

NuBot Homepage: <http://nubot.trustie.net>
NuBot GitHub: <http://github.com/nubot-nudt>



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NuBot 2017 MSL Workshop

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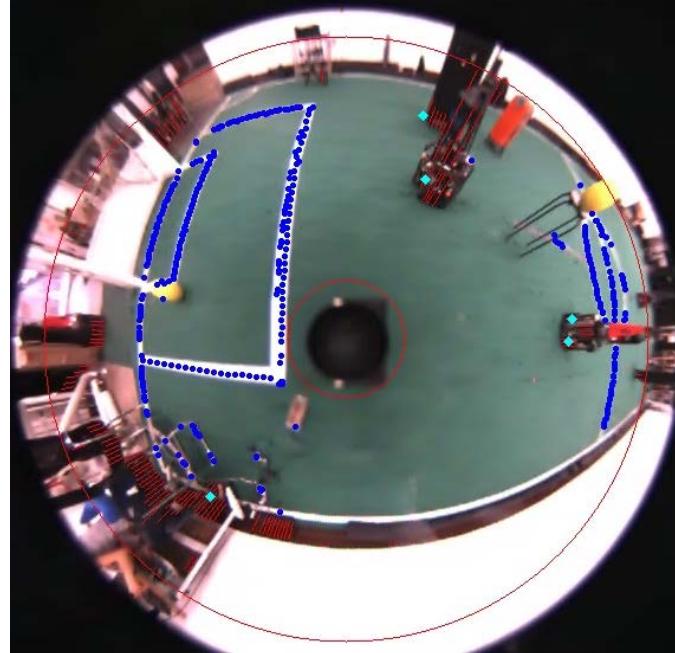
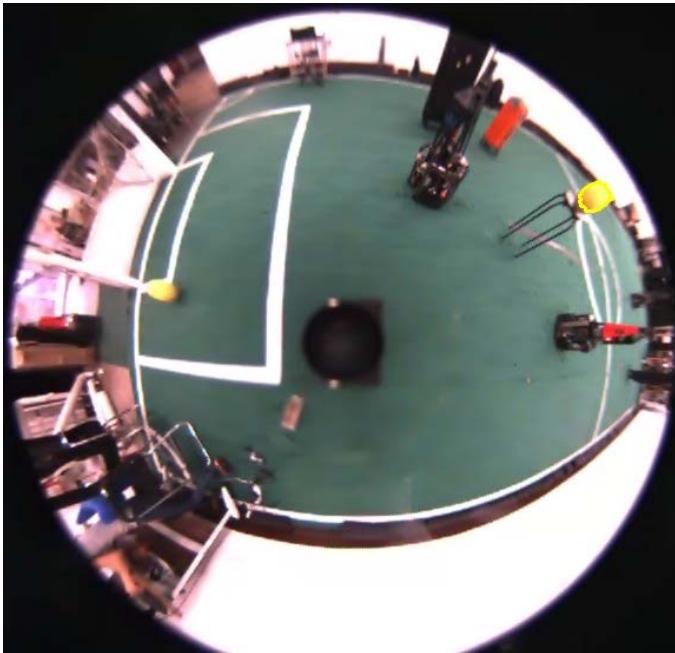
2 Simulator

- GroSim
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-

Robot - Extra Architecture



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Omni-directional Camera

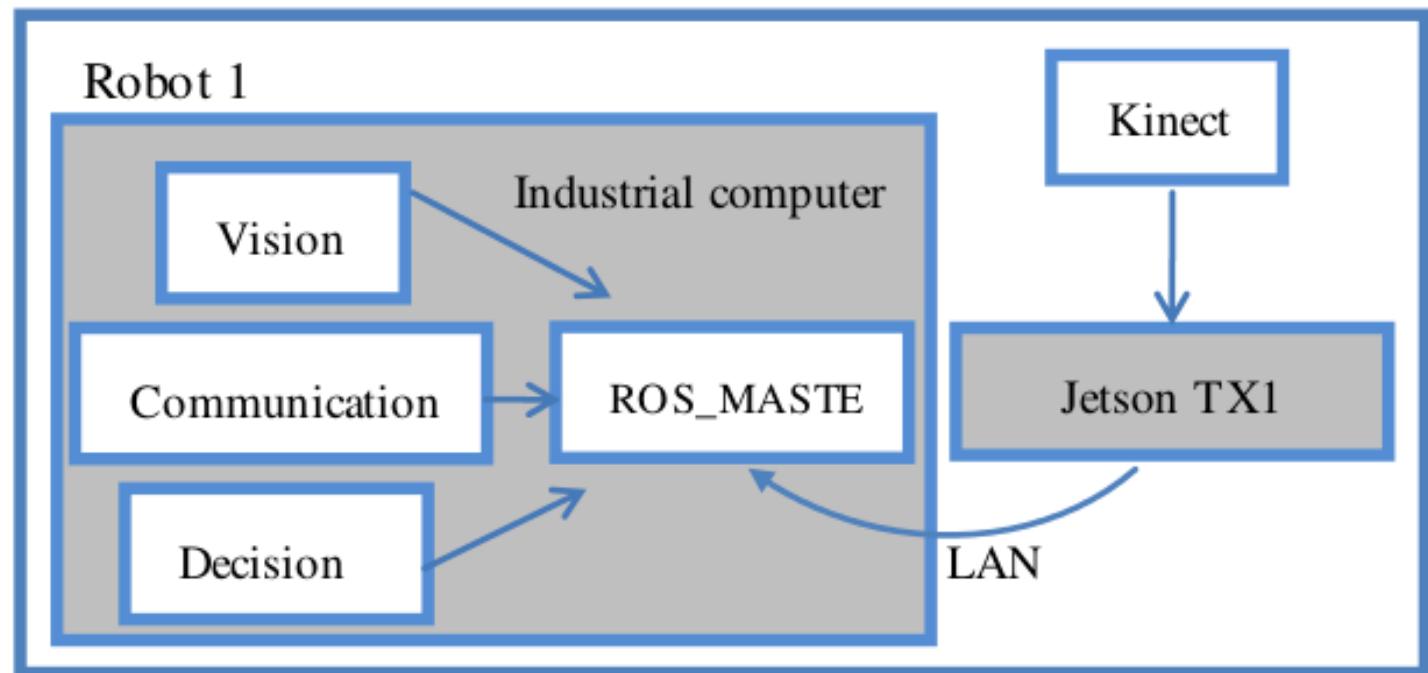
- 1 As the distance increases, the object localization error increases
- 2 Hard to get the 3D location

