News Briefs and Reports

New Technical Developments

PERFORMANCE MEASUREMENT OF MULTIPROCESSOR COMPUTERS: INITIAL PROGRESS

NBS has undertaken a project to improve the quantification of the performance of multiprocessor computers. Much of this work will apply to conventional computers as well. Computer performance measurement is seen as involving (1) an understood stimulus, the test (benchmark) programs run to test the computer; (2) techniques for attaching to the multiprocessor computer to capture its response; and (3) techniques for analyzing the response for the aid of designers and users.

The provision of test programs has taken two paths: the identification and collection of existing benchmark programs, and the creation of small test routines designed to elucidate specific aspects of performance. This growing collection of benchmark programs is now available on-line through the DARPA internet by sending mail to <nbslib@icstcmr.arpa>. If sent the message "send index," the automated mail system will return additional instructions on how to get the desired programs. The mail system was kindly supplied by Dr. J. Dongarra of the Argonne National Laboratory.

A review of techniques for capturing the response of the system under test has been reported in an NBS Interagency Report [1]. The discussion of the various parameters that could be measured estimates both their usefulness and the difficulty of measuring them. A very simple Interim Measurement System has been applied to a testbed shared-memory multiprocessor to capture detailed execution-duration measurement of short sequences of instructions with insignificant perturbation of the execution. A much more complete set of measurement hardware is under construction.

The analysis and presentation of the results of measurement are critical to its utility. The results from test programs which were run must be weighted to predict performance of the machine (architecture) under test on the algorithm (application) proposed. The designer who will improve computer hardware or system software needs information presented differently from that required by the programmer trying to improve the performance of a specific application.

For further information contact Robert J. Carpenter, National Bureau of Standards, Gaithersburg, MD 20899.

Reference

[1] Roberts, J.W., Performance Measurement Techniques for Multiprocessor Computers, NBSIR 85-3296 (1985).

GRAPHICS STANDARD APPROVED

The Secretary of Commerce has approved a standard [1] for the Federal government which specifies a library (or toolbox package) of subroutines for producing and manipulating two-dimensional pictures. The standard will make it easier to transfer graphics application programs among different computers and graphics devices. It adopts a voluntary industry standard (ANSI X3.124.1985) which NBS helped develop.

Reference

[1] Federal Information Processing Standard (FIPS) 120, Graphical Kernel System, National Technical Information Service, Springfield, VA 22161 ($35.50 prepaid).

NONDESTRUCTIVE ULTRASONIC METHOD DETECTS FLAWS IN CERAMIC POWDERS

A new ultrasonic method for detecting flaws in compacted ceramic powders has been developed at

NBS. It is the first nondestructive evaluation technique to permit ceramic producers to fully automate the inspection of compacted powders while the material is in the mold.

The NBS system provides producers with information on the uniformity and density of materials at almost any stage of compaction. It will help manufacturers screen out defective parts before costly processing takes place.

The ultrasonic sensor method, which provides a way to "dry" couple a transducer to a green-state (unfired) ceramic without contaminating the material, was developed at the Bureau by a Johns Hopkins University materials science graduate student and an NBS physicist. They modified a commercial steel mold by placing a piezoelectric transducer on the compaction shaft. The transducer generates an ultrasonic wave down into the mold where some of it is transmitted into the ceramic powder and some is reflected back towards the transducer. The ultrasonic echoes are recorded as they reflect up and down through the sample until the pulse dies out.

Measurement of the time between pulses at the top and bottom of the mold permits calculation of the velocity of sound in the ceramic powder. Since the velocity depends on the consistency of the unfired material, this information can be used by producers to improve the compaction process.

The technique can be a complementary and effective quality control tool when it is combined in a feedback loop with other in-line sensors such as those used to measure temperature, pressure, and humidity, according to the scientists.

The system can perform both compressional and shear wave measurements in ceramic powders. The resulting data can provide information on the porosity of the material and permit producers to measure how well organic binders are working. Binders are typically used to coat and lubricate ceramic particles so that they more readily slide by each other during compaction in order to form a high density compact.

