RoSHA: A Multi-Robot Self-Healing Architecture*

Dominik Kirchner, Stefan Niemczyk, and Kurt Geihs

University Kassel, Distributed Systems Group,
Wilhelmshoeher Allee 73, 34121 Kassel, Germany
{kirchner,niemczyk,geihs}@vs.uni-kassel.de
http://www.vs.uni-kassel.de

Abstract. Reliability is one of the key challenges in multi-robot systems to increase practicable applicability and hence the commercial usage. This paper presents RoSHA, a self-healing architecture for multi-robot systems. RoSHA is based on the established robot middleware ROS and provides components for application independent analysis and repair. A plug-in architecture enables the developer to simply add new components for repair and analysis. Bayesian networks are used to diagnose failures and their root causes. ALICA, a domain specific language for multi-robot systems, is applied to coordinate recovery plans in multi-robot systems.

Keywords: self-healing, multi-robot system, system monitoring, failure diagnosis, system recovery

1 Introduction

Multi-robot systems become more and more important for many application domains, like search and rescue, warehouse management, or urban exploration. Often the complexity of tasks and domains demands autonomous operation in unknown and dynamic environments. These systems are confronted with complex tasks, like planning, localization, or coordination. The dynamic environment and the intricate interaction between these tasks result in a failure-prone setting [1, 2]. Accordingly, an architecture of multi-robot systems often consists of connected components. A failure in a single component can lead to a degeneration or even a crash of the total system. For example, in a single robot task, the localization of the robot relies on the fusion of multiple sensor information, like a direction, determined by a compass module and a distance scan, extracted from a camera image. If an error occurs in only one of the involved sensors, the robot could be delocalized. Due to the coordination and interactions of single robots in a multi-robot task, the resulting susceptibility to failures is expected to become even worse.

* The project IMPERA is funded by the German Space Agency (DLR, Grant number: 50RA1112) with federal funds of the Federal Ministry of Economics and Technology (BMWi) in accordance with the parliamentary resolution of the German Parliament.