Software development and Integration in Robotics (SDIR V)

Tutorial on Component-based Robotics Software Engineering

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http://robotics.unibg.it/tcsoft/sdir2010/
- SDIR - V / ICRA 2010: Tutorial

- SDIR - IV / 2009 (ICRA Kobe, Japan):
  - Robotic software and system flexibility
- SDIR - III / 2008 (ICRA Pasadena, CA):
  - Real-time robot behavior
- SDIR - II / 2007 (ICRA Rome, Italy):
  - The art of robot software development
- SDIR - I / 2005 (ICRA Barcelona, Spain):
  - Software interoperability and reuse

5 years of Software Development in Robotics
Journal of Software Engineering for Robotics

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SDIR-V / ICRA 2010: Tutorial

The fifth edition of the ICRA SDIR workshop reflects an increased awareness within the Robotics community for the importance of identifying and developing software principles that support the development of new robotic systems as composition of reusable components in order to reduce development time and cost. **Component-Based Software Engineering (CBSE)** is an approach that has arisen in the software engineering community in the last decade. It aims to shift the emphasis in system-building from traditional requirement analysis, system design and implementation to **composing software systems from a mixture of reusable off-the-shelf and custom-built components**. In order to fully exploit the potential of CBSE in robotics, the subtle relationship between best practices in robotics, robotics requirements, needs of robotics and implementation technologies like e.g. middleware systems has to be made explicit. Bringing together researchers from these different disciplines through tutorial on CBSE and its principles for robotics lays the foundations towards the long-term goal of identifying the ingredients of a component model for robotics for model-driven system design.

5 years of SDIR - Software Development in Robotics
How Robotics Research Keeps...

Re-Inventing the Wheel

First, someone publishes...

...and they write code that barely works but lets them publish...

But inevitably, time runs out...

...and countless sleepless nights are spent writing code from scratch.

So, a grandiose plan is formed to write a new software API...

...and all the code used by previous lab members is a mess.

This prompts another lab to try to build on this result...

...but they can't get any details on the software used to make it work...
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- Software Components and Component-based Systems
  - Luca Gherardi, Davide Brugali
    University of Bergamo, Italy

Part II:
- Component-based Robotics Middleware
  - Nico Hochgeschwender, Azamat Shakhimardanov
    Bonn-Rhine-Sieg University of Applied Sciences, Germany

Part III:
- Model Driven Software Development in Robotics - It really works!
  - SmartSoft MDSD Toolchain
  - Andreas Steck, Christian Schlegel
    Ulm University of Applied Sciences, Germany
Research leading to these results has received funding from:

- **Part I / Part II: BRICS**
  - European Community's Seventh Framework Programme
    FP7 (2007-2013) under grant FP7-ICT-231940-BRICS

- **Part III: ZAFH Servicerobotik**
  - [http://www.zafh-servicerobotik.de/](http://www.zafh-servicerobotik.de/)
  - Landesstiftung Baden-Württemberg
    (foundation to support projects of general public benefit linked by the common aim of securing the future capabilities of the State of Baden-Württemberg)
  - co-funded by EFRE
    (European Regional Development Fund)
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Introduction Open Discussion
As we have just five minutes left, I will take only 3 million questions.
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Final Discussion

- do we reinvent the wheel?
  - is CBSE enough?
  - what is needed within a component model?

- are there “best practices”?
  - how to provide them?
  - how to contribute?
  - how to involve others?

- what needs to be part of a robotics modeling language?
  - what is missing when reusing insights of other domains?

- what next steps to make?
  - how to collect / provide patterns / models / best practices?

- ...
Summary
We need a systematic engineering approach for robotics software!

- robots are complex systems that depend on systematic engineering
- so far fundamental properties of robotic systems have not been made detailed enough nor explicit (e.g. QoS)
- tremendous code-bases (libraries, middleware, etc.) coexist without any chance of interoperability and each tool has attributes that favors its use

→ rely, as for every engineering endeavour, on the power of models
→ nowadays, robotics functionality is foremost based on software
→ make the step towards MDSD
Conclusion of the Discussion

- we need a forum where we can talk about differences in software models, modelling techniques, etc.
- the overall aim is to collect, compare and evaluate different software modelling approaches

- **Idea:**
  provide a column in JOSER for evaluation and comparison of modelling approaches
  - regularly provide *small, but characteristic* problems in JOSER in a standard format:
    - example / description / benchmark: maximum 1 page
  - let them work out by readers in their favourite model (only very short contributions, low effort)
  - compare / discuss / benchmark the contributions by the readers

- **Result:**
  - the column can result in a collection of best practices, explicit experiences, example solutions, patterns, anti-patterns etc.
  - it should be a growing collection of implementation-independent principles in robotics

- **Action:**
  - in 2010: come up with a first problem and start this in JOSER
  - after some first examples, invite the community to propose problems