

**Special Issue on**  
**Introspective Methods for Reliable Autonomy**

### AIM AND SCOPE

As humans, understanding our own limitations, failures and shortcomings is a key for improvement and development. This knowledge is crucial for altering our behaviors, e.g. to execute tasks in a more cautious way. Correspondingly, equipping robots with a set of skills that allows them to assess the quality of their sensory data, internal models, used methods etc. will greatly improve their overall performance.

The problem of introspection, directly or indirectly, relates to other research topics: planning, execution monitoring, active perception and mapping. Accordingly, an improved understanding of introspection in robotics has a direct impact on a large variety of application areas (e.g. search and rescue, intralogistic, assistive robotics).

The introspection impacts the most the following aspects of robotics system: safety, reliability and the maintenance costs.

Information on the internal state of the robot is crucial to make decisions if it is safe to execute the assigned mission considering not only the current state of the perceived environment, but also the internal state of the robot.

Continuous monitoring of the internal state of the robot and automatic assessment can be also used to enhance the maintenance process. Information about the internal state of the robot can be used to estimate the likelihood of potential failure and tailor the efforts to prevent it or to speed up the recovery or repair process by providing detailed information to a human operator or even enable self-repair.

Introspection takes active role in the process of preventing of malfunctions of the robotic system and help to speed the repair process up. These two features have direct impact on the running cost of a robotic system. Preventing unplanned interruptions in the robot operation and shortening the time of the planned interruptions has a direct impact on the cost of robot exploitation.

It is also important to remember that introspective information is a cornerstone of all methods aiming to robotics self-improvement. It provides information crucial in the learning and development process. In this context, it is possible to draw a parallel between human and robotic system. Assessment of the internal state is important input helping to anticipate if the planned action is feasible for the agent (either human or robot). For a complex system, it is difficult to perform such assessment relying only on predefined set of rules and conditions.

Therefore, it is necessary to use learning algorithms which will be able to connect the preexisting internal and external conditions with the outcome of a planned action. In such a configuration, a failure became a crucial element of a learning process of an autonomous system.

Finally, it is important to emphasize that introspection is a topic which spans across multiple fields. The introspection is originally a human ability. It is recent years when the idea of introspection is also becoming present in the field of robotics.

### GUEST EDITORS

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Therefore, to obtain a complete picture of the problem of introspection in autonomous systems it is important to have a closer look also at psychological aspect of introspection. Moreover, the impact of introspection in the context of the cognitive science cannot be overlooked.

The primary topic of this issue is to present work on:

*How to assess the quality of internal models, methods, sensory data and the hardware used by robots and how to alter their behavior using this information?*

The aim of this special issue is fourfold:

- Survey the state of the art in the field.
- Define open research questions in the field.
- Provide a venue to present the recent developments in the field of introspection.
- Present system papers showing how introspection is integrated and affects performance of a system.

### THEMES

This special issue is addressed to researchers interested in the development of introspective methods for robust autonomy across different research areas. We expect to receive submissions relevant for following research fields, but to name a few: Long term autonomy, safe operation of robots under uncertainty, performance awareness, reliable-aware operation, cooperative robotics, cognitive and learning robots, developmental robotics, Human-Robot Interaction. Introspection is broad term covering a set of topics. Topics relevant to this special issue include, but are not limited to:

- Internal assessment (Map quality assessment, Perception quality assessment, Classification quality assessment)
- Analysis (Failure analysis, Execution monitoring, Meta-reasoning)
- Introspection-related actions (Failure recovery, Reconfigurable robots, Planning with uncertainty)

### SUBMISSION

Manuscripts should be prepared according to the “Information for Authors” of the journal found at <http://goo.gl/0eMHUd> and submissions should be made through the IEEE TCDS Manuscript center at <https://mc.manuscriptcentral.com/tcds-ieee> selecting the category “SI: Introspective Methods for Reliable Autonomy”.

### IMPORTANT DATES

2018.01.31 - Deadline for manuscript submissions.

2018.05.15 - Notification of authors

2018.06.15 - Deadline for submission of revised manuscripts

2018.07.31 - Final decisions