The new ultrasonic sensor method has been developed as a part of the NBS effort to apply nondestructive evaluation techniques to measure the properties and characteristics of materials for in-line monitoring and process control during manufacturing.

For further information, contact Gerald V. Blessing, National Bureau of Standards, Gaithersburg, MD 20899.

SYNCHROTRON RADIATION OFFERS RESEARCHERS NEW TOOL

NBS has completed the first year of experimental operations and instrument evaluations on the materials science x-ray beamline at the National Synchrotron Light Source in Brookhaven, NY. The beamline offers materials scientists from government, industry, and universities a research tool combining the highest brightness, lowest emittance source for x rays in the world with high-resolution x-ray optics for use in characterizing the microstructures of materials. It enables researchers to conduct real-time, in-situ measurements on a micron scale. With remote control instruments, scientists can observe and record microstructural changes in metal, ceramic, and polymer materials as they are exposed to different thermal, electromagnetic, or mechanical environments.

For information on using the materials science part of the NBS x-ray beamline facility, a joint effort between the Bureau and the Naval Research Laboratory, contact Dr. Gabrielle G. Long, National Bureau of Standards, Gaithersburg, MD 20899.

SILICON DIOXIDE STUDY AIMED AT ELECTRONICS, FIBER INDUSTRIES

NBS researchers, in collaboration with Professor Joseph Katz of Johns Hopkins University, are using a diffusion flame and laser diagnostic methods to examine the formation and growth of silicon dioxide particles. How those particles form is important, for example, to the optical fiber industry. There, control of the particle formation process and deposition of a uniform layer is critical in the production of high-quality optical fibers. Katz has designed and constructed a counter-flow diffusion flame burner that simulates industrial processes by forming silicon dioxide particles in a flat, highly uniform flame well suited for optical probing. Laser scattering techniques are used to determine concentration of intermediate compounds such as SiO and OH. Electron microscopy also is being used to examine particles in samples withdrawn from the flame.

For further information contact Hratch Semerjian, National Bureau of Standards, Gaithersburg, MD 20899.

New Standard Reference Data

MATERIALS AIMED AT MORE ACCURATE ALCOHOL/GASOLINE BLENDS

Four standard reference materials now available from NBS will help laboratories maintain measurement accuracy when blending various alcohols—methanol, ethanol, and t-butanol—with automotive fuels. Blending is on the upswing because of regulatory decreases in amounts of lead allowed per fuel gallon. Alcohol, like lead, can be used to boost gasoline octane. The new SRMs provide reference standards for checking the accuracy of laboratory instruments and evaluating analytical methods.

The reference materials, which are certified accurate in their alcohol content, are as follows: SRM 1837—Methanol (9 percent by volume) and t-Butanol (6 percent) in Reference Fuel; SRM 1838—Ethanol (10 percent) in Reference Fuel; SRM 1839—Methanol (0.3 percent) in Reference Fuel; and SRM 1829—Alcohols in Reference Fuel, which consists of all three alcohols. The reference fuel is 90-octane gasoline. SRMs 1837, 1838, and 1839 each have five sealed glass vials of material, while SRM 1829 consists of two vials of each of the three alcohols. These SRMs cost $92 apiece.

New Services From NBS

NEW NBS FACILITY EYED AS IMPROVEMENT TO FLOW CALIBRATIONS

Flow Technology, Inc., a flow measurement instrument manufacturer, has donated a fluid meter calibration facility to NBS which officials anticipate will significantly expand the Bureau's flow rate calibration capabilities. The facility is valuable for checking, for instance, the operation of turbine meters the aircraft industry uses to determine engine performance. The new capability will supplement an existing facility donated to NBS by the Navy Department 30 years ago and used since to perform flow meter calibrations. NBS researchers say the new device has improved features such as high-speed data processing, efficient change of fluids, and more rapid overall performance. It also allows expansion into calibration ranges previously not covered. Because the device is more efficient than its predecessor, in-house savings will be passed on to calibration customers.

For further information, contact George Mattingly, National Bureau of Standards, Gaithersburg, MD 20899.

