



PREFACE TO THE SPECIAL SECTION ON INTELLIGENT AUTONOMOUS VEHICLES

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Intelligent vehicles and mobile robots are part of the technology which brings us to the 21st century. They make our lives easier, help to take over many tasks which are monotonous, unhealthy or dangerous to man, or extend our operations to other worlds, like undersea or other planets. IFAC started to organise special conferences in this field in 1993, when the first Intelligent Autonomous Vehicles Workshop, IAV'93, was organised in Southampton. The IAV'95 Espoo Conference in June 1995 was the second in this series. This *CEP* Special Section illustrates the breadth and diversity of the field by publishing some of the representative papers from this conference.

The area of intelligent autonomous vehicles or robots has turned out to be both lively and extensive, in terms of challenging applications, as well as being a source of theoretical developments. At present, there are several streams in automation technology which are leading developments in the same direction. Many traditional working machines, that have long been used in construction, mining or agriculture, for example, are going through changes to become mechatronic, and consequently, in many cases, remotely operated or even autonomous. Technology has made this feasible, and the users of the machines want to improve efficiency by making use of advanced computer control systems at the work-sites.

In another traditional field, the automotive industry has put much effort into developing perception and control systems to make the modern car safer and easier to operate. Autonomous driving under certain conditions is a realistic target in the near future.

The strongest development in robotics is going on in

applications outside the traditional manufacturing industry. Service or maintenance operations in hostile environments, guarding, etc., are examples of areas where prototype robots have already been developed. Last but not least, space exploration should be mentioned. Future space programs, such as explorations of Mars or asteroids, will rely strongly on mobile robots instead of astronauts.

The conference gave expression to the latest results, in both generic methods and technologies, for all IAV subsystems, as well as a number of specific applications. Sessions were presented on vision- and non-vision-based perception, route and motion planning, motion control, localisation and navigation techniques, and man-machine interfaces. Several types of applications, from autonomous road vehicles to off-road working machines, were also reported. Developments in the mobility and locomotion of robots were considered, especially in the sessions on walking and climbing machines. The session on multi-robot systems provided an interesting new dimension to the development of IAV technology in the future. One of the special papers reviewed mobile robots for planetary exploration, and another the development of autonomous systems for unstructured environments. In connection with the conference, a competition for autonomous intelligent vehicles was organised for the first time in Europe (a video with an English commentary is available, on request, from this author).

The seven papers selected for publication here illustrate the content of the conference in a nutshell. Each of them also includes a practical application, and they provide good examples of the present state of IAV technology.

Vehicle detection and recognition in grayscale imagery, by N D Matthews, P E An, D Charnley, and C J Harris, deals with the perception of mobile targets, in this case cars, using vision. A novel two-stage algorithm has been developed for detecting and recognising other cars when the camera has been installed on a car travelling on a highway.

An all-terrain intelligent autonomous vehicle with sensor-fusion-based navigation, by R A Jarvis, gives an interesting summary of work done in the author's laboratory to build up and test six different wheeled, all-terrain, autonomous robotic vehicles, and their navigation and perception systems.

Implementing and testing a reasoning-based free gait algorithm in the six-legged walking machine "MECANT", by S Salmi and A Halme, presents new results in the gait control of legged machines. The free gait proposed by the authors provides many advantages in the motion control of those machines, over the traditionally used periodic gaits.

Robots for anti-personnel mine search, by J-D Nicoud and P Mächler, is a nice application of mobile robots in work that is really dangerous for

man. A very interesting point in the paper is the relatively simple structure of the robot which, however, is fully operational in the application in question.

Development of an autonomous navigation system for an outdoor vehicle, by K Rintanen, H Mäkelä, K Koskinen, J Puputti, M Sampo and M Ojala, is a well-written paper on the practical application of an important navigation technique, where GPS is fused with inertial navigation to realise an accurate navigation system for an autonomous off-road vehicle.

Neural speed control for autonomous road vehicles, by H Fritz, is a good example of new developments in automotive control systems. It reports experience on a Daimler-Benz test project, where a neural speed controller has been developed and tested for the car's cruise control.

Mobile robots for planetary exploration, by K Schilling and C Jungius, provides an excellent and professional overview of the current development of mobile robotics for on-going space programs, especially in the Mars projects.