

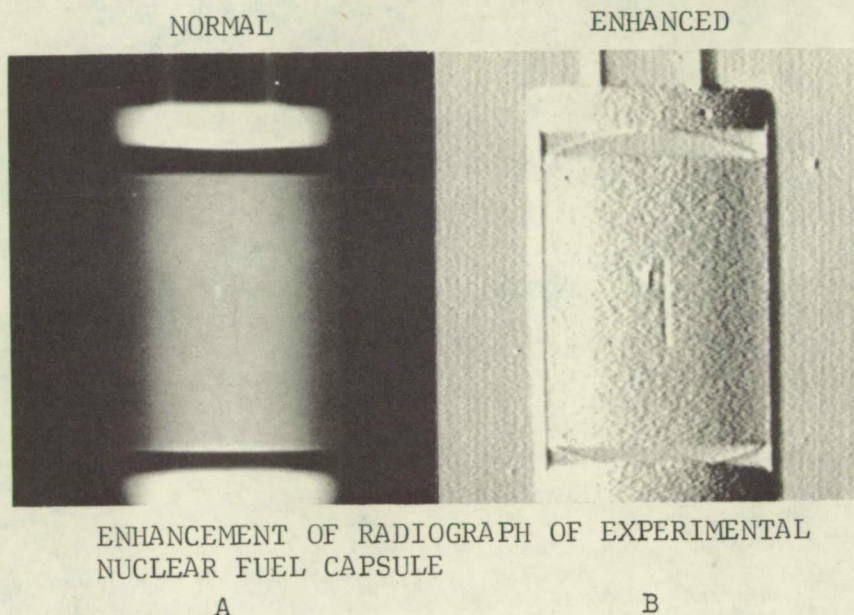
NASA TECH BRIEF

Lewis Research Center



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VIDEO ENHANCEMENT OF X-RAY AND NEUTRON RADIOGRAPHS



ENHANCEMENT OF RADIOGRAPH OF EXPERIMENTAL
NUCLEAR FUEL CAPSULE

A

B

FIGURE 1

The Problem:

Neutron and x-radiographs could be interpreted more easily and much more accurately if selected portions of the images were electronically enhanced and displayed on a viewing screen in real time.

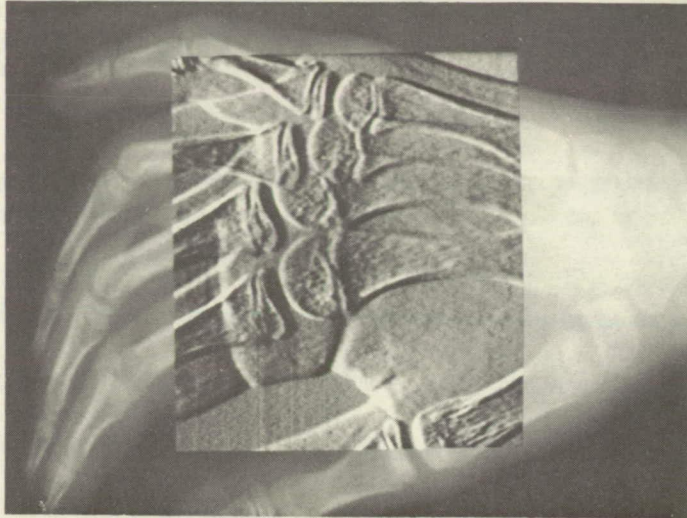
The Solution:

A system for displaying radiographs on a television screen and enhancing the fine detail in the picture was devised. The system uses analog-computer circuits for enhancing the contrast of fine lines and edges by processing the television signal from a low-noise television camera. The enhanced images are displayed in black and white on a television screen and can be controlled to vary the degree of enhancement and magnification of details in either radiographic transparencies or opaque photographs.

How It's Done:

The first step in the process is to convert the original picture into a form suitable for electronic processing. This is accomplished with a video camera equipped with a lens system capable of viewing an area of 22.5 x 30 cm (9 x 12 inches) to an area as small as 0.95 x 1.27 cm (3/8 x 1/2 inch) as required. In the case of radiographic transparencies, the film is back illuminated with a self-contained cold light source. The camera converts the density values in the photograph to a television video signal. This signal is then processed to produce a new signal whose amplitude is proportional to the rate of change of density (i.e., the first derivative of density) across each raster scan line composing the video image. The enhanced image is displayed on a television screen. In this enhanced image, regions where there are changes in photographic density

(continued overleaf)



RADIOGRAPH OF HUMAN HAND WITH CENTER
PORTION OF RADIOGRAPH ENHANCED

FIGURE 2

are accented in a manner that makes density variations stand out as though rendered in bas-relief. For example, points, lines, and edges that are seen only as subtle density differences in the original picture are brought out in sharp relief or contrast. Figure 1A is a neutron radiograph of an experimental tantalum-clad, uranium nitride fuel capsule with a barely-visible 3-mil-wide slot machined in the cladding. This slot plus other details are much more apparent in the video enhance, Figure 1B. Figure 2 is a medical x-ray as normally seen and an insert of the enhanced version. All the photographs were taken directly from the television screen.

The video enhancement system can be used to display pictures in the normal mode both as a positive or negative. In either the normal or enhanced mode, the contrast can be adjusted to reveal subtle density variations that might otherwise escape notice. Moreover, the image can be manipulated so that horizontal features are factored out in the enhanced version while vertical features only are accented. Or, the image may be set to bring out both horizontal and vertical elements in the enhancement. Another capability is to locate details with up to 30X magnification of images on the television screen in either the normal or enhanced mode.

This enhancement system has been applied to a variety of pictures including ordinary photographs, infrared photographs, metallographs, medical x-rays, and neutron radiographs of aerospace components. The system is a valuable adjunct to scanning microdensitometric image analysis. It can also be useful in nondestructive evaluation to complement other image analysis techniques (e.g., digital computer processing, photographic processing, and laser spatial filtering).

Notes:

1. An advanced version of the system combines black and white enhancement with a digitally coded color television display.
2. More information on this image enhancement system is contained in the article entitled "Investigation of An Electronic Image Enhancer for Radiographs," Materials Evaluation - Journal of American Society for Non-Destructive Testing, December 1972, Vol. XXX, No. 12, pp. 259-267.
3. No additional documentation is available. Specific questions, however, may be directed to:
Technology Utilization Officer
Lewis Research Center
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Cleveland, Ohio 44135
Reference: B73-10009
4. The video image enhancement system described was developed by Spatial Data Systems, Inc., 132 Aero Camino, Goleta, California 93017, under the direction of the Lewis Research Center.

Patent Status:

NASA has decided not to apply for a patent.

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