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INTELLIGENT ROBOTS FOR JOINT TRANSPORTATION TASKS: A DYNAMICAL SYSTEMS APPROACH

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ABSTRACT

The dream of an automated society, with autonomous machines capable of performing the work of humans came with us for several centuries. Humans have always try to compensate for their weaknesses with the construction of physical artifacts. Over time these devices have evolved and the humans were creating machines capable of performing the most arduous tasks. An example is the arduous task of transporting large objects, as illustrated in Figure 1.

Figure 1 - Illustration of a possible arduous task.

Currently, investigations in robotics and autonomous agents, general are rising, demonstrating the importance of these research areas. The rapid development of computers has increased significantly the concept of autonomous agents. The advantages of autonomous agents are numerous, but the main thing is the ability to adapt to the environment and to act without human intervention.

Tasks such as handling and/or transport objects in radioactive environments, in extra-planetary explorations, in environments polluted with harmful gases to human beings, are a great motivation for the use of autonomous mobile robots.

A fundamental problem in controlling teams of robots that jointly carry an object, move it to maintain a fixed geometric configuration, for transporting the object, what it makes the team have to move so needs, then the margin of error must be minimal (Lewis and Tan (1997), Kosuge et al. (2000), Pimentel et al. (2002) e Zaerpoor et al. (2003)).

It is noteworthy that the greater the number of robots that make up the team becomes more complicated the problem, since the movements have to be even more accurate. The problem becomes even more complex when the robots in addition to having to carry the object while avoiding collisions with obstacles.

The motivation for using nonlinear dynamical systems comes from recent work showing that the methods of the theory of nonlinear dynamical systems can be used as a language and conceptual tool to describe the dynamic coupling between a robot and the environment that surrounds including their partners (ex: Bicho and Schöner (1997), Bicho et al. (2000), Bicho et al. (2003), Bicho et al. (2004) e Soares et al. (2007)). The work aims at the implementation and validation of control strategies based on nonlinear dynamical systems, for a team of autonomous mobile robots that collectively carry an object from an initial position to a target position, and simultaneously avoid collisions with static and / or dynamic obstacles that they can find on their way. A team of autonomous mobile robots can be seen in Figure 2.

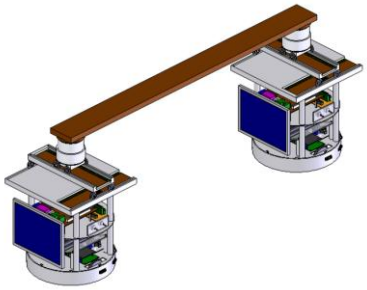

Figure 2 - Teams of two autonomous mobile robots.

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TONI MACHADO was born in Guimarães, Portugal and went to the University of Minho, Portugal, where he studied Industrial Electronics and Computer Engineering and obtained his degree in 2005, and he completes his master degree in 2008. Since 2004 he works in Autonomous Mobile Robots research area at University of Minho, Portugal, in the team led by Professor Estela Bicho. Since 2008 he started his PhD work in robotics, in University of Minho, Portugal. His e-mail address is: `tmachado@dei.uminho.pt`.

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