OVERVIEW

This fourth **MiCon** (microstructural control) symposium describes advances in video technology and their application to image collection, enhancement, measurement and storage - irrespective of the means for producing the image or its scale, i.e., macroscopic or microscopic, or the material being studied. Indeed, as illustrated by several of the papers, these images need not be produced by microscopes nor by the familiar light or electron sources; images from acoustic or ultrasonic devices or from x-ray radiographs are fair game as well.

This technology has grown at a terrific pace, driven partly by the phenomenal developments in personal computers and PC software during the past decade. In the materials field, except for more convenient group viewing (compared to ground-glass projection screens), video technology has only been utilized for image analysis. Today's image analyzers are vastly more sophisticated than the original Quantimet A introduced in 1963. ASTM Committee E-4 has been involved in the application of this technology and the development of standards through its subcommittee on quantitative metallography, founded in 1960. We are now observing video applications in materials science beyond group viewing and image analysis, although substantial use of this technology has already been achieved in the medical and biological fields. Metallographers are just beginning to electronically enhance images and to create electronic image databases. Within the next ten years, storage and printing of digitized images is expected to become the dominant method for photomicroscopy.

As a result of these trends and developments, and due to E-4's long interest in this field, the fourth **MiCon** symposium was devoted to advances in video technology, particularly as related to equipment or methods that could be used to control microstructural characteristics and thus improve materials or our understanding of their behavior. The symposium covered specific applications of these ideas as well. Because this technology is being used by materials people in different fields, for example, metallography and nondestructive testing, we developed papers in both areas to improve cross communications between these groups. Several papers of broad, general appeal were also obtained to provide a common foundation.

Introductory Papers

Cole has provided us with an overview of computer-aided image enhancement techniques with illustrations of some of the more popular algorithms being employed. Russ describes the advantages and disadvantages of the standard RS-170 video signals for image analysis and details characteristics of both black and white and color cameras that influence performance. Schleitweiler and Ransick review systems that they have developed for capturing, storing, retrieving and printing digital images from several types of systems at use in their laboratory.

NDT Papers

Four papers deal with non-microscopy images, in the areas of nondestructive examination and mechanical property testing. Basart demonstrates how video image enhancement technology has been used to more clearly reveal defects present in x-ray radiographs and to aid in their interpretation. Generazio and Roth describe how video technology has been used in nondestructive characterization of high temperature materials, composites and ceramics. Adler and Nagy discuss scanning acoustic images, i.e., images

produced by ultrasonic waves. Sutton *et al.* describe how video can be used to detect and measure surface deformation on a test specimen under load.

Application Papers

A number of papers deal with traditional metallographic tests or techniques. For example, Forget outlines the development of an image analysis computer program for producing ASTM E 45 JK inclusion ratings according to ASTM E 1122 while Hetzner describes an image analysis approach for assessing isolated vs encapsulated inclusions in calcium-treated steels. Friel *et al.* document the problems associated with image analysis measurement of grain size using both areal and lineal approaches, particularly as influenced by incompletely etched grain boundaries.

Several papers deal with the characterization of segregation or the nonuniform distribution of second-phase constituents. Abbott and Brownrigg describe a video approach for mapping phosphorus segregation based on use of an etchant sensitive to phosphorus enrichment in an effort to improve the quality of continuously cast steels. Horálek and Klofác examined the nonuniformity of columnar grains in continuously cast copper and desribe a new homogeniety test based on the intraclass correlation coefficient. Green describes a sizing approach being used to assess carbide size and improve the quality of powder-made T15 high speed steel. Two papers describe image dilation approaches for assessing clustering tendencies of second-phase particles - Boutin and Baumer deal with the reinforcement phase in metal-matrix composites while Vander Voort is concerned with sulfides in free-machining steels and with carbides in superalloys.

Grande describes image analysis characterization of α phase in Ti-6Al-4V along with details of specimen preparation problems and solutions and a computer database of digitized images of Ti alloys with composition, heat treatment and property information. Karlsson and Cruz-Orive provide a description of stereological methods applied previously in biological studies but now for the study of pores in a sand cast aluminum alloy. These techniques are the disector, the selector, and Cavalieri's principle. Jenkins *et al.* describe the use of image analysis in the study of iron ore sinter while Cole *et al.* describe the use of image analysis in the study of polymer/glass composites.

Three papers deal with fractographic studies. Jenkins and Cherry show how fractographic measurements were applied to model hydrogen stress cracking, Gokhale describes stereological measurement of creep cavitation and Underwood discusses the treatment of fracture profile overlaps. Two papers deal with the use of fractals. Underwood describes a modified fractal equation for irregular profiles obtained with metal fracture surfaces while Smith and Petruk describe an image analysis fractal method used to study texture of base metal ores.

These papers demonstrate the present state of the art in video technology as applied to image enhancement, documentation, measurement and data bases. As the technology has become more powerful, easier to utilize and less expensive, applications have proliferated. Much more is anticipated.

George F. Vander Voort
Carpenter Technology Corporation
Symposium chairman and editor