Towards a Generic Software Platform for Agricultural Robotics based on Autopoietic Separation of Safety and Functionality

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Safety: a challenge

Safety is a fundamental challenge in agricultural robotics as large, mobile robots are operating in an open and unpredictable environment. A key obstacle for the agricultural robots design is the lack of methods for efficient development of safety-verifiable control software.

In an effort to address this safety challenge, various software architectures have been suggested for agricultural robotic vehicles, but none of them provide isolation of the safety-critical parts of the software.

Autopoiesis: a solution

One way to address the safety challenge is to separate the software into an autopoietic safety kernel and an allopoietic functionality-providing layer. Autopoietic separation of safety and functionality has not yet been used in robotics.

Autopoiesis - originally presented to describe living organisms - literally means "self-creation", and expresses a fundamental relation among structure, mechanism and function concerned with continuous existence. In contrast, allopoiesis means producing something else than the system itself.

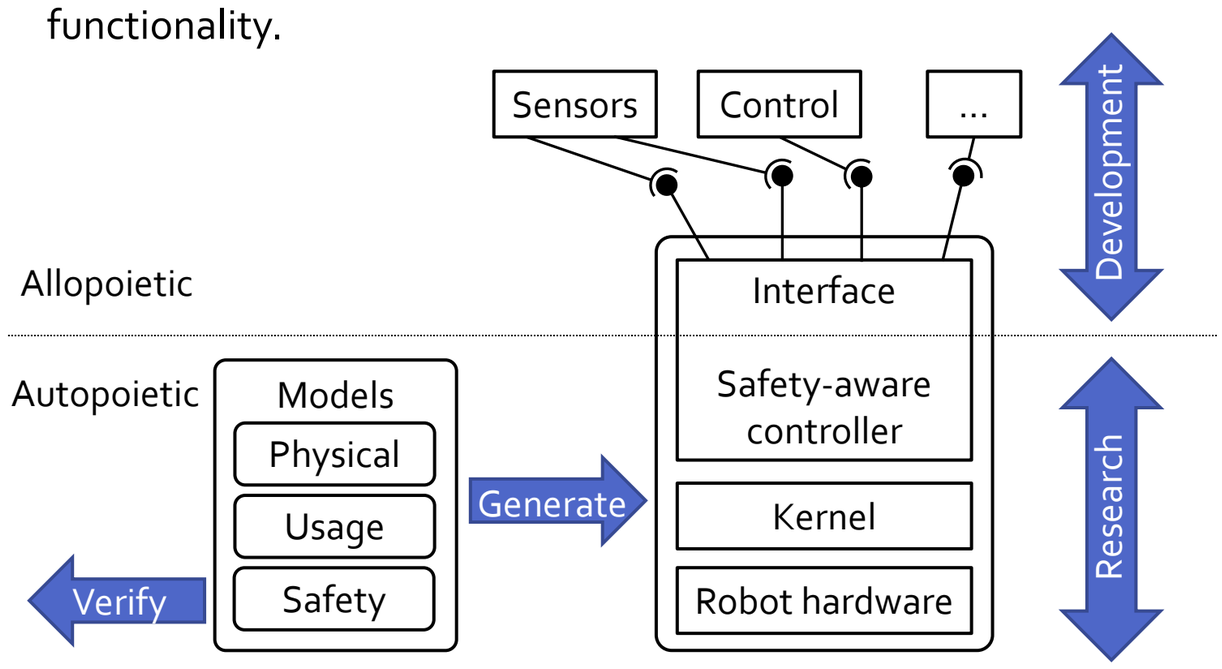
Research hypothesis

The research project hypothesis is that it is possible to design a software architecture that enables automatic safety verification and generation of control software for mobile agricultural robotics.

This could be based on the biologically inspired principle of autopoietic separation of the software into an autonomic safety kernel and a functionality-providing layer.

Software architecture based on autopoietic separation

The robot controller software architecture is proposed to be structured in terms of an autopoietic core, consisting of a safety kernel that has exclusive access to a low-level actuator interface, and a layer of allopoietic components providing functionality.



The physical model formally describes the physical characteristics of the robot and its environment.

The usage model deals with all types of scenarios within which the robot operates.

The safety model provides the framework for supervising the interaction between the robot and its environment, with focus on lowering the safety risks.

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