NBS AND HEALTH PHYSICS SOCIETY LAUNCH NEW PROGRAM FOR RADIATION INSTRUMENT CALIBRATION

NBS and the Health Physics Society have begun a new national program to accredit laboratories that calibrate instruments used to measure ionizing radiation.

NBS will continue to be the primary standards lab for these instruments, such as Geiger counters, which are regularly used in industry to protect radiation workers by making on-the-spot measurements of radiation levels. The Society will provide a new service to accredit secondary- and tertiary-level calibration laboratories using procedures and technical criteria developed by the Society in cooperation with the NBS Office of Radiation Measurements.

The Health Physics Society is a national organization of professionals in occupational radiation protection dedicated to improving the standards and performance of their profession.

The new program, according to the HPS, will provide radiation protection professionals greatly expanded access, directly and indirectly, to the national standards maintained by NBS. This, says the Society, will result in improved uniformity, accuracy, and traceability of ionizing radiation measurements. There are more than 1.3 million industrial radiation workers in the United States who could be affected by the new program.

Initially, laboratories will be accredited for the calibration of x-ray and gamma-ray instruments. The program will later be extended to include beta and neutron radiation. Fees, scaled to cover the costs of the program, are expected to range between $5,000 and $8,000 for a 3-year secondary-level accreditation, and between $3,000 and $4,000 for tertiary-level accreditation.

HPS plans to accredit as many as 12 secondary laboratories, which will have their standards calibrated and performance tested by NBS, and up to 40 tertiary labs, with standards calibrated and performance tested by the secondary labs. Applications for accreditation will be accepted by HPS after January 1, 1987.

NBS has actively pursued this system of secondary calibration laboratories for radiation mea-

surements for several years to satisfy rapidly increasing demands for calibrations.

NBS currently has similar programs with the Conference of Radiation Control Program Directors, which accredits secondary-level calibration labs to serve state radiation control officers; and with the American Association of Physicists in Medicine, which accredits laboratories that calibrate instruments which in turn are used to calibrate radiation equipment in hospitals and clinics.

NBS also has set up a procedure, under its National Voluntary Laboratory Accreditation Program (NVLAP), to accredit laboratories that process the personnel dosimeters worn by radiation workers.

New Standard Reference Materials*

NBS DEMONSTRATES ADVANCES IN COMPUTERIZED DATABASES

Several new prototype databases for use with personal computers were demonstrated by NBS scientists to more than 300 data experts from the world's leading industrial nations at the 10th International CODATA (Committee on Data for Science and Technology) Conference held in Ottawa, Canada, July 1986. The demonstrations included databases on the thermophysical properties of water (steam) and of 12 different fluids. Special graphics software programs also were displayed for phase diagrams of ceramics and for diagrams on corrosion in materials.

Dr. David R. Lide, Jr., director of the NBS Office of Standard Reference Data and newly elected president of CODATA, says the international group is working to establish agreements on the format of computerized databases, including those designed for personal computers. Lide says, "Many organizations are exploring the use of magnetic and optical discs which will provide users in physics, chemistry, and other fields with an easy, portable way to access databases only available in printed form or through on-line networks."

For information on CODATA or the NBS standard reference data program, contact the Office of Standard Reference Data, National Bureau of Standards, Gaithersburg, MD 20899.

* SRMs can be ordered from the Office of Standard Reference Material, NBS, Gaithersburg, MD 20899, Telephone 301-921-2045.

Report: I-R 100 Winners

SIX NBS PROJECTS WIN 1986 I-R 100 AWARDS

Six projects in innovative instrumentation and measurement technology from NBS have been cited in the annual I-R 100 competition sponsored by *Research & Development* magazine.

I-R 100 awards are given by the magazine to honor the "100 most significant" new technical products of the preceding year. NBS has received 51 I-R 100 awards since first entering the competition in 1973.

