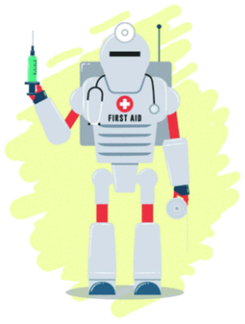

ROS2 compatible simulation environment for RoboCup Rescue Simulation

Benefiting from the ROS2 multi-robot capabilities

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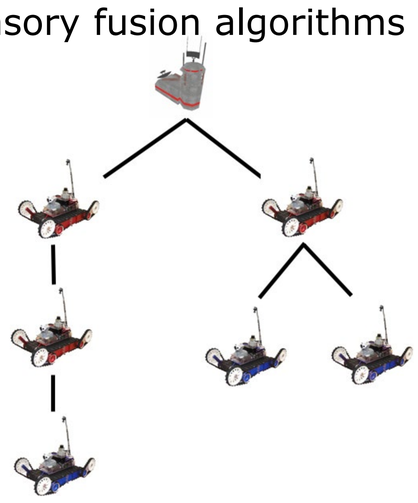
Challenge

- After a disaster a team of robots must explore the devastated area. The major technical goal is to encourage intuitive human interfaces, combined with autonomous and semi-autonomous algorithms that can be used to supervise and control multiple heterogeneous robots operating in challenging environments.
- At the last DARPA challenges principal solutions have been demonstrated, but those advanced robot systems need large teams of specialized operators. DARPA made e.g. the following recommendations (Norton et al, 2017):
  - Balance the capabilities of the operator and the system to effectively perform the task.
  - More autonomy from the robot to perform simple mobility tasks
  - More interaction from the operator to augment robot autonomy when planning difficult mobility tasks
  - Maintain operator awareness of the robot state
  - Duplicate sensor fusion displays using different perspectives

Operator station during the DARPA challenge (Kohlbrecher 2015)

- So, the RoboCup Virtual Robot competition (Sheh 2016) encourage to explore the boundary between autonomous and semi-autonomous algorithms by forcing the teams to use a single operator for the whole team. Challenges that the teams have to solve to reduce the number of operators:
  - Autonomous multi-robot control
  - Human multi-robot control interfaces
  - Localization, 3D mapping
  - Navigation and exploration
  - Robust sensory fusion algorithms



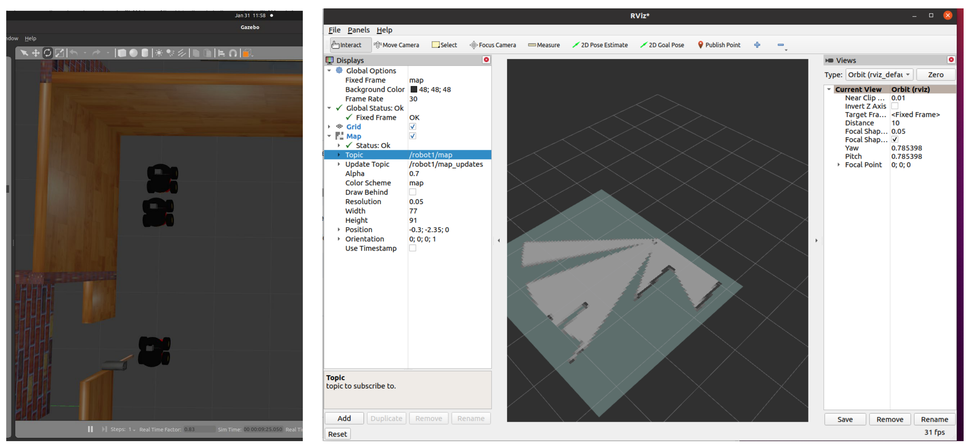
Controlling multiple robots from a single base station

ROS2 capabilities

- In 2022 the Virtual Robot competition ported the simulation environment to ROS2 Foxy.
- ROS2 has several advantages compared to ROS1:
  - Teams of multiple robots: while it is possible to build multi-robot systems using ROS1, there is no standard approach
  - Non-ideal networks: we want ROS2 to behave as well as is possible when network connectivity degrades due to loss and/or delay (Blass, 2021)
  - Production environments: ensure that ROS1-based lab prototypes can evolve into ROS2-based products suitable for use in real-world applications.

Virtual Robot demonstration

To support the teams, the technical committee has made several scenarios and demos available:



Multi-Robot Map Exploration Demo for ROS2

Essential for current rescue exploration scenarios is that these demos are extended with aerial and crawler robots.

Conclusion

- ROS2 made it possible to build multi-robot systems with a standardized approach. It also allows to flexible start scenarios by creating launch files with logic.
- The scenarios can be evaluated remotely during a pandemic in a cloud ROS2 environment such as the one provided by The Construct.

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- Kohlbrecher, S., Romay, A., Stumpf, A., Gupta, A., von Stryk, O., Bacim, F., Bowman, D.A., Goins, A., Balasubramanian, R. and Conner, D.C. (2015), Human-robot Teaming for Rescue Missions: Team ViGIR's Approach to the 2013 DARPA Robotics Challenge Trials. J. Field Robotics, 32: 352-377
- R. Sheh, S.Schwertfeger and A. Visser, "16 Years of RoboCup Rescue", KI - Künstliche Intelligenz, Volume 30, Issue 3, October 2016.

More information https://github.com/RoboCup-RSVRL/RoboCup2022RVRL_Demo