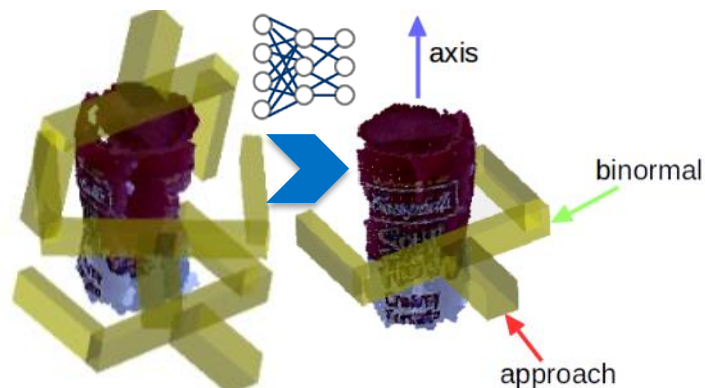
```
python3 mo_caffe.py
  --input_model <path_to_caffemodel>
  --input_proto <path_to_prototxt>
  --output_dir ./fp32
  --data_type FP32 --log_level DEBUG
```

3. Use Inference Engine API to create classifier

OpenVINO™ classifier

Useful resources

- Model optimization [FAQ](#), inference application [examples](#), OpenVINO™ Toolkit [documentations](#)



Andreas ten Pas, Marcus Guaitieri, Kate Saenko, and Robert Platt. [Grasp Pose Detection in Point Clouds](#)
The International Journal of Robotics Research, Vol 36, Issue 13-14, pp. 1455 - 1473. October 2017

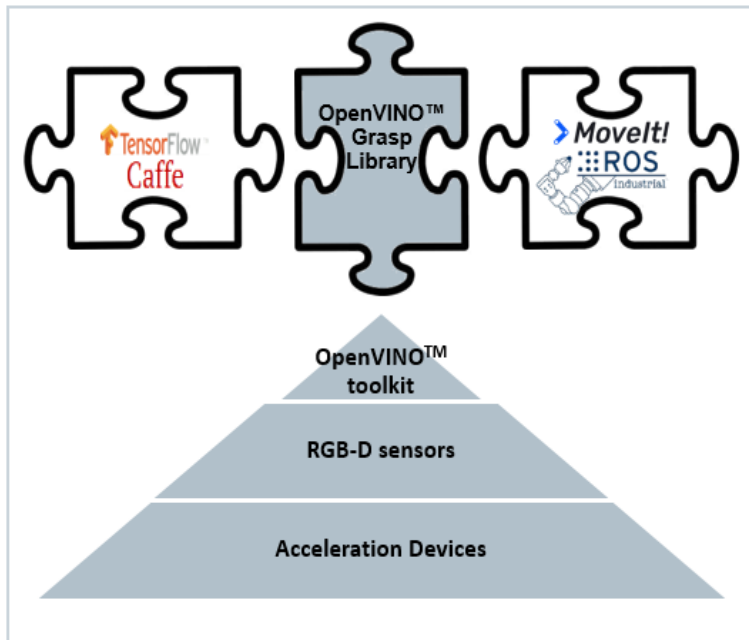
ROS2 Grasp Library

Subscribed Topics

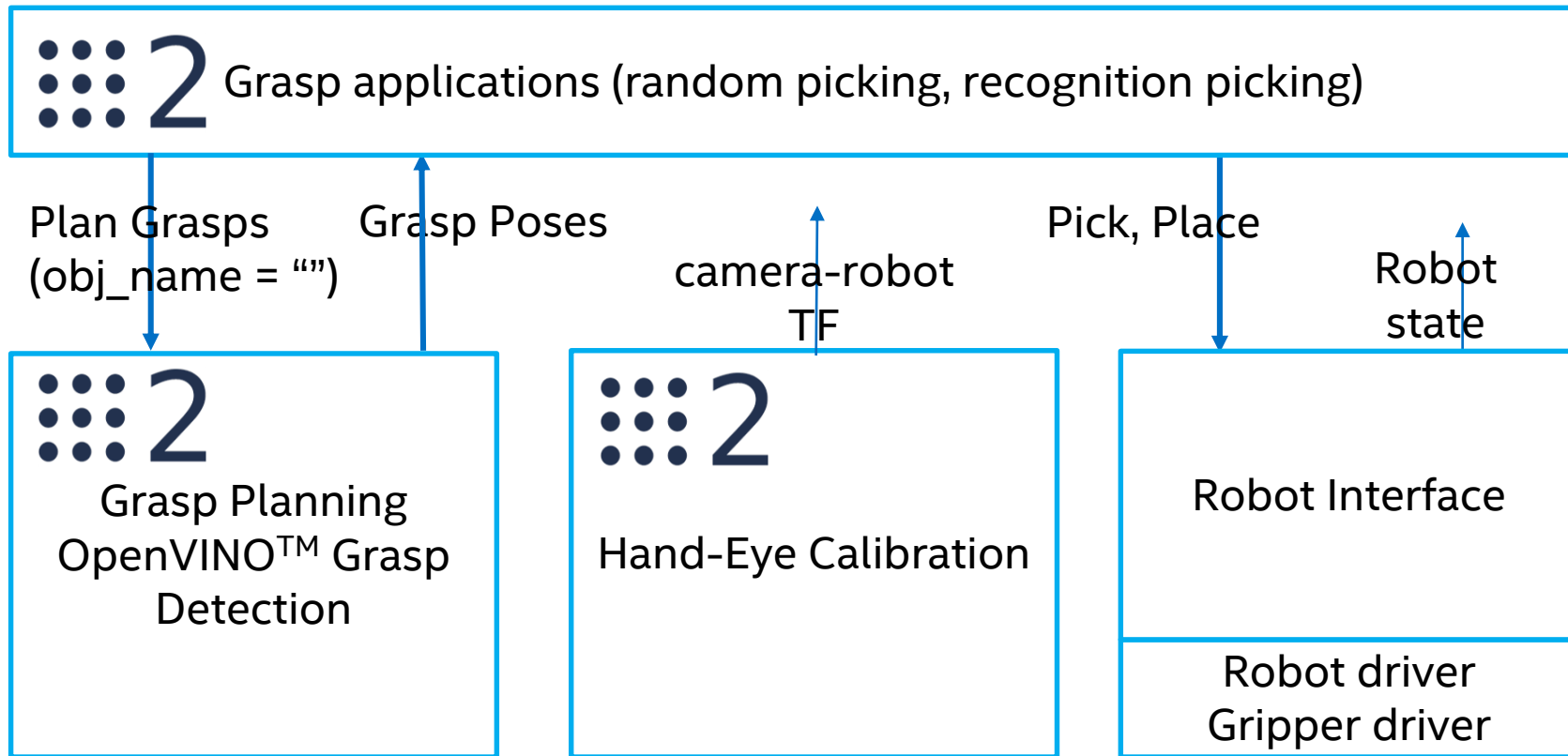
- RGB image from sensor
(`sensor_msgs::msg::Image`)
- PointCloud2 topic from RGBD sensor
(`sensor_msgs::msg::PointCloud2`)
- Segmented object topic
(`people_msgs::msg::ObjectsInMasks`)

