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Automating Cataloging and Discovery of Services for Service-Oriented Robotic Systems

Lucas Bueno R. Oliveira\textsuperscript{1,2}, Diogo B. Martins\textsuperscript{1}, Felipe A. Amaral\textsuperscript{1}, Flavio Oquendo\textsuperscript{2}, and Elisa Yumi Nakagawa\textsuperscript{1}

buenolro@icmc.usp.br, dbrdem@usp.br, felipeaa@usp.br, flavio.oquendo@irisa.fr, and elisa@icmc.usp.br

\textsuperscript{1} Dept. of Computer Systems, University of São Paulo - USP, São Carlos, Brazil

\textsuperscript{2} IRISA Research Institute University of South Brittany, Vannes, France

LARS 2014, São Carlos/SP
Agenda

Introduction
Developing RoboSeT
Case Study
Discussion
Conclusion and Future Work
Introduction

• Robots have been used in several areas of the society
• Complexity and diversity challenge the development of robotic systems
• Service-Oriented Architecture (SOA) promotes better reusability and flexibility to robotic systems
• Several Service-Oriented Robotic Systems (SORS) can be found in the literature
• Development environments for SORS are also available
Introduction

• Motivation:
  • SORS development environments do not provide facilities for location and selection of services
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Introduction

• Main goal:
  • To present RoboSeT (Robotics Services Semantic Search Tool), a mechanism that supports cataloging and discovery of services for robotic systems using semantic information.
Developing RoboSeT

• First step: Establishment of a common vocabulary [1]

Developing RoboSeT

• RoboSeT is divided into two main subsystems:
  • Service repository (Web Interface)
  • Service plug-ins (GUI or command line)
Developing RoboSeT

• Service repository:
  • Account management
  • Service publication
  • Service search and detailing
  • Service management
  • News about services

• Plug-ins:
  • Service search
  • Service identification
  • Service obtaining and deployment
  • Feedback about services (quality, bugs, comments)
Case study

• Design of a robotic system for robust navigation
  • Motion Planning
  • Trajectory generation
  • Obstacle detection and representation
  • Obstacle avoidance
  • Position and velocity control
  • Localization
  • Laser controller
  • Pioneer P3-DX controller
## Case study

• Mapping requirements into service types

<table>
<thead>
<tr>
<th>Functionality</th>
<th>Service type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motion Planning</td>
<td>Service/Task/Path planning</td>
</tr>
<tr>
<td>Trajectory generation</td>
<td>Service/Task/Path planning</td>
</tr>
<tr>
<td>Obstacle detection and representation</td>
<td>Service/Task/Mapping</td>
</tr>
<tr>
<td>Obstacle avoidance</td>
<td>Service/Task/Path planning</td>
</tr>
<tr>
<td>Position and velocity control</td>
<td>Service/Task/Navigation</td>
</tr>
<tr>
<td>Localization</td>
<td>Service/Task/Localization</td>
</tr>
<tr>
<td>Encoder controller</td>
<td>Service/Device/Sensor/Movement</td>
</tr>
<tr>
<td>Differential drive controller</td>
<td>Service/Device/Actuator/Locomotion</td>
</tr>
<tr>
<td>Laser controller</td>
<td>Service/Device/Sensor/Distance</td>
</tr>
</tbody>
</table>
Case study

• Searching for ROS services
## Case study

• Searching for ROS services (Part I)

<table>
<thead>
<tr>
<th>Functionality</th>
<th>Task service type</th>
<th>ROS Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motion Planning</td>
<td>Path planning/Heuristic Search</td>
<td>NavfnROS, CarrotPlanner</td>
</tr>
<tr>
<td>Trajectory generation</td>
<td>Path planning/Heuristic Search</td>
<td>TrajectoryPlannerROS, DWAPlannerROS</td>
</tr>
<tr>
<td>Obstacle detection and representation</td>
<td>Mapping/Metric/Grid</td>
<td>CostMap2D</td>
</tr>
<tr>
<td>Obstacle avoidance</td>
<td>Path planning/Heuristic Search</td>
<td>TrajectoryPlannerROS, DWAPlannerROS</td>
</tr>
<tr>
<td>Position and velocity control</td>
<td>Navigation</td>
<td>MoveBase</td>
</tr>
<tr>
<td>Localization</td>
<td>Localization/Probabilistic</td>
<td>Amcl</td>
</tr>
</tbody>
</table>
Case study

• Searching for ROS services (Part II)

<table>
<thead>
<tr>
<th>Functionality</th>
<th>Device service type</th>
<th>ROS Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Encoder controller</td>
<td>Sensor/Movement</td>
<td>RosAria</td>
</tr>
<tr>
<td>Differential drive controller</td>
<td>Actuator/Locomotion</td>
<td>RosAria</td>
</tr>
<tr>
<td>Laser controller</td>
<td>Sensor/Distance</td>
<td>SICK Toolbox</td>
</tr>
</tbody>
</table>
Case study
Discussion

• Advantages:
  • Services can be transparently shared and discovered
  • Services that are easier to be found are more likely to be reused
  • Structured information can support identification of more suitable services
  • Reuse improvements positively influence productivity in software systems development
  • Community feedback can guide the development of services of better quality
Discussion

• Main limitation:
  • RoboSeT is depended on community adoption and cooperation

• Current initiatives to mitigate such limitation:
  • To promote RoboSeT in the robotics community
  • To release an open source version of RoboSeT
Conclusion and Future Work

- SOA is a promising architectural style for robotics
- A mechanism for supporting cataloging, publishing, and discovery of services can contribute to the SORS development
- Results indicate that RoboSeT can ease the discovery of services for SORS
- Future work:
  - To perform an experiment
  - To develop new functionalities and plug-ins
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