Symposium

— Applications of a Digital Computer for Radioisotope Image Processing —

The NIRS On-line Computer System for Data Acquisition and Processing in Radioisotope Imaging

T. A. IINUMA

National Institute of Radiological Sciences, Chiba

(1) Introduction

A new radioisotope imaging system has been developed in which radioisotope image detectors are considered to be one of the input/output devices of a general purpose digital computer. Thus, the computer collects as much information as possible from the image detector and processes the information so that doctors can see an R.I. image pattern of better quality and also obtain other quantities that are useful for more precise diagnosis than those obtained from the usual image detectors. In the R.I. imaging application, the computer must have several important characteristics: (1) data acquisition in on-line mode, (2) image display in on-line and interactive mode (3) capability to process image data by a program written in compiler level.

In this paper we describe our solution to a new R.I. imaging system and show the results obtained.

(2) General description of the NIRS on-line system

The system consists of a central computer room and three on-line experimental sites which are connected by several co-axial cables for signal transmission. The computer room has a central processing unit (CPU) (Tosbac 3400 model 31), main core memory (CM) (16 KW, 24 bits/w), and a direct access controller (DAC). Various on-line input/output devices are attached to DAC through which the on-line devices can access directly to CM. Other peripheral devices such as line printer and card reader are attached to the CPU. Among the on-line devices, an impedance converter (IC), an input/output typewriter (IOT) and a cathode-ray tube display (CRT) are installed at the experimental sites that are situated about 300 m distance from the computer room. Other on-line devices include three analog-to-digital converters (ADC), a timer (TM), an input format converter (IFC), three increment units (INC), a sequence unit (SEQ), two display controller (DSP), a communication controller (COC) and a fixed information generator (FIG). Analog pulse signals originated from R.I. image devices (such as a recti-linear scanner and/or an Anger camera) are transmitted via IC to ADC at the computer room through co-axial cables. Height of each pulse is then digitized into 12 bits parallel information at the maximum and connected to INC and/or SEQ by changing the cable connections on IFC. The TM produces 10 bits parallel information that is also used as an input to INC or SEQ when necessary. The INC accumulates pulse height distribution in terms of counts versus pulse height in CM. The SEQ stores each pulse height and time information in a time sequence corresponding to its arrival time and then finally transfers all information into a magnetic disk (DK). Using these two units, of ways so that one can choose either a R.I. image data are gathered in a variety static image or a dynamic image.

(3) Image processing and display

Purposes of image data processing are twofold: one is to process the image data so as to display more intelligent pattern of R.I. image to doctor than that of usual scan image, and the other is to process the data

to measure various characteristics as an image and to extract several features which are useful for automatic diagnosis.

We think the first step is more important at the present stage, since the doctor is getting diagnostic information by viewing the R.I. image.

Our effort has been concentrated on the software for the display of R.I. image on a CRT unit, a line printer and a curve plotter. For the routine diagnosis, we found an on-line CRT display is most useful because it is easily changed interactively between doctor and computer. Various programs for improvement of image quality are being developed which include many kinds of smoothing and restoration. These are being tested on the phantom image and also on the clinical images. In the near future, we will complete the on-line R.I. imaging system starting from digital data acquistion and image quality improvement to final image display on the CRT unit.

Furthermore, we will challenge to a difficult but rewarding task of pattern regonition of radioisotope images.

Applications of a Digital Computer for Radioisotope Image Processing (Use of the Clinical Data Analyzer CDS-4096)

K. KOJIMA

Radiation Technician School, Kanazawa University, Kanazawa

K. HISADA

Department of Radiology, School of Medicine, Kanazawa University, Kanazawa

Scintillation camera and scanner are being used for obtaining radioisotope images, and processing of radioisotope image data was studied by coupling a computer with them.

[I] Use of a digital computer to scintillation camera

In radioisotope images obtained by scintillation canera, the counts in each picture element are statistically random and influenced by the limitation of the resolving power of its detector. In order to process digitally the data with a computer to improve and analyze them, the clinical data analyzer CDS-4096 (made by Nuclear-Chicago Inc.) was connected to the scintillation camera PHOGAMMA III. The analyzer consists of memory capacities of 4 kilowords (64 × 64 matrix) and is said a wired program mini-computer. According to the built-in programs the data manipulation is performed just by switching selectors or pushing buttons the results can be obtained on a CRT, a paper tape puncher or a typewriter at real time. For the purpose of processing other htan the built-in programs, the image data is transfered to the small general purpose computer NEAC-2230 and results are displayed on a CRT of the CDS-4096 after feedback from NEAC-2230 by the medium of paper tape.

A) On-line data processing programs

In the CDS-4096 some programs are incorporated as hardware. They are the functions of differentiation/integration, addition/subtraction of constants and so on.

In addition, data threshold, smoothing and isocount display manuplations are possible. Results are reported on the phantom with defects of the plastic spheres, the bar phantom arrayed lead bars and a few clinical data.

a) Data threshold

Continously varied cut off levels are permitted. As in a certain cut off level the variation of counts was enhanced, we could obtain the emphasized image, but the quality of the image was not always satisfactory.

b) Smoothing

This operation is to decrease statistical fluctuations of image data by operating a simple averaging of points neighbouring to