Delivered Services

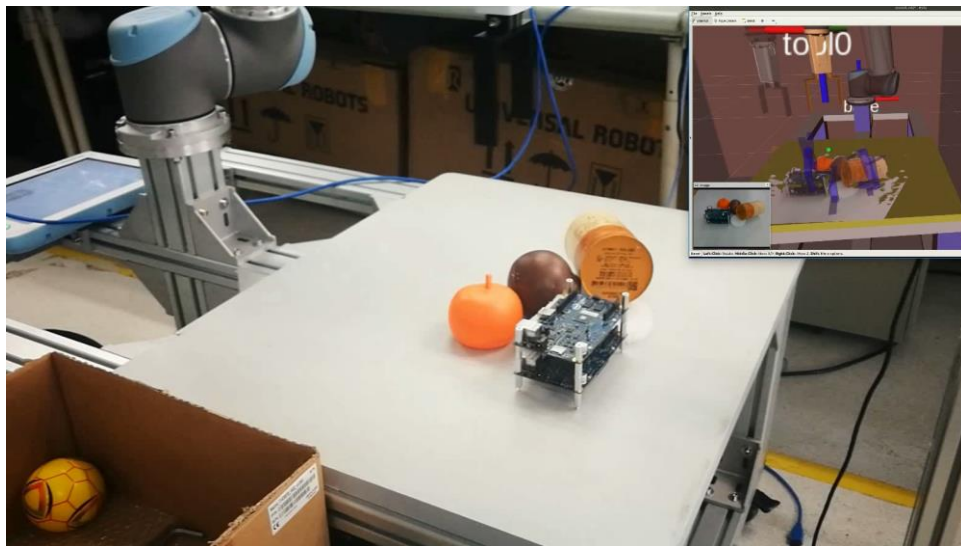
- `plan_grasps` (`moveit_msgs::srv::GraspPlanning`)



ROS2 Grasp Library



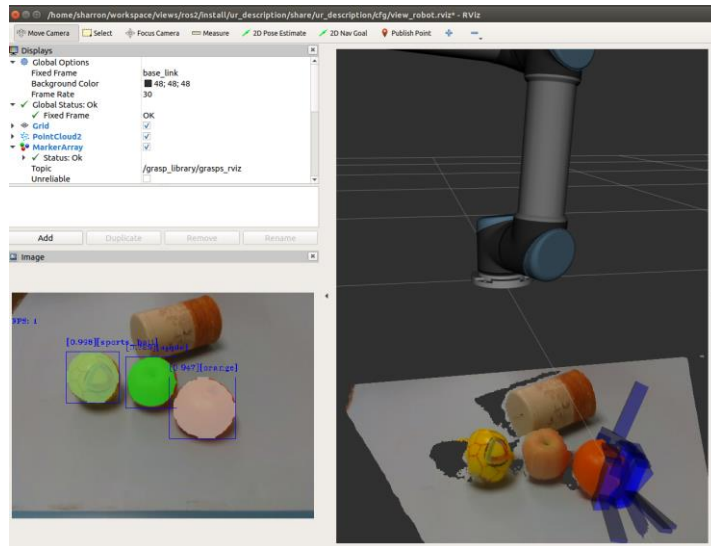
Intelligent Visual Manipulation Applications



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_openvino_toolkit



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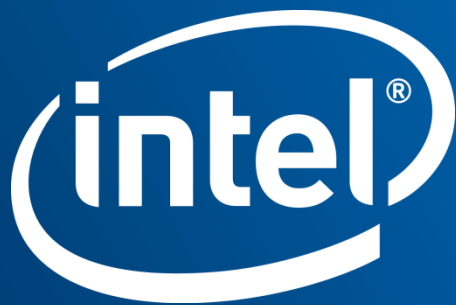
Yu YAN



Chao LI



Lewis LIU



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