Robot - Extra Architecture



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System architecture of Kinect, Jetson TX1 and the industrial computer

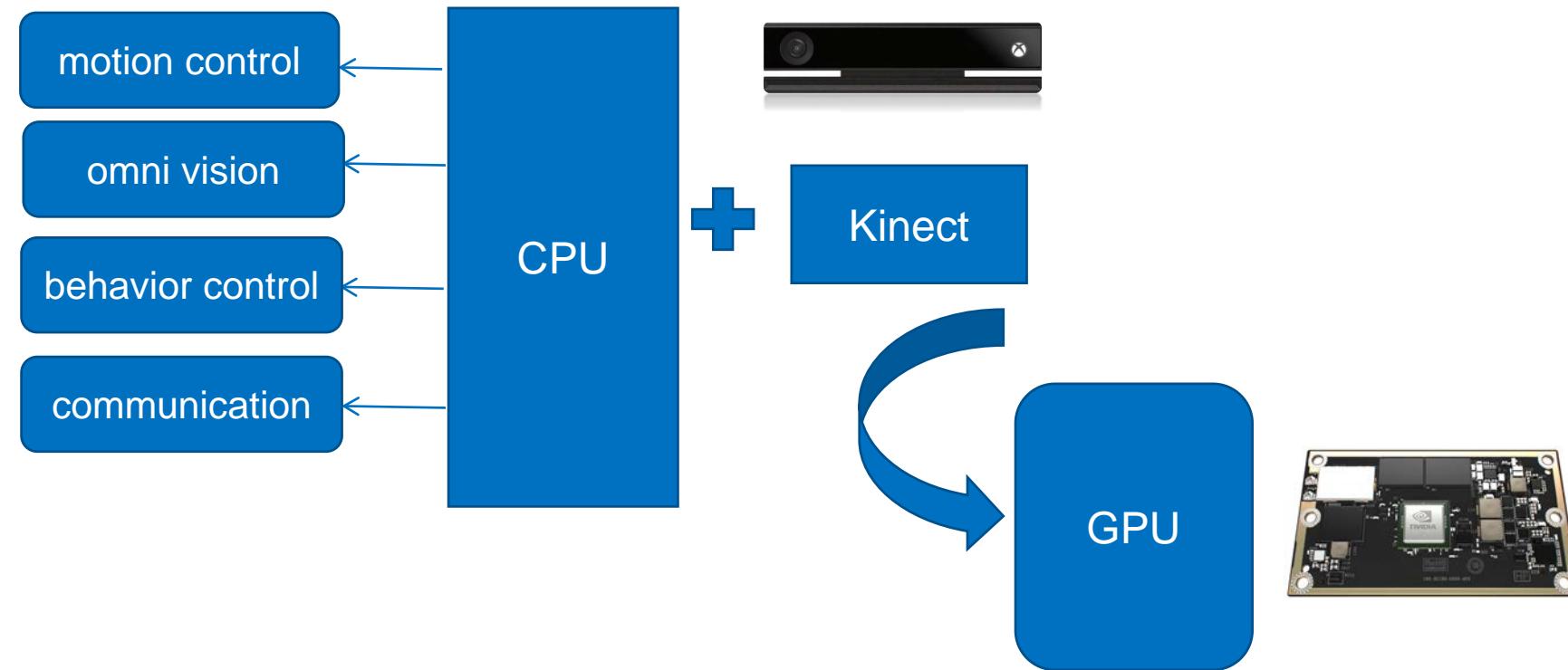




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Robot - Extra Architecture

Object detection based on CUDA parallel computing



Robot - Extra Architecture



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Results

1 high accuracy

2 ball's 3D position

3 arbitrary-colored obstacle detection

Robot - Extra Architecture



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Possible Direction: Multiple Kinect sensors onboard different robots to obtain a best coverage of the soccer field (local region);

