Dependability in Human-Centered Robotics

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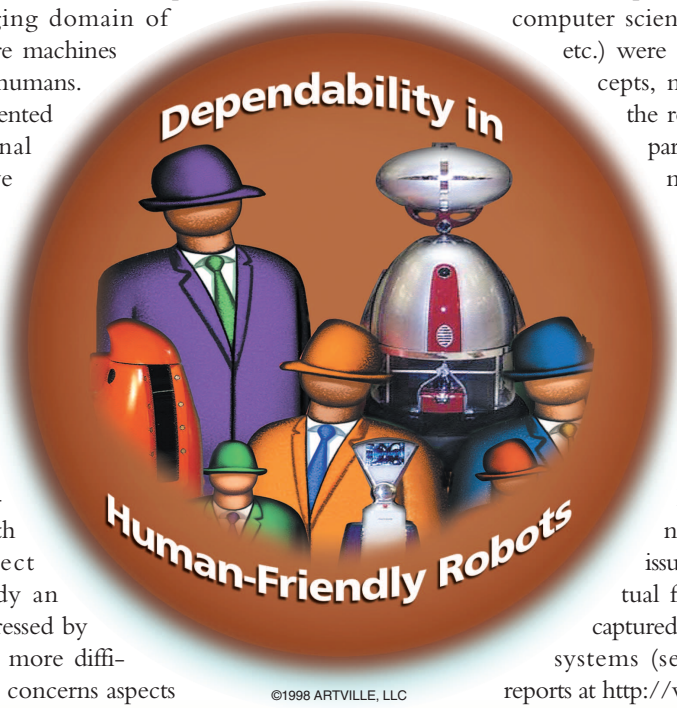
At the turn of the century, robotics opens a large perspective for seminal and technical achievements well articulated to a meaningful economic and societal broad host of novel applications. Central to those developments there is the highly challenging domain of human-centered robotics where machines have to closely interact with humans. Applications such as public-oriented service, assistive and personal robots, medical robots involve human-robot interactions where the person may be a nonprofessional user, a bystander, or both.



Unlike the industrial robotics domain where the workspace of machines and humans can be segmented, service and personal robots must, by definition, have physical contact and interaction with the user. The safety aspect entailed is, of course, already an important challenge to be addressed by robotics research. However, a more difficult and far-reaching challenge concerns aspects related to operating robustness when the system implies issues that are central to the very concept of an "intelligent" robot. Indeed machine intelligence is a necessity as soon as we consider applications not strictly related to a sole and very simple task. Task diversity in not completely engineered environments and in the presence of nonprofessional users implies necessarily significant levels of robot decisional autonomy, learning, and sophisticated, efficient, robust, friendly machine-intelligence based interfaces.

Such application cases and related technical issues raise critical questions of physical safety, reliability, and, more generally, communication and operating robustness. All these aspects can be captured by the concept of dependability.

Two IARP/IEEE-RAS Workshops (Seoul, Korea, May 2001; Toulouse, France, October 2002) on robot dependability in the human environment have been fully dedicated to assess the state of the art and to characterize the main research issues and directions. Inputs from system dependability in computer science and other domains (space, etc.) were considered to outline the concepts, methods, and tools that define the robot dependability field, with a particular emphasis on the above-mentioned aspects of safety, reliability, communication, and operating robustness.

One of the most salient aspects in considering dependability in relation to human-friendly robotics relates to the multifaced interactions between the human and the machine (dialog, contact, etc.). Here, we need to encompass very difficult issues, some of them key conceptual factors different from the ones captured by dependability in computing systems (see the workshop papers and reports at http://www.laas.fr/rdhe/).

Streaming from the two workshops, this special issue presents six articles covering a variety of problems that illustrate the paramount role of robot dependability in its different aspects.

The first two articles, from Stanford University and Pisa University, concern compliant and intrinsically safe robotic arms. The third article, from Toyota Technical Institute, deals with the safety problem in a car assembly line in particular cases where human operators physically interact with robot arms. The following article, from LIRMM, Montpellier, develops the design of safe actuated medical robots. The last two articles are related to mobile robots: one from CMU covers the issue of fault diagnosis and identification, while the second one, from IPA, Stuttgart, presents recent results obtained on extensive museum tour operations.