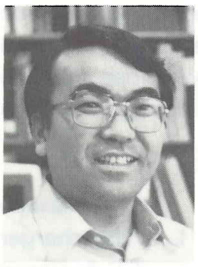
Robotics and Autonomous Systems 7 (1991) 83–84
North-Holland

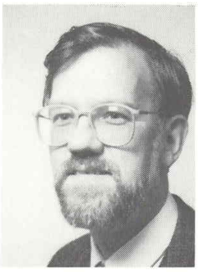
Guest editorial

Intelligent Autonomous Systems



T. Kanade

L.O. Hertzberger



F.C.A. Groen

An intelligent autonomous system must have a capable mechanism for mobility and manipulation, a sensing and perception system, and an intelligent decision-making capability, all integrated into a self-contained system. Such autonomous robots were mostly on the drawing board in late 1985, when we began to plan the First International Conference on Intelligent Autonomous Systems, which was later held in Amsterdam in December 1986. The United States had just launched DARPA's ambitious Autonomous Land Vehicle (ALV) Project for vision-guided on-road and off-road navigation. In Europe, the ESPRIT and later Eureka Information Technology programs investigated intelligent autonomous control and robotics for hostile and hazardous environments. In Japan, the Advanced Robot Technology Program, by then a year old, was aimed at building autonomous and tele-operated robots for nuclear power plants, subsea, and disaster intervention and fire fighting.

Since then we have observed great progress. In basic technologies, we see new mechanisms for fingers, hands and locomotion. We have new, faster, more precise sensors for shapes, force and other properties. Force control and multiple arm configurations are common. We employ unified architectures for integration. Not only have the above mentioned projects produced working demonstration systems, new applications have been emerging: on-orbit robots, planetary exploration rovers, and environmental restoration robots.

In December 1989 at the Second International Conference on Intelligent Autonomous Systems, again held in Amsterdam, it was exciting to witness these advances. This special issue is a collection of papers selected from those presented at the conference.

Visual navigation plays a major role in autonomous systems. Visual navigation for autonomous robots is discussed in 4 papers. Thorpe describes the outdoor visual navigation systems built for the CMU Navlab and AMBLER robots, illustrating the different task-specific models needed. Davis' paper provides an overview of the research performed in visual navigation during the past five years at the University of Maryland. A modular vision system is discussed by Dickmanns and Christians. It is used for the relative 3D state estimation of a road vehicle. Experimental results with VaMoRs, a 5-ton test vehicle, are given. Crowley et al. describe a real-time 3D vision system which uses stereo matching of vertical edge segments. The system is designed to permit a mobile robot to avoid obstacles and to position itself within an indoor environment.

Besides indoor and outdoor vehicles, a potential important application of autonomous systems can be found in undersea robotics, in agriculture, and in farming. The paper of Blidberg et al. reviews the current state of underwater robots and hihglights some research opportunities in this field. The paper of Negahdaripour et al. discusses passive optical sensing for short-range positioning in uncontrolled ocean environments. They show that optical sensing can overcome some of the shortcomings of existing tech-

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niques. Honderd et al. discuss the strategy and control of an autonomous cow-milking robot system as part of a large overall farm automation project.

Other major research topics in autonomous systems are path planning, exception handling and their required control architectures. Dorst et al. discuss the geometrical representation of path-planning. He uses the notions of the flow of vector fields and geodetics in metric spaces to formalize and unify path-planning problems. Meijer et al. describe exception handling for autonomous robot systems, based on a procedural expert system. Hörmann et al. present a control architecture for an advanced fault tolerant robot system. Their test environment is the autonomous, mobile, two-arm robot system KAMRO. The question of how to describe the mobile robot's sensor-based behaviour is posed by Suzuki et al. They introduce a new concept: Action Modes to take into account the robot dynamic property and the uncertainty of the environment.

In the last paper Fukuda et al. describe a new class of reconfigurable robotic systems: the Cell Structured Robotic System CEBOT.

All these papers illustrate that the field of autonomous systems is rapidly making progress. A conference such as this is impossible without the help of various people. We want to acknowledge the help of the local organizers of the 1989 IAS conference as well as the international program committee. We hope that the establishment of the International Society for Autonomous Systems, that will take place shortly, will be a guarantee for the continuation of IAS conferences in the future.

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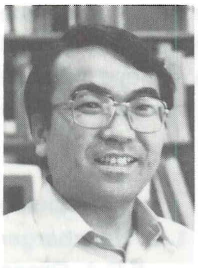

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