

## Component Interface Formalization in Robotic Systems

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**Abstract :** Components are heavily used in many software systems, including robotics systems. The growth of sophistication and diversity of new capabilities for robotic systems presents new challenges to their architectures. Their complexity is growing exponentially with the advent of AI, smart sensors, and the complex tasks they have to accomplish. Such complexity requires a more rigorous approach to the creation, use, and interoperability of software components. The issue is exacerbated because robotic systems are becoming more and more reliant on third-party components for certain functions. In order to achieve this kind of interoperability, including dynamic component replacement, we need a way to standardize their interfaces. A formal approach is desperately needed to specify what an interface of a robotic software component should contain. This study performs an analysis of the issue and presents a universal and generic approach to standardizing component interfaces for robotic systems. Our approach is inspired by well-established robotic architectures such as ROS, PX4, and Ardupilot. The study is also applicable to other software systems that share similar characteristics with robotic systems. We consider the use of JSON or Domain Specific Languages (DSL) development with tools such as Antlr and automatic code and configuration file generation for frameworks such as ROS and PX4. A case study with ROS2 is presented as a proof of concept for the proposed methodology.

**Keywords :** CPS, robots, software architecture, interface, ROS, autopilot

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