This year, NBS research teams were cited for work on an extremely efficient spectrometer for measurements in the "soft x-ray" portion of the spectrum; for the development of a new reference standard for the U.S. volt; for the development of a new calibration tool for electrical waveform recorders; for the development of a novel reference electrode suitable for use in nonaqueous media; for the invention of an innovative new "computing engine" to process images for machine vision systems; and for the development of a new reference material for microscopic measurements, which is also the first commercial product to be made in space.

Soft X-Ray Spectrometer

A team from Oak Ridge National Laboratory, NBS, and the University of Tennessee at Knoxville won an I-R 100 award for the development of a new, extremely sensitive spectrometer for use with synchrotron radiation sources in the soft x-ray region of the spectrum.

The instrument was specially designed to measure very-low-intensity radiation with efficiencies 1,000 to 10,000 times higher than conventional spectrometers. This means that measurements can be made either with weaker sources, at much higher resolutions, or in much less time (e.g. minutes instead of days). The new spectrometer detects radiation in the range from 50 nanometers to 1.2 nm (20 eV to 1 KeV).

It is particularly well suited to studying the spectra of light elements, particularly in fragile materials such as surface layers, organic materials, and light alloys. The spectrometer is presently being used in experiments at the NBS Synchrotron Ultraviolet Radiation Facility (SURF-II) and the Brookhaven National Synchrotron Light Source (NSLS) facility.

The high-efficiency, soft x-ray spectrometer was developed by Thomas A. Callcott and King L. Tsang of the University of Tennessee at Knoxville, Edward T. Arakawa of Oak Ridge National Laboratory (Martin Marietta Energy Systems, Inc.), and David L. Ederer of NBS.

New Voltage Standard

Three NBS researchers shared an I-R 100 award for the development of a voltage reference system that gives any laboratory access to a useful voltage standard comparable in accuracy to the U.S. national standard maintained by NBS.

The U.S. standard volt is defined in terms of quantized voltages produced by a superconducting device known as a "Josephson junction." The voltage produced by a Josephson junction depends only on a fundamental constant and the frequencyof a microwave field applied to the junction, thus any laboratory can produce standard voltages limited in accuracy only by the accuracy of the frequency generator, which can be quite high.

The problem has been that a single junction produces only very low levels of voltage—about five thousandths of a volt at best—which limits its usefulness to a handful of national standards laboratories. Previous attempts have been made to link several junctions together in series to produce more reasonable voltages, but technical difficulties limited these to arrays of 20 junctions or fewer.

After 10 years of effort, NBS researchers succeeded in developing an integrated circuit chip that incorporates 2,076 Josephson junctions, and that can produce any voltage between 0.1 and 1.3 volts at accuracies 10 to 100 times better than any system previously available, even at NBS.

Because the Josephson array is a direct implementation of the U.S. legal volt, it needs no calibration. The device has the potential to completely revolutionize the national system for voltage measurements.

Clark A. Hamilton, Richard L. Kautz and Frances L. Lloyd of NBS developed the Josephson series array voltage standard.

Precision Step Generator

Three NBS researchers have introduced a calibration standard for transient waveform recorders that is an improvement over existing commercial instruments in either accuracy or variability of voltage levels.

Transient waveform recorders are used to measure rapid voltage pulses in applications such as research into automotive engine performance or the testing of electric power equipment for its vulnerability to lightning. These instruments also play key roles in nuclear fusion research and weapons testing.

The NBS device generates precise, fully programmable voltage steps which exhibit fast transitions and exceptionally smooth settling to the final voltage value. Two ranges, ± 5 V and ± 1 V, are available for insertion into high impedances and 50-ohm inputs, respectively. The transition duration of the step is about 6 nanoseconds and it settles exponentially to 0.02 percent of the final value in less than 25 ns.

The NBS step generator was developed by Howard Schoenwetter, Donald Flach, and T. Michael Souders.

Nonaqueous Reference Electrode

An NBS/University of Texas team won an I-R 100 award for developing a new kind of reference electrode for measuring voltages in nonaqueous electrochemical systems. These measurements are important to industries such as battery manufacturers who use electrochemical techniques to research new materials for their products. Nonaqueous electrochemistry also is being used increasingly in the production of industrial chemicals, an example of where the new electrode's reproducible measurements can be an important factor in improving chemical process control and efficiency.

