The Scintillation Camera Data Processing System for Dynamic RI Image Study

M. Moti and A. Koyano

Japan Radiation and Medical Electronics, Inc., Mitaka

Z. Hompo, M. Koga and S. Hakariya

Department of Radiology, Faculty of Medicine, Nagasaki University, Nagasaki

In this presentation we would like to introduce a new digital data processing system of scintillation camera data.

The system is assembled by following components, a data acquisition unit including dual high-speed analog-to-digital converter, a data display unit with light-pen, a central processing unit having 8K words core memory (1 word=24 bits), a direct memory access channel, a high-speed burst channel, a magnetic drum (100K words), a high-speed digital magnetic tape recorder and teletypewriter. A rectilinear scanner and a RI dynamic function test instrument such as renogram apparatus can also be connected to the system.

The signals from scintillation camera are digitized X- and Y-coordinates and they used to direct each incoming count to the proper address area in the magnetic-core memory of the central processing unit via direct memory access channel. There are two data areas in the magnetic-core memory and used like flip-flop, so that the counts detected by scintillation camera can be recorded with no dead time between frames. Then, the data is transfered to magnetic tape semi-permanently using a high-speed digital magnetic tape recorder. Recorded frames are identified by an identification number entered by the operator through the teletype keyboard before transfer of the recorded frame to magnetic tape. The stored frame data on core memory are displayed on an oscilloscope and displayed dot represents the counts accumulated in that particular address. The irregular shape of region-of-interest for computer integration can be chosen by a light-pen. All of the system regulation instructions are given by the operator through the teletype keyboard to the system like conversation.

According to the phantom tests and some clinical evaluations, it is recognized that the system has sufficient characteristics.

Clinical Evaluation of Processed Scan Images with an On-Line Computer System

E. Yabumoto, T. Matsumoto and N. Fukuda

National Institute of Radiological Sciences, Chiba

In order to obtain more diagnostic information in interpretation of scintigrams, an on-line computer system was applied to routine radioisotope scans using a 3-inch rectilinear scanner. The system has capability of data acquisition, construction of digital image, image processing and CRT display all in an on-line mode. The following image processing methods are available in the system, 1) simpel smoothing, 2) weighted smoothing, 3) matched filtering, 4) non-linear matched filtering (Fukuda), 5) differential operator method (Nagai, Iinuma and Fukuda), 6) least square method (Fukuda), 7) iterative

approximation method (Nagai and Iinuma) and 8) limited sampling least square method (Fukuda). According to phantom and clinical experiments, weighted smoothing and non-linear matched filtering with 13 data points size were chosen as standard processing method. Display on the CRT was photographed on Polaroid film as a map view with 5 levels of brightness and also 4 isometric presentations with different direction. Fifty one computer processed scans out of 216 digital scans were retrospectively compared, in terms of detectability of cold or hot lesion, with simultaneous photoscans and the patient's clinical findings. In 42 patients, no further information was added to the photoscan results by the computer processing and agreement with clinical findings was obtained. There were 6 cases in which the computed scan was diagnostically superior to the photoscan. In 2 cases, however, the computed scan showed false positive lesions while the photoscan and clinical findings excluded the lesion. Since the lesions on the photoscan were mainly blurred by poor count statistics, smoothing was effective in all instances resulting better S/N ratio. In some cases, however, mottle appearances were enhanced by smoothing or other processing methods and may cause false positives. Although focusing methods to improve the resolution of collimators showed better detectability of small lesion in phantom experiments with good count statistics, no definite improvement was obtained in the present series of clinical scans.

Quantitative Evaluation of Radioisotope Distribution in Vivo by Isosensitive Scanner Plus 4,096 Word Multi-Channel Analyzer Coupling

K. HISADA, K. KOJIMA and M. MATSUDAIRA

Department of Radiology and Nuclear Medicine, Kanazawa University Hospital, Kanazawa

The concept of isosensitive radioisotope scanning was advocated by us in 1966. The essential feature is the adaptation of two opposed detectors snychronized and moved in a rectilinear scanning system with the output of the two detectors combined to a single recording. The delineation of the radioisotope distribution is completely independent of depth so that any deposition of radioactivity has an equal opportunity to be visualized. For the quantitative evaluation of radioisotope distribution in vivo, isosensitive scanning is a prerequisite. Instead of analogue recording, digital acquisition of scan data is more suitable and flexible for data manipulation.

For this reason, the CDS-4,096 multi-channel analyzer (Nuclear Chicago Co.) was coupled to isosensitive scanning system with an aid of proper interface. Data obtained from the scanning detectors were stored in a 64×64 digital matrix. The digital image on a CRT screen was processed in a real time just by simple operation of selectors and switches. Various data manipulations and displays such as smoothing, thresholding, isocount display, profile histogram etc. were executed on line program for the convenience of visual interpretation.

One of the most useful function in CDS-4,096 analyzer is the integration of all of the data within selected area. Validity of quantitative evaluation method was proved using Alderson Research Laboratory Organ scanning phantom. The ratio of known amounts of radiogold ^{198}Au in the phantoms of the liver and spleen could be detected very precisely.

In the clinical application, area must be selected according to variable contours of the organ and light-pen system is more desirable.