RobMoSys
Composable Models and Software for Robotics Systems

Dennis Stampfer, Hochschule Ulm, stampfer@hs-ulm.de
speaking for the RobMoSys Consortium

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Outline

- About the project: Introduction and Goals
- The RobMoSys-Approach
- Current State and Progress
- Opportunities to get involved via open call funding (4M€)
The project ID

- **RobMoSys**: Composable Models and Software for Robotic Systems
- In response to **H2020** Project – ICT-26- TOPIC : System abilities, development and pilot installations
- **SubTopic c**: **Innovation Action** on systems development technology.
  - The “**System development tools**” sub-call

- **Start Date** 01/01/2017
- **End Date** 31/12/2020
- **Duration** 4 Years
- **Budget** 8M, where 4 M for Open-Calls
- **Web Site** [http://robmosys.eu/](http://robmosys.eu/)
Video:

https://www.youtube.com/watch?v=8GUSDTNoGRM
AMBITION

RobMoSys will coordinate the whole community’s best and consorted efforts to realize a step-change towards an industry-grade software development European ecosystem

• open
• sustainable
• industrial quality

RobMoSys part of the effort on Digital Industrial Platforms for Robotics (together with ROSIN)
APPROACH

Model-driven engineering as key enabler for
- complex software and system integration
- high-quality standards compliance
- integrating existing technologies

Expected results
- repository of formal models for robotics
- tooling for correct-by-construction composition and code generation
- open-source software and tools “track”

Community Involvement
- Workshops Series (e.g. ERF) and Summer Schools
- Funding: Open Calls (better tools, models, and systems)
What is the aim of RobMoSys?


- **RobMoSys** envisions an integrated approach built on top of the current code-centric robotic platforms, by applying model-driven methods and tools.
- **RobMoSys** will enable the management of the interfaces between different robotics-related domains in an efficient and systematic way according to each system’s needs.
- **RobMoSys** aims to establish Quality-of-Service properties, enabling a composition-oriented approach while preserving modularity.
- **RobMoSys** will drive the non-competitive part of building a professional quality ecosystem by encouraging the community involvement.
- **RobMoSys** will elaborate many of the common robot functionalities based on broad involvement of the community via two Open Calls.

**Better models, as the basis for better tools and better software, which then allow to build better robotic systems**

The project is open for constructive suggestions from the community, as long as "platform", "composability" and "model-tool-code" are first-class citizens of those suggestions.
What is the aim of RobMoSys?

Commercial User Stories...

- Reduction of development time
- Reduced development costs
- Shorter time to market
- Larger production volumes possible

- Certifyable systems
- Predictable safety
- Systems become more easily re-usable
- Commoditisation of base components
What is the aim of RobMoSys?

Technical User Stories...

- Composable components
- Traceable properties
- Predictable properties
- Reliable quality of service
- Certifiable systems
- Replaceable components
- Re-usable
- Commoditisation of base components
• **composability** is the ability to combine and recombine as-is building blocks into different systems for different purposes. It requires that properties of sub-systems are invariant („remain satisfied“) under composition.

• **compositionality** requires that the behavior of a system is predictable from its sub-systems and that of the composition „glue“.

• **system composition (activity)**: the activity of putting together a set of existing building blocks to match system needs with a focus on flexible (re-)combination.

• **system integration (activity)**: the activity that requires effort to combine components, requiring modifications or additional actions to make them work with others.
System Composition in an Ecosystem

- RobMoSys adopts a **composition-oriented** approach to **system integration** that manages, maintains and assures **system-level properties**, while preserving **modularity** and independence of **existing robotics platforms** and code bases, yet can build on top of them.

- Towards an open and sustainable European robotics software **ecosystem** based on models and supporting **separation of roles**

- Apply **model-driven** techniques

- Manage **non-functional properties**

- From integration-centric to **composition-oriented** approaches

We operationalize architectural patterns and composition such that properties of system-of-systems become known in order to build trust in the system under development.

- Composition is about the **management** of the **interfaces** between different **roles** (participants in an ecosystem) in an efficient and systematic way.

