AUTOMATION AND ROBOTICS RESEARCH
THE FEDERAL HIGHWAY ADMINISTRATION

DAH-CHENG WOO

In April 1992 the Federal Highway Administration formally established the Office of Advanced Research for the application of the latest technical advances to highway transportation. One of the six major areas of research is named robots/-automation/man-machines. Research on remote controlled equipment began with the Strategic Highway Research Program in the form of a pothole repairing machine and an automatic pavement crack sealing machine. The establishment of the Office of Advanced Research acknowledges the potential impact of this area of research on the highway industry.

Program

The current program, which deals with construction, maintenance, and operation, has three major goals: to enhance safety, improve quality, and increase the productivity of highway transportation. FHWA's special projects on intelligent transportation systems are not included.

The program consists of research for innovative ideas, feasibility studies, and the development of final practical products for use by highway practitioners. To take advantage of as many resources as possible, FHWA not only sponsors robotics research studies, but also encourages state participation through the State Planning and Research (SP&R) program and other joint application studies.

Accomplishments

Through an interagency agreement, the National Institute of Standards and Technology conducted an in-depth study of the application of robotics to highway transportation. A panel of robotics experts of many disciplines was assembled for the study, which included workshops, site visits to highway construction projects, and numerous discussions with state highway personnel, contractors, and equipment manufacturers. After the final analysis of cost-benefits, four areas of research with significant potential value to the highway industry were identified: site integration, automated pavement inspection and crack sealing, automated bridge inspection and maintenance, and automated bridge deck construction. The study set the tone for FHWA's robots/automation/man-machine research for the next five years.

To stimulate innovative ideas, FHWA awarded two research grants in this area in 1993. After a year of intensive work and the support of the North Carolina Department of Transportation, North Carolina State University, under the leadership of Leonhard E. Bernold, produced and field tested an initial prototype of robotic bridge paint removal equipment (see the article by Luces et al. elsewhere in this issue). This prototype shows great potential for the development of equipment for safe and accurate bridge paint removal. It can also be modified for bridge inspection and painting. The University of Arkansas at Little Rock, under the guidance of J. Douglas Wilson, successfully researched and constructed a second-generation imager, optimized for aggregate analysis. This equipment has been tested with known samples.

Current Research

Ongoing research includes a study at the University of Texas at Austin, jointly sponsored by FHWA and the National Science Foundation, on a large manipulator for use by the highway industry. Another pooled-fund study conducted by the California Department of Transportation involves the development of an aerial bridge inspection device for safe initial bridge inspection (see article by West et al. in this issue).

FHWA has initiated a long-range new research project on site integration. It is believed that by integrating design, planning, scheduling, and real-time control of operations, computer technology can be used to assist human operators and supervisors at all levels to apply their knowledge and skills in more efficient ways. Computer use can help a project proceed smoothly with minimum interruption and delay and can greatly increase the safety of workers, quality of work, and project productivity. Thus the time needed to complete a construction project can be shortened and the total cost considerably reduced.

In 1994 North Carolina State University was awarded a grant to conduct a study on trench excavation and pipe-laying. Researchers will investigate the technical feasibility and effectiveness of a laser-based spatial position control under real field conditions and innovative technology for the detection of buried metal obstacles.

A minor development study of a semi-automatic pavement crack sealing machine is being sponsored jointly by the FHWA's Office of Technology Application, the Texas Department of Transportation, and an equipment manufacturer. This research will advance technology initiated in a SHRP study (see article by Haas and Dailey in this issue).

Future Plans

Future research will focus on increasing the safety of highway workers and users and providing better quality highways. It will cover more innovative ways of continuously monitoring highway pavement performance and earlier stress detection; improved methods for safety zone traffic control; and sound, continuous bridge inspection, which includes the underwater inspection of abutment and pier scour. Research will be continued on the development of environmentally sound and continuous operation for bridge painting and bridge paint removal. These studies are part of FHWA's continuing program to seek innovative ideas for improving highway transportation.

For additional information on FHWA's automation and robotics program contact Dr. Dah-Cheng Woo, Hydraulic Research Engineer, Office of Advanced Research, Turner-Fairbank Highway Research Center, Federal Highway Administration, 6300 Georgetown Pike, McLean, Virginia 22101-2296.