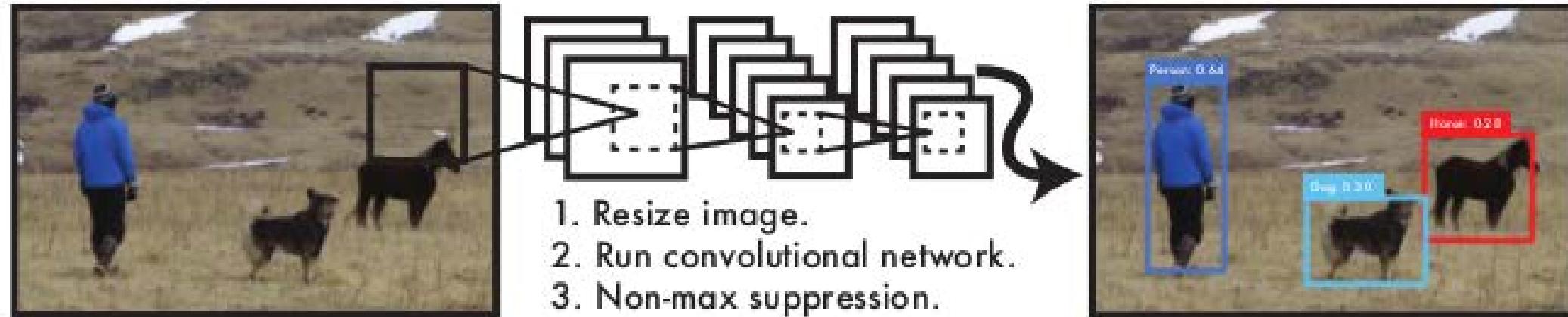


Robot - Machine Learning



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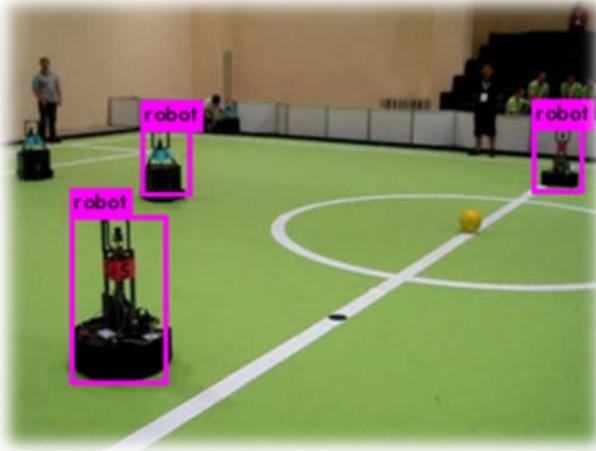
YOLO: Unified, Real-Time Object Detection



Robot - Machine Learning



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YOLO: Unified, Real-Time Object Detection

Test Result	
Correct	1109/1170
RPs/Img	3.37
IOU	72.76%
Recall	94.79%
Proposals	1351
Precision	82.09%
mAP	70.65%

Robot Dataset: github.com/nubot-nudt/robocup-MSL-dataset

Robot - Machine Learning



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1

Problems

- real-time requirements
- precision not good enough

2

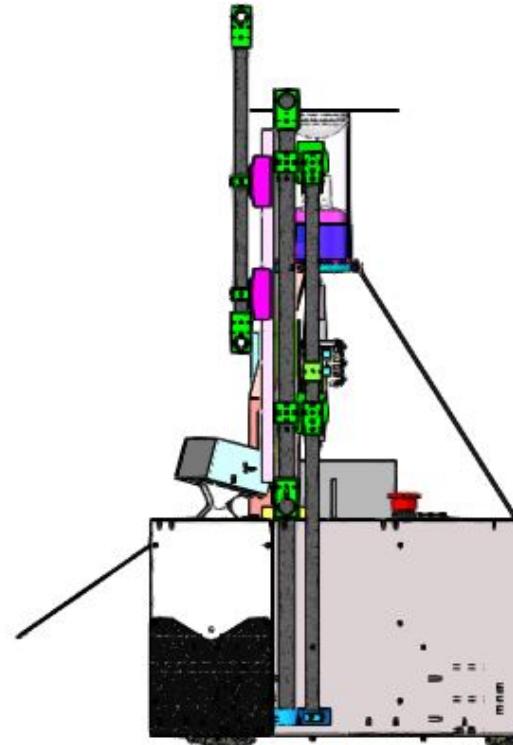
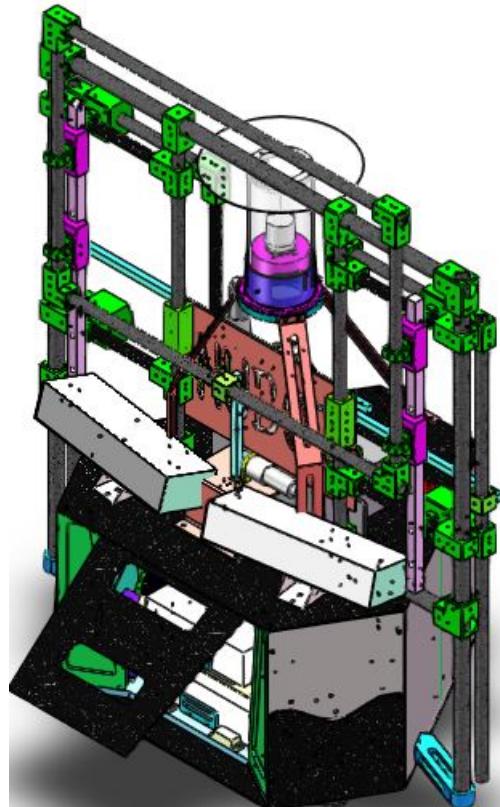
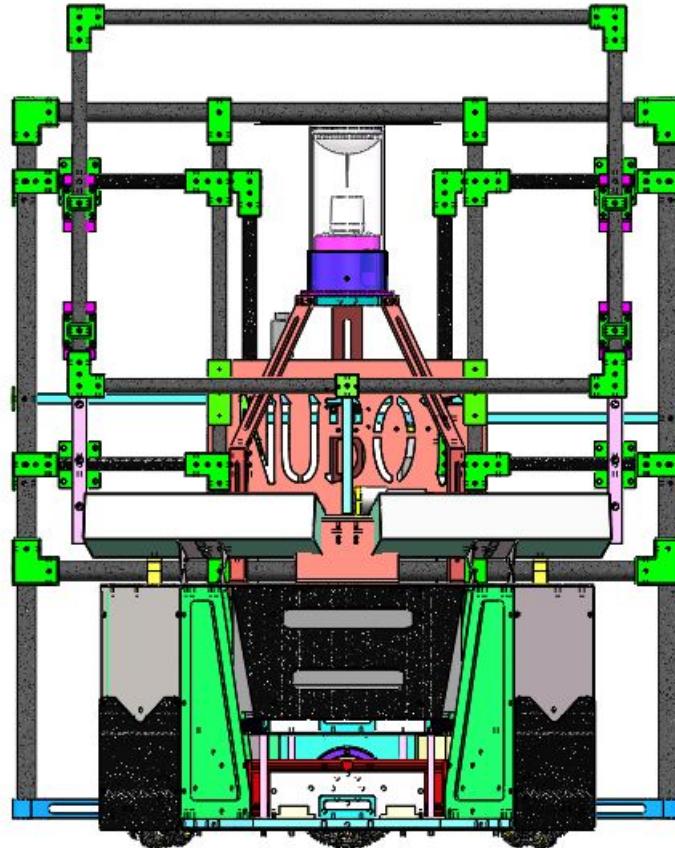
Directions

