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AXIAL TOMOGRAPHY FROM DIGITIZED REAL TIME RADIOGRAPHY

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ABSTRACT

Axial tomography from digitized real time radiographs provides a useful tool for industrial radiography and tomography. The components of this system are: X-ray source, image intensifier, video camera, video line extractor and digitizer, data storage and reconstruction computers.

With this system it is possible to view a two dimensional x-ray image in real time at each angle of rotation and select the tomography plane of interest by choosing which video line to digitize. The digitization of a video line requires less than a second making data acquisition relatively short.

Further improvements on this system are planned and initial results are reported.

INTRODUCTION

The unique features of the "Video Cat" System (axial tomography from digitized real time radiographs) make it a very useful tool for industrial radiography and tomography.

A unique aspect is the formation of an x-ray image on the phosphor of the Delcalix image intensifier. With the video camera it is possible to view the x-ray image and select the tomography plane of interest by choosing which video line to digitize. Also, the real time x-ray image at each angle of rotation can be examined while the tomographic data is acquired. The digitization of a video line requires less than a second making data acquisition relatively short.

VIDEO CAT COMPONENTS

A block diagram of Video Cat components is shown in Figure 1. These components are discussed in this section.

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The Front End

The source of radiation is one of several x-ray machines we have available. The choice depends on the energy required to penetrate the object.

The real time x-ray image is produced by a Delcalix image intensifier tube. The image is viewed by a video camera.

The Daedal stage provides object positioning for the XZ and θ axes. An interface to an LSI-11/23 controls the positioning.

Data Acquisition and Control

Data acquisition and control employs a Digital Equipment Corporation LSI-11/23 microcomputer. The LSI-11/23 system consists of the 11/23 central processing unit, 256K bytes of memory, a DSD-880 30 Mb Winchester/floppy disk combination, a VT-100 video terminal, and an interface for controlling a Daedal stage.

The IP-512 imaging system is an extensible set of circuit cards that allow digitization, processing, and display of RS-170 video signals. These cards plug conveniently into the LSI-11/23 QBUS back plane. Four boards comprise the VCAT's IP-512 imaging system: analog processor, arithmetic processor, and two 8-bit 512 x 512 frame stores.

Data Analysis

The actual reconstruction algorithm is applied to the data stored on floppy disks using a VAX 11/780 computer. The VCAT system is able to acquire a complete set of 180 512-point scans in less than 10 minutes. Reconstruction then takes an additional 30 minutes on a VAX 11/780 using the Donner reconstruction algorithms available from Lawrence Berkeley Laboratory.

