High-Level Commands in Human-Robot Interaction for Search and Rescue

Alain Caltieri and Francesco Amigoni

Artificial Intelligence and Robotics Laboratory, Politecnico di Milano, Milano, Italy
alaincaltieri@gmail.com, francesco.amigoni@polimi.it

Abstract. Successful search and rescue operations require an appropriate interaction between human users and mobile robots operating on the field. In the literature, use of waypoints for driving the robots has been identified as the main approach to trade-off between fully autonomous robotic systems, which can exclude human users from the control cycle, and completely tele-operated robotic systems, which can excessively burden human users. In this paper, we propose an intermediate level between full autonomy and waypoint guidance. Specifically, human users can issue *high-level commands* to the robots, like "explore along a direction" and "explore in this area", which do not explicitly specify the target locations, but introduce a bias over the autonomous target selection performed by the robots. Experimental results show that high-level commands are effective, provided that notification messages coming from the robots are filtered.

Keywords: human-robot interaction, search and rescue, multirobot systems

1 Introduction

In many search and rescue settings, the interaction between human users and mobile robots operating in harsh environments is fundamental, given the time constraints and the importance of rescuing victims. Although some fully-autonomous multirobot systems for search and rescue have been developed in the last years, they are not expected to be widely employed in real scenarios, mainly because human users tend to be excluded from the control cycle [1, 2]. As a consequence, autonomy and human components should be balanced. In most of the current multirobot systems for search and rescue, this trade-off is obtained by allowing human users to directly issue waypoint commands (by which the user specifies a target location, often close to robot current position, and the robot autonomously plans a path to reach it) or lower-level tele-operation commands.

In this paper, we propose to introduce an intermediate level between full autonomy and waypoint guidance. Operating at this level, human users can issue *high-level commands* to the robots, like "explore along a direction" and "explore in this area", which do not explicitly specify the target locations, but introduce a bias over the autonomous target selection performed by the robots. High-level commands give the robots more autonomy than waypoint guidance and require an exploration technique that supports them. Experimental results show that using high-level commands increases both the area explored and the number of victims found, but increases also user's *workload*,