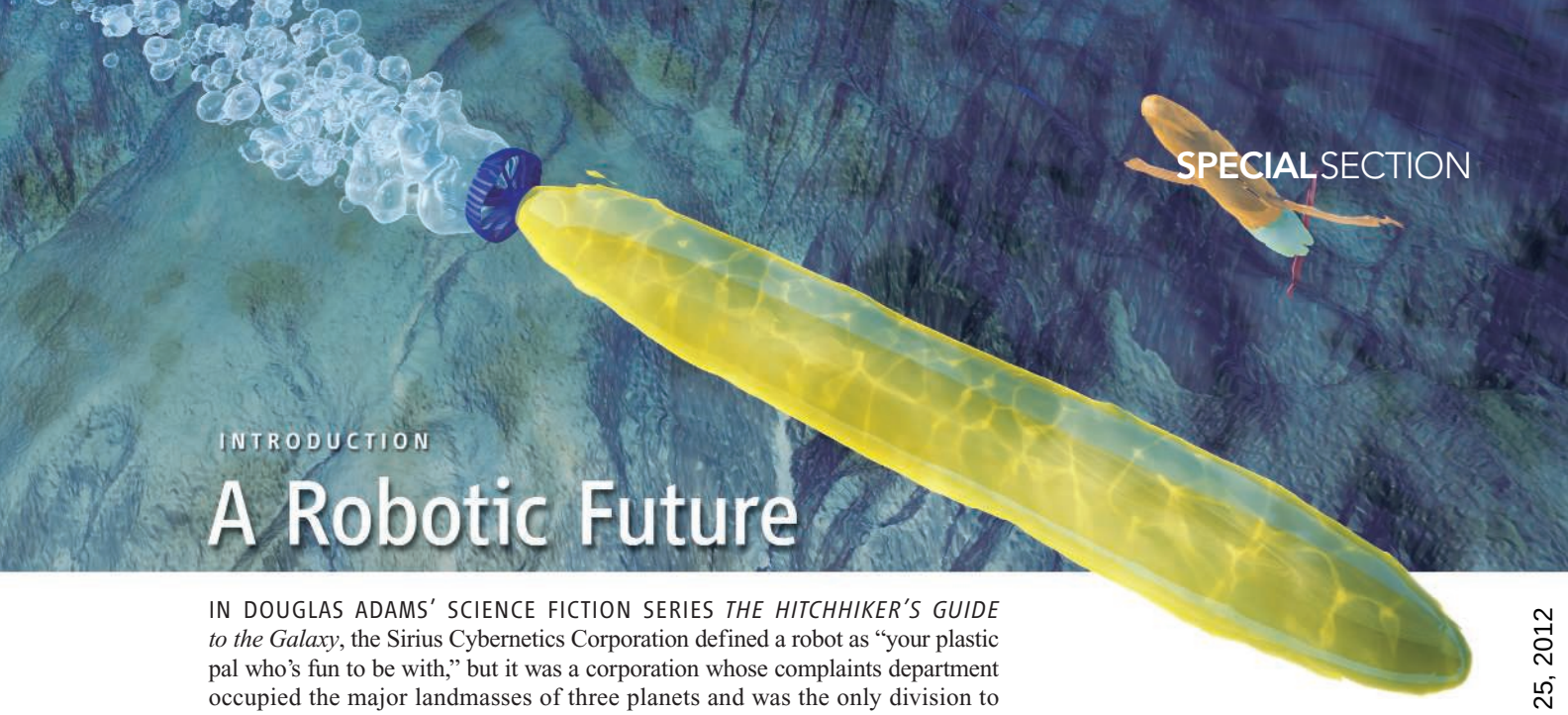



INTRODUCTION

# A Robotic Future

IN DOUGLAS ADAMS' SCIENCE FICTION SERIES *THE HITCHHIKER'S GUIDE to the Galaxy*, the Sirius Cybernetics Corporation defined a robot as "your plastic pal who's fun to be with," but it was a corporation whose complaints department occupied the major landmasses of three planets and was the only division to constantly show a profit.

Technology and automation have provided a huge number of labor-saving devices and have at times relieved humans from having to do monotonous and dangerous jobs such as painting sheet metal or cleaning oil pipelines. However, there are times when one really needs to interact with another human being, and at these times, the automated "customer service" or banking machine is a poor substitute for a human.

What differentiates robots from other pieces of technology is their ability to combine automation with action and at times a considerable amount of mobility. They are not only able to do static tasks such as dispense money or direct phone calls, but they can also lift, walk, weld, paint, vacuum, or explore. Unlike most devices that are designed to be used by a human operator, robots are increasingly being built to function within a human environment and are thus becoming more and more humanoid. Perhaps for this reason we view them in a different light than other technologies.

This special section looks at robots and robotics from a wide range of perspectives. Bellingham and Rajan (p. 1098) tell how robots with an increasing sense of autonomy are being used to explore the hostile environments under the oceans and in outer space. Pfeifer, Lungarella, and Iida (p. 1088) examine recent efforts to design robots based on lessons learned from biological organisms. They show that robots can improve their performance by borrowing living body plans and substructures. Madden (p. 1094) reviews the progress that has been made in developing artificial muscles that can compete with the properties of human muscle and may one day enable untethered robots to run, leap, jump, or climb. But even as robots become more lifelike, the biological function of self-replication still eludes them, as Cho (p. 1084) reports.

The last two pieces take us from body to brain. In a story by Lester (p. 1086), we find that robots are increasingly used in secondary schools and undergraduate programs as tools to interest students in engineering and computer science. From a different direction, a Perspective from Edelman (p. 1102) describes a research program in which robots equipped with brainlike devices learn to carry out tasks in the presence of visual cues and other sensory feedback. These "Darwin" bots may teach us something about our own ways of thinking and learning.

Outside the special section are two stories in News Focus. Service (p. 1056) looks at future exploration of the Northeast Pacific Ocean using partly robotic platforms, and Cho (p. 1060) covers the DARPA Urban Challenge, an international competition for self-navigating driverless cars held in California earlier this month. In looking to the future it is also prudent to look at the past. In an Editorial by Sawyer (p. 1037), we learn how the science fiction literature has long considered a robotic future and the many ethical questions this will raise.

They most certainly won't be all plastic, and they may not be our pals, but robots are going to play an increasing role in both scientific and everyday life. It will certainly be interesting to see where we take them and where they are able to take us.

**–MARC S. LAVINE, DAVID VOSS, ROBERT COONTZ**

CREDIT: DAVID FIERSTEIN

## Robotics

### CONTENTS



*See also related Editorial page 1037; News stories by Pennisi, Service, and Cho; Report page 1155; and online material page 1031 or at http://www.sciencemag.org/sciext/robotics*

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Published by AAAS