- collect datasets from the Kinect
- simplify the network architecture
- combine the depth information to train the network

Robot - Goalkeeper



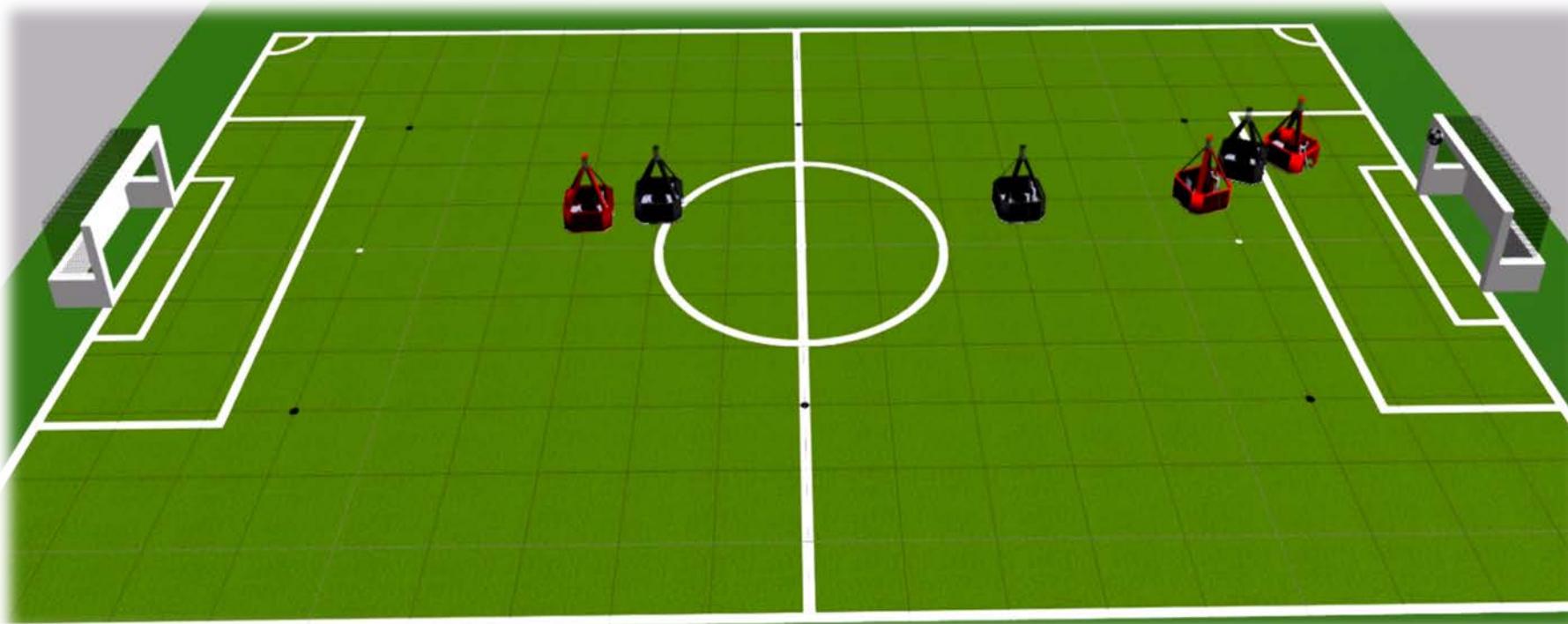
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Simulator - GroSim

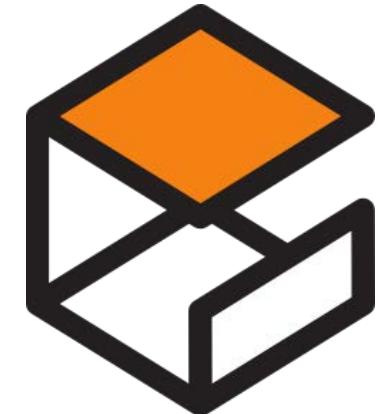


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- https://github.com/nubot-nudt/single_nubot_gazebo
- https://github.com/nubot-nudt/gazebo_visual
- <https://github.com/nubot-nudt/simatch>

ROS



GAZEBO

Yao W , Dai W, Xiao J, Lu H, Zheng Z. A simulation system based on ROS and Gazebo for RoboCup Middle Size League [C]. In 2015 IEEE International Conference on Robotics and Biomimetics (ROBIO). 2015:54-59 IEEE, 2015

Junhao Xiao, Dan Xiong, Weijia Yao, Qinghua Yu, Huimin Lu, Zhiqiang Zheng, Building Software System and Simulation Environment for RoboCup MSL Soccer RobotsBased on ROS and Gazebo, Springer Book on Robot Operating System (ROS) –The Complete Reference (Volume 2), pp. 597-631, 2017.

