Pursuing a flexible path toward the factory of the future

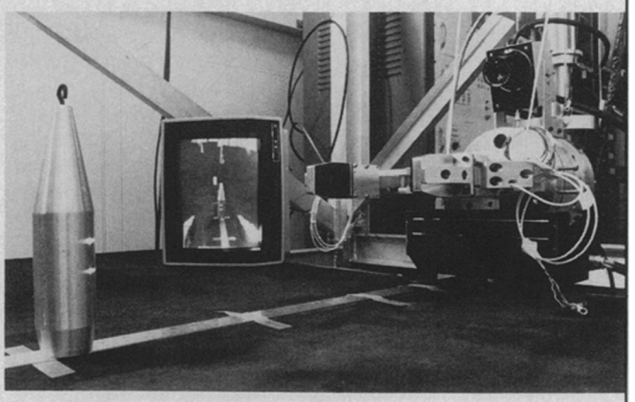
A novel combination of robots, computers and machine tools may soon duplicate a skilled machinist's ability to fashion a wide variety of intricate parts from chunks of metal. Using off-the-shelf machinery and thousands of lines of innovative computer programming, researchers at the National Bureau of Standards (NBS) have performed a computer engineering feat comparable with getting, say, a dozen chefs — all with widely varying abilities, individual specialties and different native languages — to work together to prepare a sumptuous gourmet feast. The NBS scheme promises to make computer-aided, flexible manufacturing accessible even to machine shops that produce only small numbers of a mixture of metal parts.

The NBS vision of a future automated factory resembles a computer installation of today, except that devices such as printers and terminals are replaced by robot arms and machine tools such as lathes. "In other words, the 'peripherals' for the first time will have muscles," says John A. Simpson, director of the Center for Manufacturing Engineering at NBS. "Such systems will, in the future, manipulate materials much as computer installations of today manipulate information," he adds.

Last week at the $5 million, experimental Automated Manufacturing Research Facility in Gaithersburg, Md., NBS officials publicly displayed their first steps in linking computer-controlled robots and tools, no two of which came from the same maker, into a working system. This initial demonstration showed that computer software could be devised to allow different equipment from a variety of manufacturers to "talk" with and control one another, without, for example, requiring a common programming language or revealing trade secrets about how a particular machine works.

The computer software developed at NBS operates like a manager, sending appropriate commands while continuously collecting data from an elaborate system of sensors that includes a sophisticated vision capability. The control system allows the user to change the part being manufactured simply by changing the description of the part in the data base. The system, which incorporates artificial intelligence ideas, can even learn from experience. Because the software is modular, a manufacturer can adopt as little or as much of the system as a particular task requires. Simpson contends, "It is uniquely simple to understand, maintain or modify."

NBS



Robot vision systems increase machine shop flexibility.

At the official unveiling, Secretary of Commerce Malcolm Baldrige noted that this approach will allow a company that manufactures small batches of parts to buy new and improved machinery one piece at a time without having to worry about how to plug them all together into a functioning system. Currently, only the largest mass producers can afford flexible manufacturing systems.

Although some of the concepts being tested at the NBS facility are already available for practical use, particularly in the form of standards for linking different machines, Simpson says it will be at least a decade before this type of flexible manufacturing becomes common practice. The next research steps involve adding more tools, robots, sensors and control systems and introducing quality control — a kind of self-diagnosis for machines that would let them detect changes from the norm and correct problems that otherwise could lead to defective parts.

In contrast to the use of special-purpose robots for mass production in countries such as Japan, Simpson says, "we believe that the use of software and computer technology can take us much further into the next generation of manufacturing technology. In that field, we know of no work anywhere in the world that is ahead of us." — *I. Peterson*

American Heart Association annual meeting

Genetic link found in artery disease

A genetic defect in two cases of premature atherosclerosis — hardening of the arteries — has been found by researchers at Harvard Medical School and Children's Hospital Medical Center in Boston. The problem gene is the one that directs the production of apolipoprotein A-I (apo A-I), the major protein component of high density lipoprotein (HDL), one of the compounds that carries cholesterol through the blood. HDL is the "good" lipoprotein — it has been linked with increased longevity and a decreased incidence of heart disease (SN: 4/22/78, p. 244).

Sotirios K. Karathanasis and co-workers found an extra piece of DNA in the apo A-1 gene in two sisters, aged 29 and 31, with premature atherosclerosis. They each had two defective genes, while unaffected members of their family had none or one defective gene and one normal gene. In addition to the apo A-1 gene defect, Karathanasis showed that the defective gene prevented the activity of a nearby normal gene for another lipoprotein.

"We're trying to see how the insertion relates to the inactivation of the two genes and if this inactivation is responsible for premature atherosclerosis," Karathanasis says.

Karathanasis, who won the Irvine H. Page Young Investigator Award of the American Heart Association for his work on the gene, says he is not certain how the apo A-I gene got the extra piece of DNA. It could have been via a transposable element, the "jumping gene" discovery for which Barbara McClintock won a Nobel prize (SN: 10/15/83, p. 244). Or, he says, it could have been introduced by a virus, or a breakage and reconnection of the chromosome.

— *J. Silberner*

Anti-cholesterol success

A 10-year study of over 100 men and women has shown that a new drug, cholestyramine, can halt the progression of atherosclerosis, hardening of the arteries linked to high cholesterol levels.

The drug has to be taken two to four times a day, and its powdery texture is difficult to disguise. "I think it will be less of a trial now that we know it makes a difference," study director Robert Levy of Columbia University in New York says.

The drug binds bile acids in the gastrointestinal tract, decreasing cholesterol absorption and causing cells to break down cholesterol to replace the lost bile acid, Levy says. Five percent of the adult population have high cholesterol levels that could be lowered by this drug, Levy says. The results from the second phase of the study — cholestyramine's ability to prevent hardening of the arteries in *healthy* people — will be announced in January. □