

Robot Intelligence for Tunneling and Confined Space Search and Rescue

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ABSTRACT

The horrific nature of structural collapse and natural disaster has unquestionably risen to the forefront of American perspective in the aftermath of recent terrorist attacks of 09/11/01. In responding to these events, heroic rescue personnel are routinely faced with a tremendously complex, hazardous, and often frustrating task environment that all too often leaves them without success in the presence of seemingly endless streams of carnage and body bags. The use of robots to assist in mitigating this challenge has been validated with a moderate degree of success by recent response efforts at the World Trade Center, but the tele-operated nature of the systems employed there did not fully exploit robot employment potential.

This paper presents the case for machine reasoning in the context of robot assisted search and rescue. A description of the USAR challenge is presented first in an effort to develop the reader's appreciation for complexities and challenges of the problem at hand. This is followed by a brief evolutionary review of mobile robot development and the motivation behind a shift toward portable platforms. A more detailed review of CRASAR's evolution and its pioneering actions in response to the World Trade Center attack is provided next with emphasis on platform shortcomings and the need for semi-autonomous control schemes. A concept for USAR (Urban Search and Rescue) oriented micro-tunneling is presented next as a new challenge in volumetric reasoning. The paper concludes with sequence of grand research challenges for roboticists interested in the USAR task domain.

Keywords: robot, robotics, confined space rescue, search and rescue, tunneling, micro-tunneling, artificial intelligence, intelligent systems