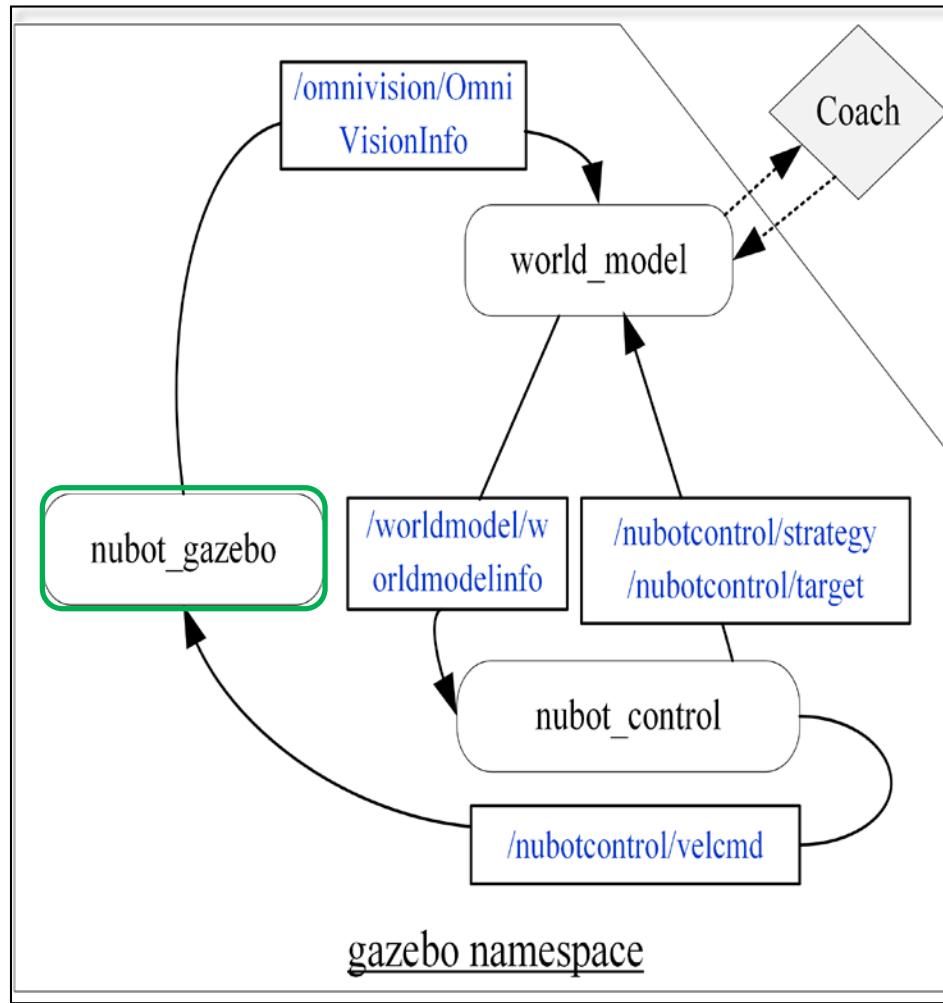


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Simulator - GroSim

01

Easily adapted



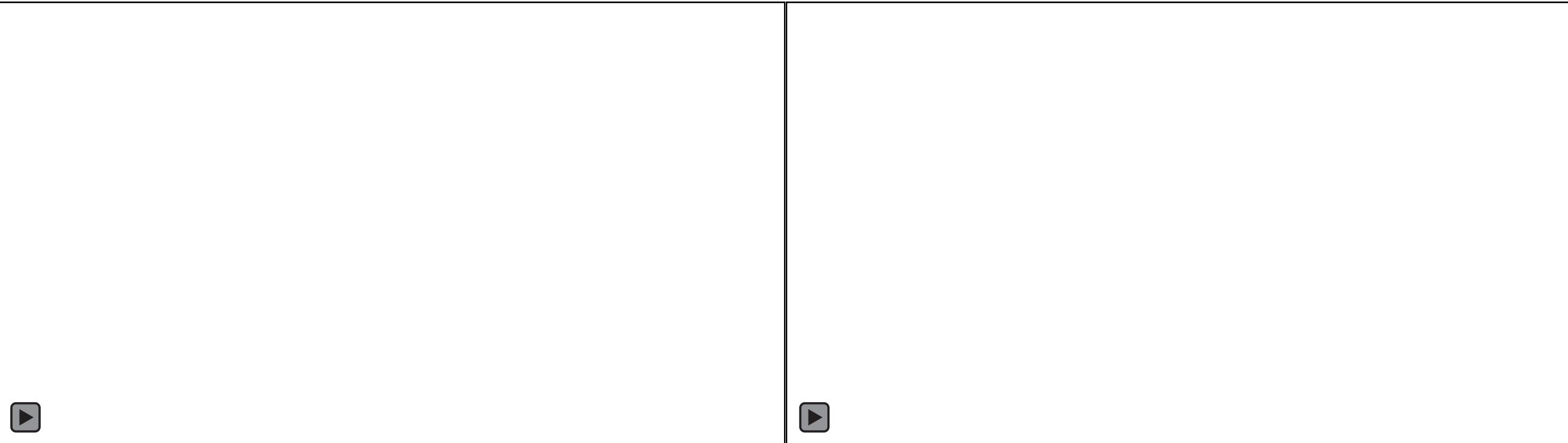
ROS messages are the interface

Topic/Service	Type	Definition
OmniVisionInfo	nubot_common/OminiVisionInfo	Header header BallInfo ballinfo ObstaclesInfo obstacleinfo RobotInfo[] robotinfo
Velcmd	nubot_common/VelCmd	float32 Vx float32 Vy float32 w
BallHandle	nubot_common/BallHandle	int64 enable --- int64 BallIsHolding
Shoot	nubot_common/Shoot	int64 strength int64 ShootPos --- int64 ShootIsDone