Previously, in the absence of a nonaqueous reference electrode, many industries have resorted to adapting electrodes intended for aqueous systems. Results often have been unsatisfactory.

There have been other industrial attempts to perfect a nonaqueous electrode, but limitations such as difficulty of use and lack of stability have hampered development. The NBS/Texas team, however, has overcome these hurdles and now offers a design that can be readily adapted for industrial use or for commercial production.

The electrode consists of a thin polymer film of polyvinylferrocene that has been electro-deposited on a platinum disk. The film is then treated with a crosslinking agent which, when thermally activated, stabilizes the film for use.

The device was developed by Rosanne Kannuck, Elmo Blubaugh, and Richard Durst of NBS, and Allen Bard and Pamela Peerce-Landers of the University of Texas.

Image Processing Engine

Ernest W. Kent, formerly of NBS, and James M. Herriman, Randall L. Luck, and Gerald S. Henrici of Digital/Analog Design Associates, Inc., won an I-R 100 award for the invention and development of an advanced parallel-architecture computer designed specifically for the high-speed processing of video images in "real time."

The Pipelined Image Processing Engine, modeled after processes in the human visual cortex, is expected to have application in a wide variety of advanced image-sensing equipment where continuous, real-time, processing is necessary, such as in machine vision systems for robots and robotic vehicles.

The computer handles the complex preprocessing of images from a digital video camera, performing hundreds of millions of calculations every second to manipulate raw visual images and generate all the information necessary for a vision system computer to recognize specific features such as texture, shade, the presence or absence of an edge, or motion at every point in a 256 by 256 "frame."

Its advanced features include a "multiple instruction-stream, multiple data-stream" capability that allows it to perform different operations on different regions of the same frame, depending on the nature of information at each point, and the ability to do a wide variety of motion-analysis and stereo operations. Other features include a sophisticated, graphics-oriented programming capability and a high-speed interface system that organizes the results of its analyses in a convenient form for the memory of another computer.

A commercial version of the device is being offered by Digital/Analog Design Associates, Inc., of New York. Kent now works for North American Philips Corporation at Philips Laboratories in Briarcliff Manor, NY.

Microscopic Reference Material

Standard Reference Materials are carefully prepared samples of materials of industrial or medical interest for which NBS certifies the values of certain physical or chemical properties. They are commonly used in labs throughout the world to assure the quality of measurements and scientific instrument performance.

NBS has received an I-R 100 award for the development of SRM 1960, 10-Micrometer Polystyrene Spheres, the first space-made product to be sold. The spheres are a nearly ideal microlength standard to improve microscopic measurements in electronics, medicine, and in the manufacture of finely ground products such as flour, cosmetics, paint pigments, and chemicals. The billions of tiny spheres, each of which measures about 1/2500th of an inch in diameter, were produced by Lehigh University and the National Aeronautics and Space Administration (NASA) aboard the space shuttle Challenger in April 1983 using a specially developed chemical process.

They were manufactured in space because earthbound processes have not produced sufficiently uniform materials in usable quantities. When produced in a low-gravity environment, however, the polystyrene spheres grow uniformly in size and shape.

The new measurement standard was certified by NBS physicists Thomas R. Lettieri, Arie W. Hartman, and Gary G. Hembree, and coordinated by project manager Lee J. Kieffer (deceased) and Stanley D. Rasberry, chief of the NBS Office of Standard Reference Materials. Russell C. Obbink, NBS Research Associate from the American Society for Testing and Materials (ASTM), worked in the NBS laboratories and coordinated industry participation in the certification program.

John W. Vanderhoff, Fortunato J. Micale, and Mohamed S. El-Aasser of Lehigh's Emulsion Polymers Institute (Bethlehem, PA) and Dale M. Kornfield of NASA's Marshall Space Flight Center (Huntsville, AL) were in charge of producing the spheres used to make SRM 1960.

*U.S. GOVERNMENT PRINTING OFFICE: 1986-181-096:40012.