- Composition is about guiding the roles via **superordinate composition-structures**.

- Composition is about explicating and managing **properties**.

- Composition is about the right **levels of abstraction and views** for roles.
RobMoSys Ecosystem Organization: Analogy with the PC Domain

Examples of Robotics:

- e.g. robotics architectural patterns and robotics composition structures (service-oriented software component model, robotics task models etc.)
- e.g. Flexible Navigation Stack, Active Object Recognition, Motion Stack, Perception Stack etc.
- e.g. robotics software components (Motion Planning, SLAM, Object Recognition), robotics functional libraries (MRPT, OpenCV, PCL), applications (Pilots, Logistics Fleet, Production Cell, Healthcare Servicerobot), etc.
RobMoSys enables the composition of robotics applications with managed, assured and maintained system-level properties via model-driven techniques.

- RobMoSys enables **communication of design intent, analysis of system design before it is being built and understanding of design change impacts**

- RobMoSys enables systems **correct by construction**

- RobMoSys supports management (design, assurance, traceability) of **(extra-functional) system properties** (e.g. resources, safety, QoS, accuracy, adequateness, etc.) in all development phases and at run-time:
  - deliver goods in time
  - trade-off energy consumption, speed, safety, etc.
How to build models for different parts and different aspects of a robotic system?

- be able to correctly **compose models**
- be at least as detailed as needed for a certain level of confidence into the properties of the outcome (by simulation, by testing, by reasoning, ...)
- cannot be done easily as long as you do not adopt to a notion of Meta-Models
- Meta-Models allow to **transform** in a consistent way **between models** including constraints, tolerances etc.
RobMoSys Open Calls

Call I: <closed 10/2017>
- Platform and structure
- Basic components, technologies, and bridges to other worlds
- Meta-Models, software, and tooling

Call II: <opens 04/2019>
- Pilots, focus on applications
- Models, software, and tooling

Dec. 2017
Details Call: RobMoSys-1FORC

- Number of experiments to be funded in the first Call: **6-7**
- Total indicative funding: **€ 2,000,000**
- Maximum budget granted to one experiment: **€ 300,000**
- Max. budget per institution cross-experimental: **€ 250,000**
- Funding rate – 100% (non-profit), 70% (for-profit) of direct costs
  - plus 25% overheads
- 25% of prefunding
- Duration of participation: **12 months**

These are details of first open call! Second open call to be published 4/2019!
RobMoSys enables the composition of robotics applications with managed, assured, and maintained system-level properties via model-driven techniques. It establishes structures that enable the management of the interfaces between different robotics-related domains, different roles in the ecosystem, and different levels of abstractions. Documents that provide an overview and introduction:

- "Section 1 / Excellence": excerpt of RobMoSys Grant Agreement, Annex 1 (part B)
- Presentation of the RobMoSys project at European Robotics Forum 2017, Edinburgh

The RobMoSys Wiki provides technical details on the RobMoSys approach including examples realizing the RobMoSys structures. For general information about the RobMoSys project or its open calls, please refer to the project website.

Please note: The RobMoSys consortium is continuously updating this wiki to provide early insights. See the changelog. If you came here through a RobMoSys document, please see the jumppage to find related pages.

Glossary and FAQ

The glossary contains descriptions of used terms. The technical FAQ provides answers to frequently asked questions.

Your Role in the RobMoSys Ecosystem

http://www.robmosys.eu/wiki
Conclusions and Takeaway Messages

- The overall goal of RobMoSys is to achieve a “EU Digital Industrial Platform for Robotics” where robotic systems are built from composable models and software and where different experts collaborate to share risks and efforts.

- RobMoSys does not start from scratch, nor does it create models or approaches in complete isolation. Instead, RobMoSys provides a solid framing structure and according software baseline that will be extended during the run-time of RobMoSys via the open call projects.

- **4M€ funding available**: RobMoSys wants community involvement towards better models, as the basis for better tools and better software, which then allow to build better robotic systems.