# Introducing Crospi: an open-source Constraint-based Reactive and Orchestrated Sensor-driven PIpeline for robot control

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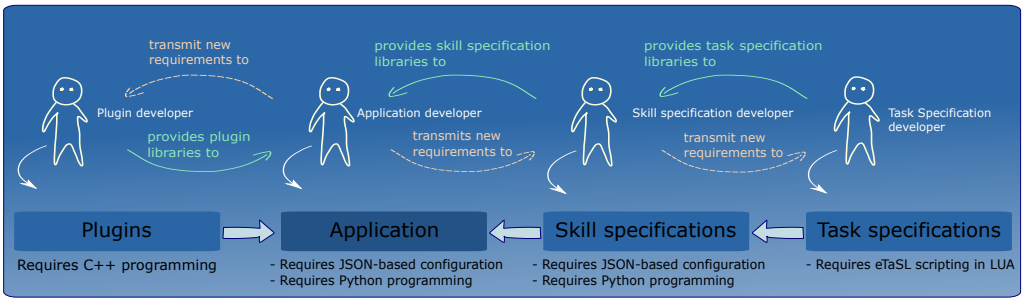


Figure 1: Architecture that separates the concerns of robot application development into four blocks, each with its corresponding stakeholder.

## 1 Introduction

Crospi[1] is an open-source software that enables reactive robotic behaviors, while reducing the expertise required for application development (see Fig. 1). Multiple sensors (e.g. force/torque, vision, IMU, tactile, etc.) can be easily integrated (via ROS2 or other communication channels) into robot control loops to generate real-time sensor-driven behaviors.

## 2 Methodology

Crospi relies on a constraint-based approach to specify the desired robot behavior at a high level of abstraction based on task specifications written in eTaSL [1]. Crospi reads these task specifications in configuration states of the orchestrator [2] to automatically generate real-time controllers that execute the desired behavior in multi-robot systems. Crospi is designed to be modular and extensible, allowing to easily integrate new sensors, robots, solvers, etc. It is implemented in C++ with real-time performance and ROS2 integration.

Fig. 1 illustrates Crospi hierarchical architecture, which reduces the expertise required by the different stakeholders. The reusability of the different blocks is facilitated, e.g. by automatically-generated JSON Schemas that define configurable parameters of each block.

[1]Code and tutorials available at: https://rob.pages.gitlab.kuleuven.be/crospi/.

[2]We provide integration for Behavior trees and FSMs using BetFSM https://github.com/Robotics-Research-Group-KUL/betfsm, but other alternatives such as YASMIN can be also used.

## 3 Application example

Crospi has been used in several use cases, including a mobile manipulation use case for cable harnessing, combining Neura's MAV mobile base with the MAiRA robotic arm (see Fig. 2). The task relies on force-based skills that regulate cable tension during manipulation, requiring low-level closed-loop control at 1 kHz. By coordinating MAV's mobility with MAiRA's fast dynamics, the system robustly executes sensor-driven cable routing, integrating vision for coarse localization with force feedback to handle geometric and mechanical uncertainties. This use case obtained the second place in the Neura Robotics Challenge 2025. A video is available in the following link: https://youtu.be/vRGSpFZ4Pgo?si=g5OYncd4LnIHBNLy

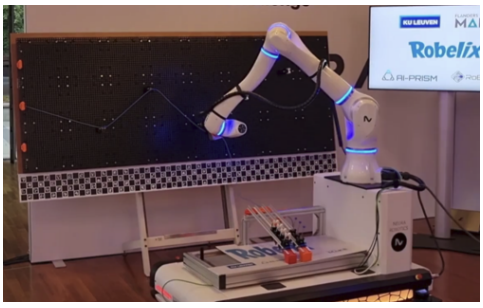

Figure 2: Application example setup.

## References

[1] E. Aertbeliën, J. De Schutter, "eTaSL/eTC: A constraint-based Task Specification Language and Robot Controller using Expression Graphs" 2014 IEEE/RSJ IROS, 2014.