Simulator - GroSim



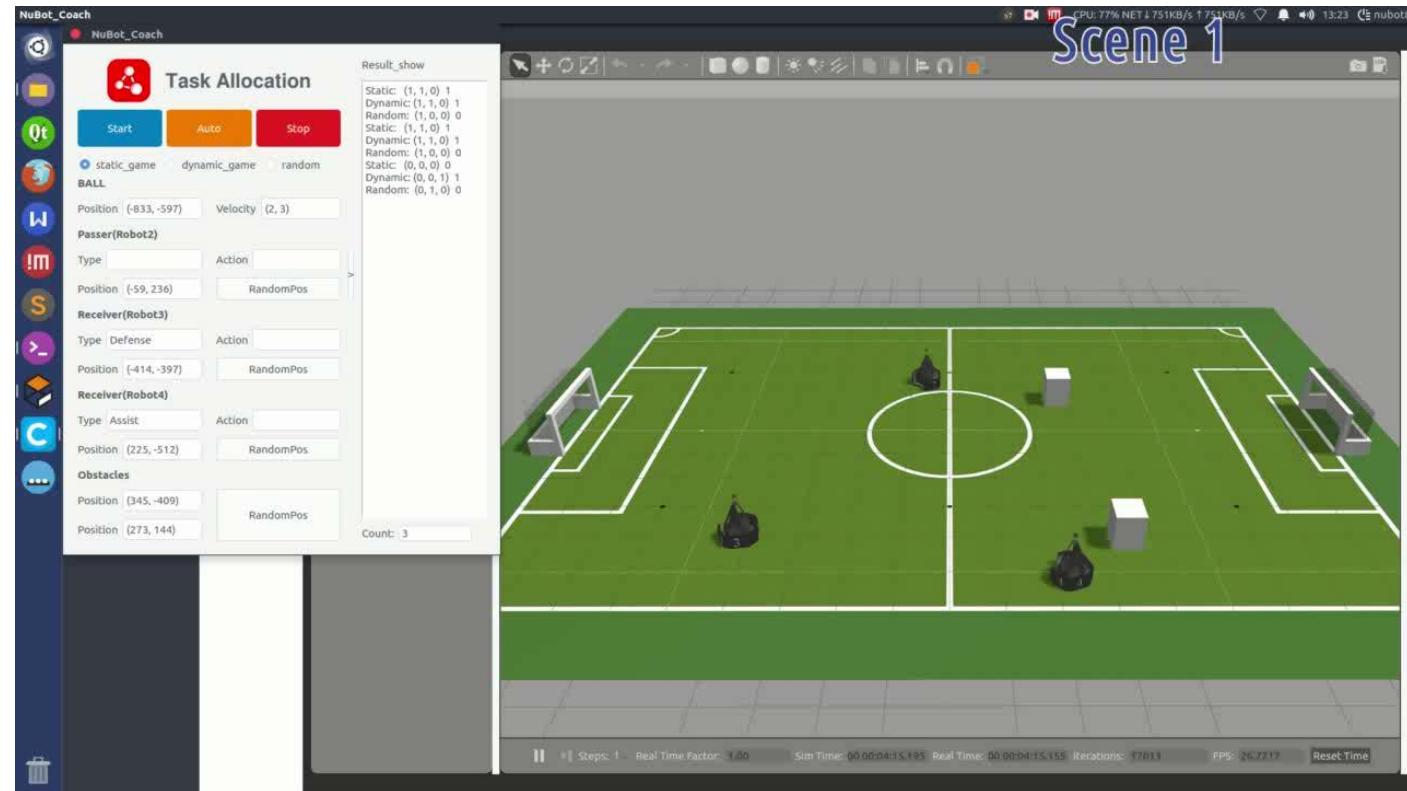
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- **Yao W** , Zeng Z, Wang X, Lu H, Zheng Z. Distributed encirclement control with arbitrary spacing for multiple anonymous mobile robots [C]. In 2017 Chinese Control Conference (CCC). IEEE, 2017.
- **Yao W**, Lu H, Zeng Z, Wang X, et al. Distributed Circumnavigation Control with Dynamic Spacing for a Heterogeneous Multi-robot System [C]. Submitted to IEEE International Conference on Robotics and Automation (ICRA). 2018
- **Yao W**, Lu H, Zeng Z, Xiao J. Zheng Z. Distributed Static and Dynamic Circumnavigation Control with Arbitrary Spacings for a Heterogeneous Multi-robot System. Submitted to Journal of Intelligent and Robotic System, 2017



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Task Allocation without
Communication Based on
Incomplete Information Game
Theory

https://github.com/nubot-nudt/task_allocation_gazebo

- **Wei Dai**, Qinghua Yu, Junhao Xiao, and Zhiqiang Zheng, Communication-less Cooperation between Soccer Robots. In 2016 RoboCup Symposium, Leipzig, Germany
- **Dai W**, Lu H, Xiao J. Zheng Z. Task Allocation without Communication Based on Incomplete Information Game Theory for Multi-robot Systems. Submitted to Journal of Intelligent and Robotic System, 2017



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Simulator - GroSim



Simulate game play and replay

2016 and 2017 China Robot Competition
Middle Size Simulation League

Name
CSU_Yunlu-BITCS-10-30-10:00.bag
CSU_Yunlu-Nubot-10-30-09:00.bag
Nubot-BITCS-10-30-11:00.bag
Nubot--CSU_Yunlu-11:00.bag