RESULTS AND FUTURE DIRECTIONS

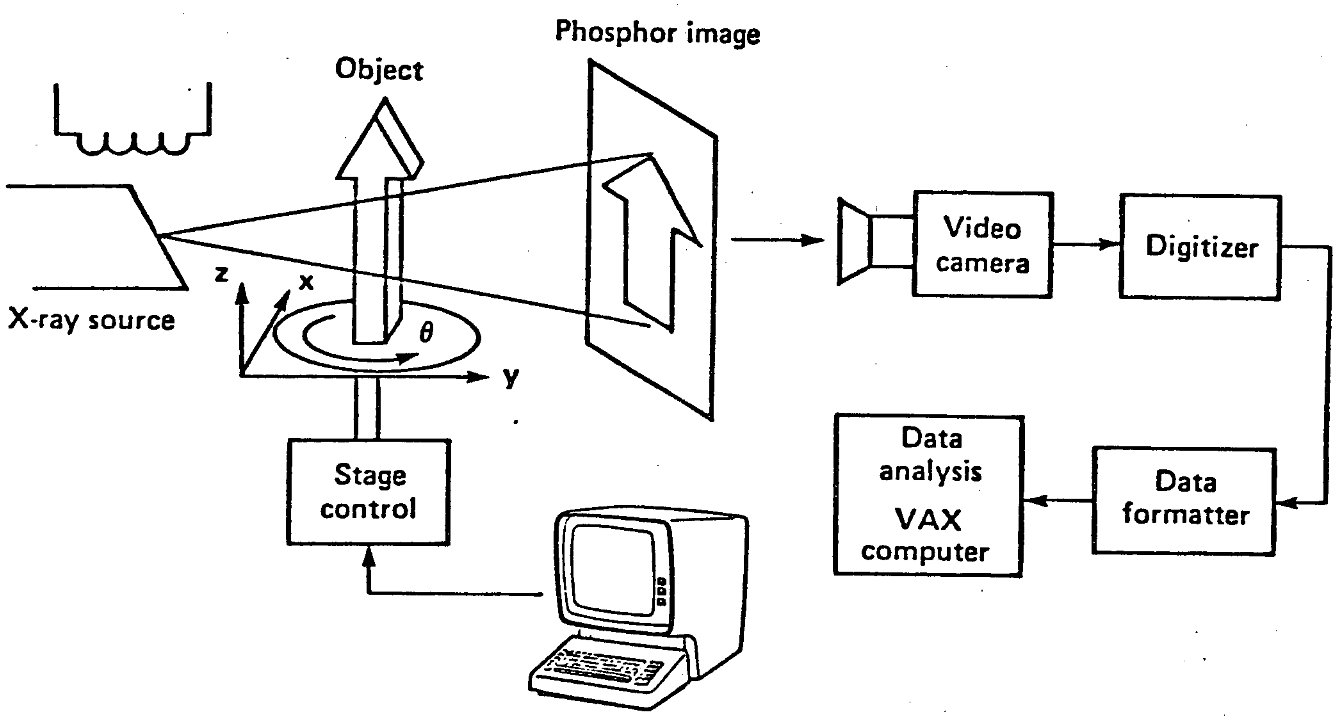
Results

Our first tomography attempt with the Video Cat System is shown in Figure 2. This is a reconstructed image (approximately actual size) of a test object consisting of iron, aluminum and lucite. The outermost checkered area is an artifact. Two concentric iron tubes of 14.3 cm and 10.9 cm outer diameter and 4 mm wall thickness contain five posts. The three large diameter posts are made of lucite, aluminum and iron with holes drilled in their centers. The two small posts are solid aluminum and iron. The important features of the object are discernible. For these materials, the resolution of the system is better than 3 millimeters (the diameter of the small posts and the holes in large posts) since features of this size can be easily seen.

Future Directions

The digitization of a video line at 512 locations is roughly equivalent to a tomography system with 512 discrete detectors. This provides a very fast acquisition system. We plan to characterize the root mean square noise of the video line digitizing process to compare system capabilities to other detectors such as sodium iodide and plastic scintillators. We also hope to establish a direct link to the VAX 11/780 via a high speed network (ETHERNET).

Figure 1. Computerized axial tomography using an image intensifier and video camera (video CAT)



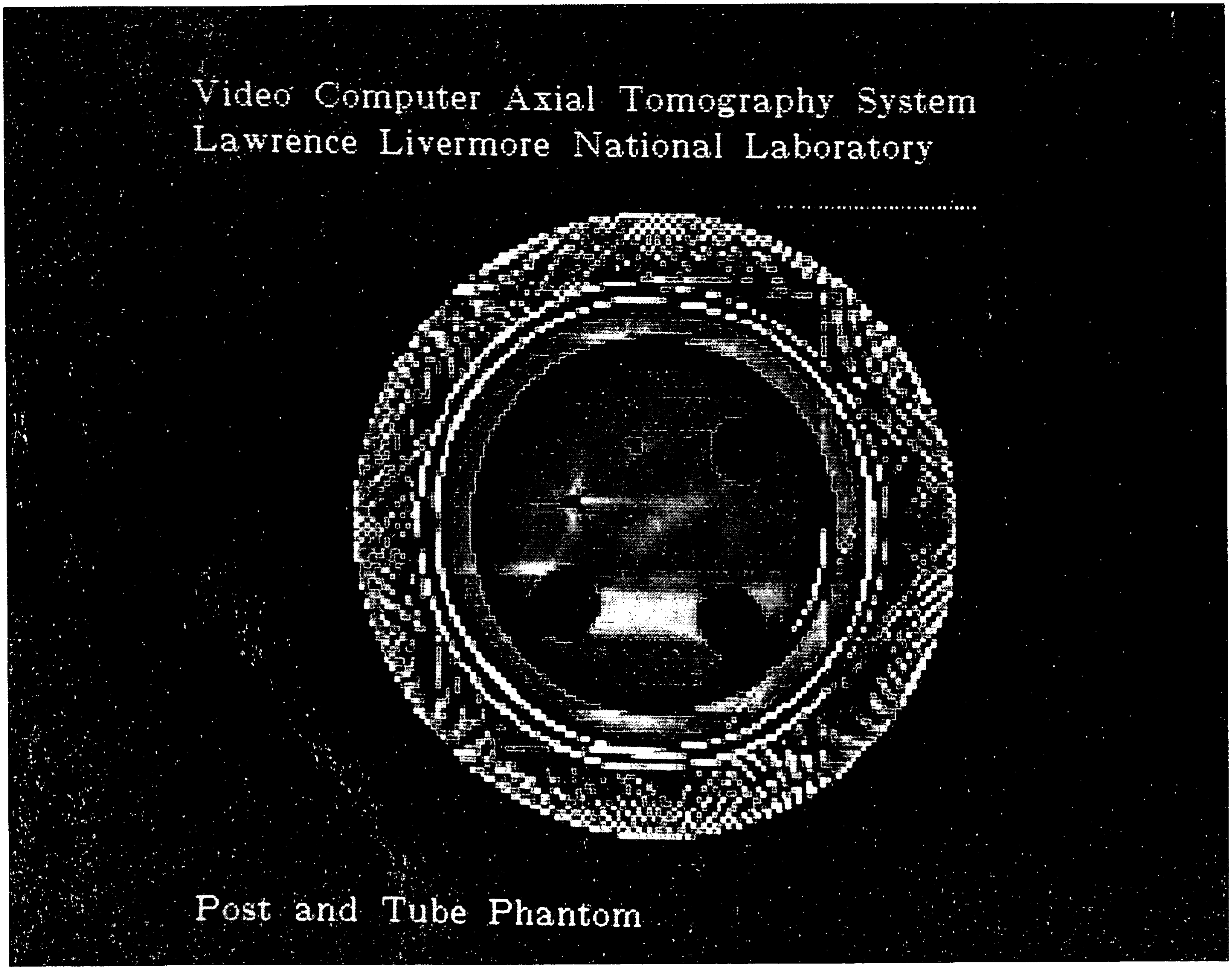

Video Computer Axial Tomography System
Lawrence Livermore National Laboratory
Post and Tube Phantom

Fig. 2

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