



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

The Journal of Software Engineering for Robotics is an open-access, peer-reviewed electronic journal that aims to promote the synergy between Software Engineering and Robotics. It invites both empirical research papers that evaluate the effectiveness of existing Software Engineering approaches and methods in the development of robotic software systems, as well as theoretical contributions that present new Robotics-specific Software Engineering results.

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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...



...a paper with
a proof-of-
concept robot.



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



But inevitably,
time runs out...



...but they can't
get any details
on the software
used to make it
work...



...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.



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<http://www.willowgarage.com/blog>



Time	Title	Speaker
09:00 - 09:15	Welcome and opening remarks	Christian Schlegel
09:15 - 10:45	Software Components and Component-based Systems	Luca Gherardi Davide Brugali
10:45 - 11:00	<i>Coffee break</i>	
11:00 - 12:30	Component-based Robotics Middleware	Nico Hochgeschwender Azamat Shakhimardanov
12:30 - 14:00	<i>Lunch</i>	
14:00 - 15:30	Model-Driven Software Development in Robotics - It really works! SmartSoft MDSD Toolchain	Christian Schlegel Andreas Steck
15:30 - 15:45	<i>Coffee break</i>	
15:45 - 17:00	Open discussion	All





■ **Part I:**

- 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

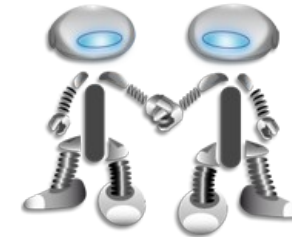




Research leading to these results has received funding from:

▪ **Part I / Part II: BRICS**

- <http://www.best-of-robotics.org/>
- European Community's Seventh Framework Programme FP7 (2007-2013) under grant FP7-ICT-231940-BRICS



▪ **Part III: ZAFH Servicerobotik**

- <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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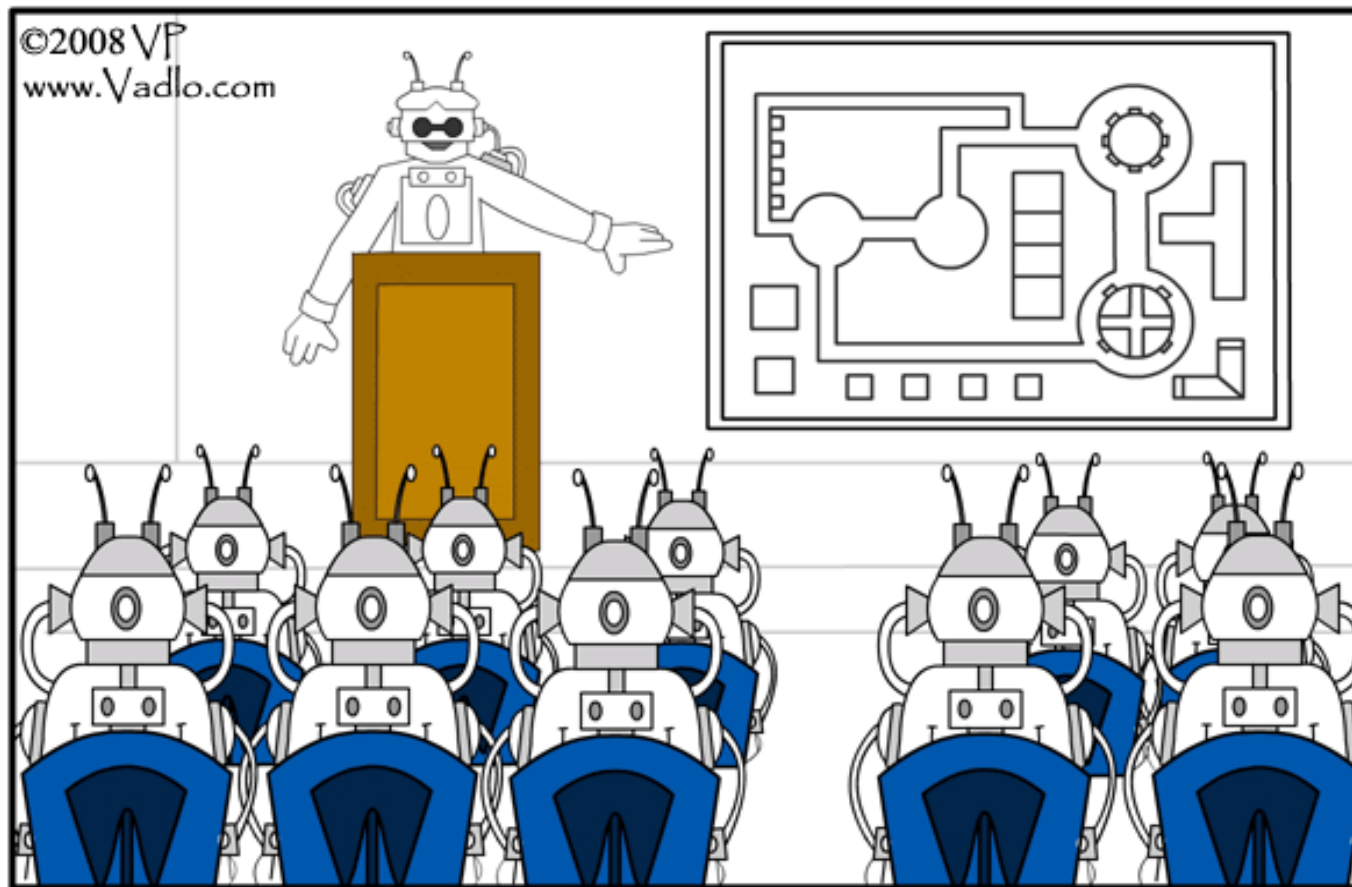




Introduction Open Discussion



ROBOT SEMINARS



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 ?***
- ...

again, think of JOSER - Journal of Software Engineering for Robotics

7 May 2010

ICRA 2010 (SDIR V) Tutorial

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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*



etc.



7 May 2010

ICRA 2010 Workshop / Schlegel



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, explicated 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