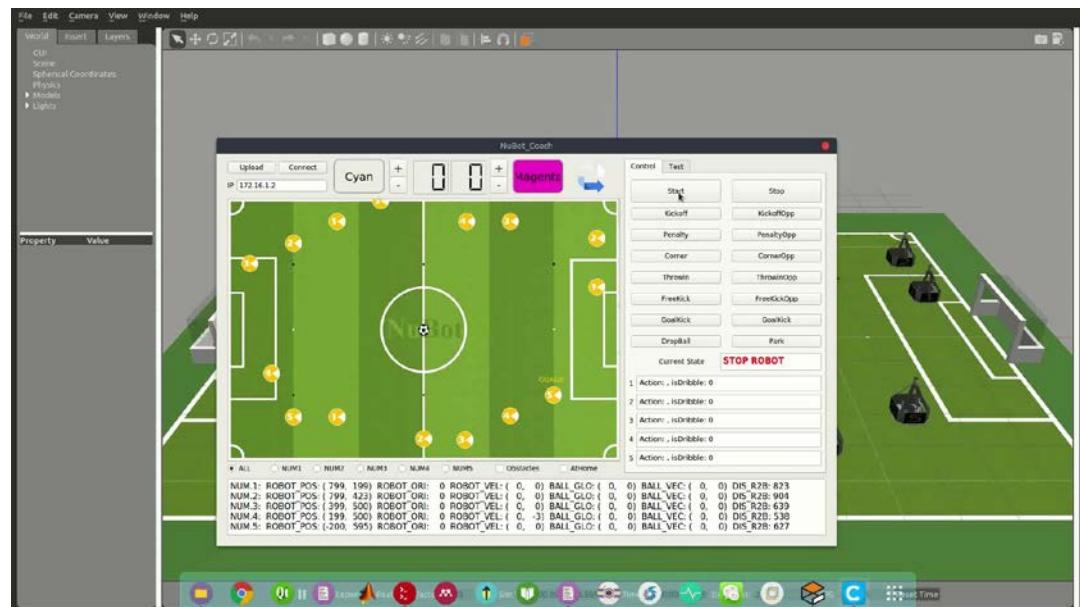
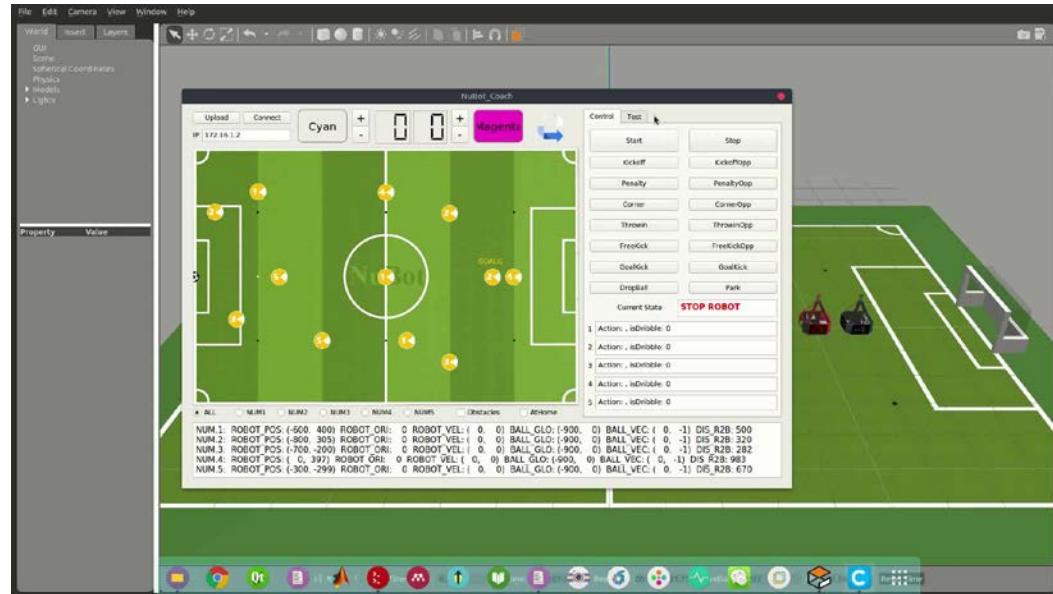


Simulator - GroSim

03

Distributed Computation

Single Computer Specifications	
Model	Lenovo Thinkpad X240
OS	Ubuntu 16.04 LTS
Memory	8 GB
Processor	Intel Core i7-4600U CPU @ 2.10 GHz x 4
Graphics	Intel Haswell Mobile



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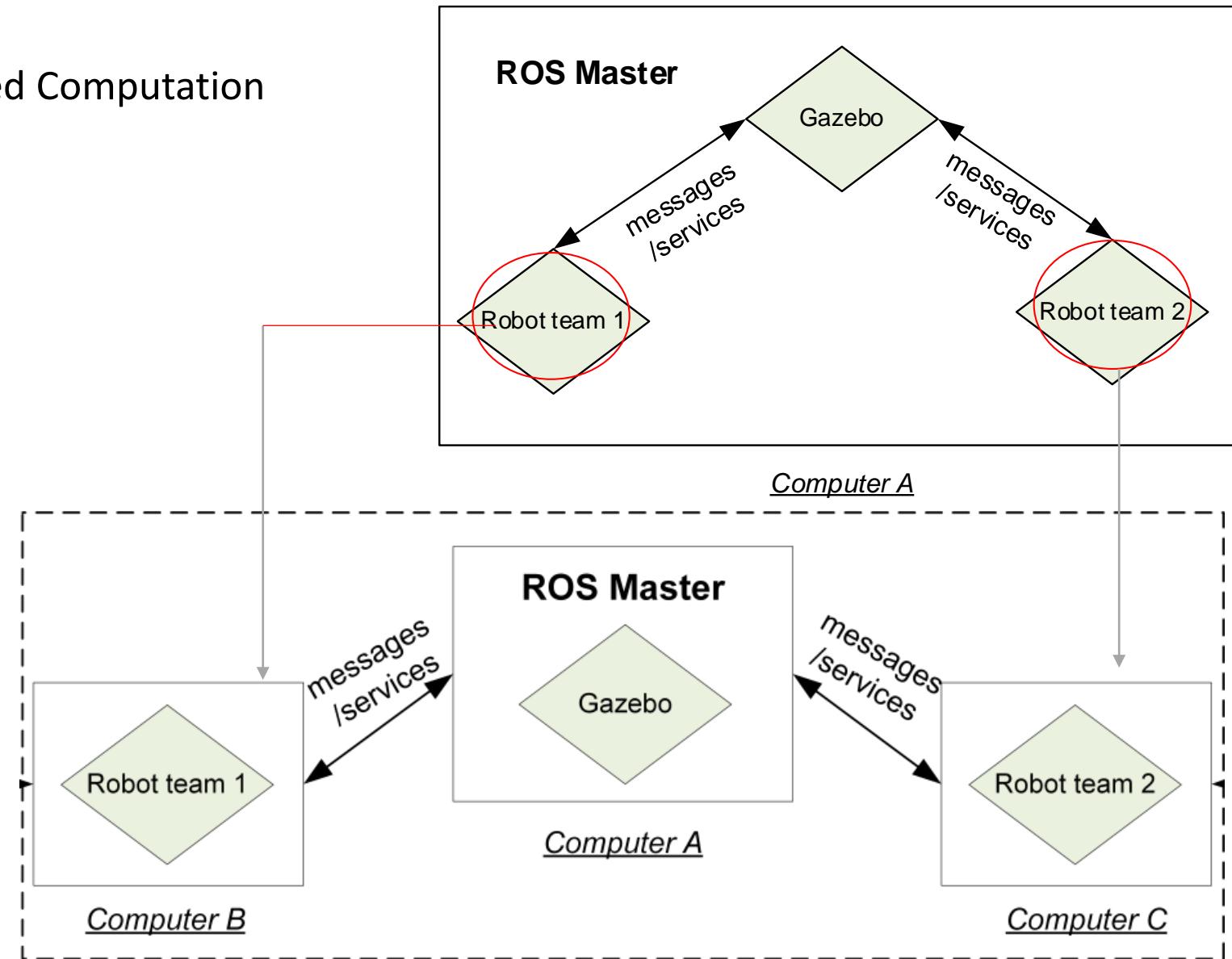
Simulator - GroSim



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03

Distributed Computation



Simulator - GroSim



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3D simulation

Far Future: **robotic arm** as the goalkeeper?

Possible research direction:

- Real time image processing
- Real time control of the robotic arm
- Accurate positioning in 3D
- Robust hardware
-

More Challenging!!



SuperDroid HD2-S Mastiff Tactical / Surveillance Robot w/ 5DOF Arm



Open Source with detailed documentation



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You are welcome to contribute to it!

- China Robot Competition 2018
- Sim Referee
- Robot models
- Simulation
- Documentation
-

- https://github.com/nubot-nudt/single_nubot_gazebo
- https://github.com/nubot-nudt/gazebo_visual
- <https://github.com/nubot-nudt/simatch>

用户手册 User manual

Quick Start Video Tutorial

Video

NOTE: If you want to have a basic understanding of how Gazebo and ROS combines to work together, it is recommended to check out the repository '[single_nubot_gazebo](#)'. This contains how to clone the repository, how to build it, how to run the simulation, and how the robot is simulated. You could run the ROS tool '[rqt_graph](#)' to visualize the ROS messages and service flow.

Recommended Operating Environment

1. Ubuntu 14.04;
2. ROS Indigo or ROS Jade. (It is recommended to install ROS Jade)
3. Gazebo 5.0 or above;



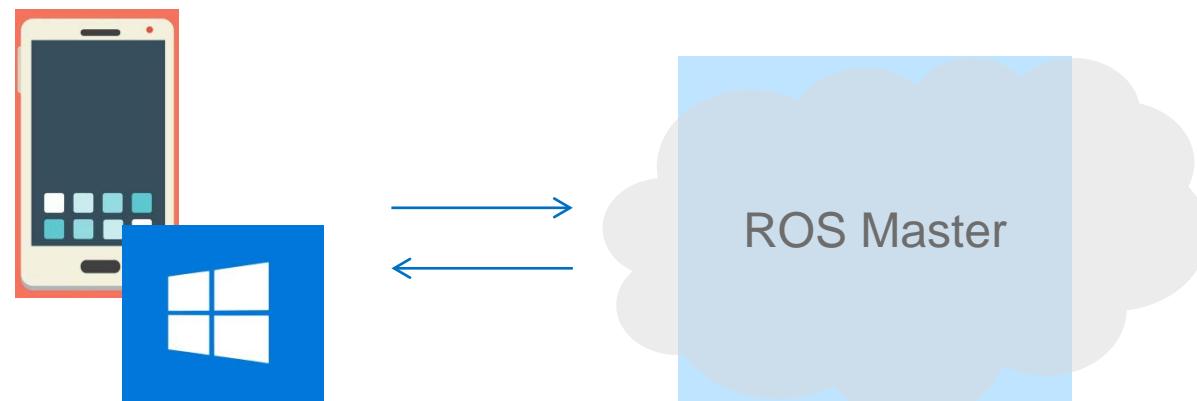
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Simulator – Cross-platform

Solution: Web-interface

Rosbridge Overview

Rosbridge is a package and API, which provide a JSON interface to ROS so that non-ROS programmers -- and non-ROS platforms! -- can access and use ROS. The standard implementation provides the JSON API via WebSockets, which allows developers to interface with the ROS world from web browsers, along with a very broad range of Programming Languages and Development Environments due to the wide support of JSON and websockets in many languages.





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THANK YOU