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COMPUTER CONTROLLED WHOLE BODY SCANNER FOR RADIATION PROTECTION

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New techniques for activity distribution measurement have been introduced in the course of the reconstruction of the low background whole body counter of the institute.

Two dimensional profile and rectilinear scanning measurement can be carried out by using either autonomous or computer based control electronics.

The main features of the hardware and control software systems as well as some illustrative results of the first applications are presented in the paper.

Introduction

The whole body counter of the Central Research Institute for Physics, Budapest, has been reconstructed and improved with the aim of being able to determine activities in a more sophisticated way in the whole body and/or in separate organs. The measuring possibilities have been extended by introducing whole body integrating-, profile- and rectilinear scanning arrangements using two detectors (Fig. 1). Autonomous and computer controlled electronics have been developed controlling the measurements over wide ranges of parameter values.

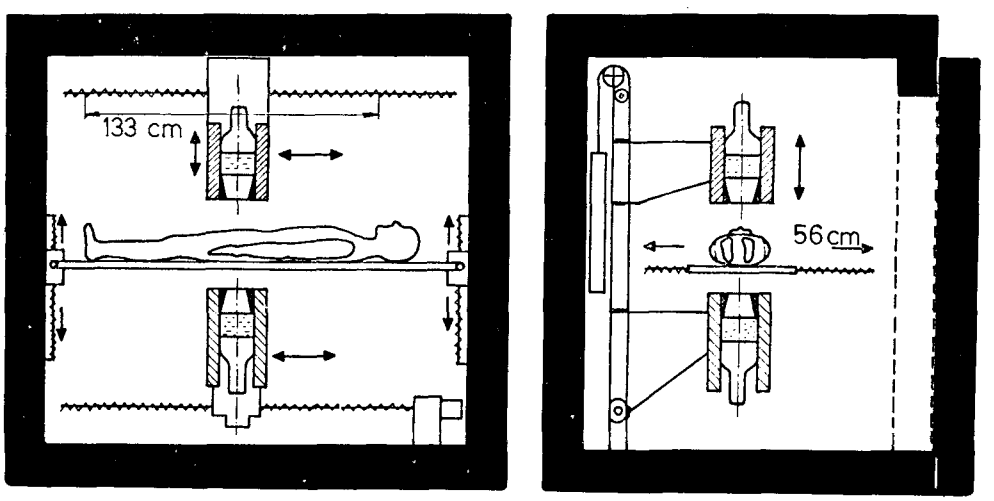

Fig. 1. Sketch of whole body scanning arrangement

Hardware system

The block diagram of the hardware system can be seen in Fig. 2. Whole body activity and distribution measurements using a single detector are controlled by an autonomous control unit whereas the more sophisticated two--detector rectilinear scan is computer controlled. A Crate Controller directly interfaces the CAMAC DATAWAY to the PDP 11/34 UNIBUS. The signals of the detectors are processed by four single-channel analysers /CAM 4.12 and CAM 5.04/ and their output signals are collected by a 16 channel scaler /CAM 2.15-1/; a quartz controlled Calendar and Clock module /CAM 6.04/ is utilized for timing. The command /one 24 bit word/ consisting of information on the speed and on the end-coordinates of the movement of detectors and/or bed is transmitted to the Autonomous Moving Controller by a Parallel Output Register /CAM 2.12/.

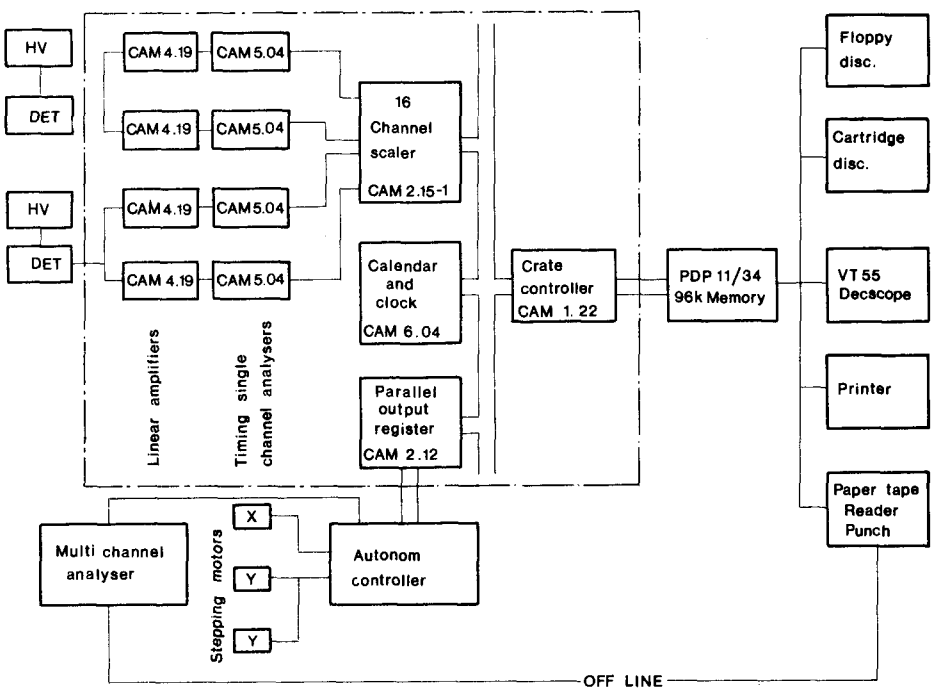

Fig. 2. Block diagram of measuring and control electronics

Control software

The control software is built from MACRO routines which can be called from high level languages, e.g. FORTRAN. The functional flow-chart of a measurement is illustrated in Fig.3.

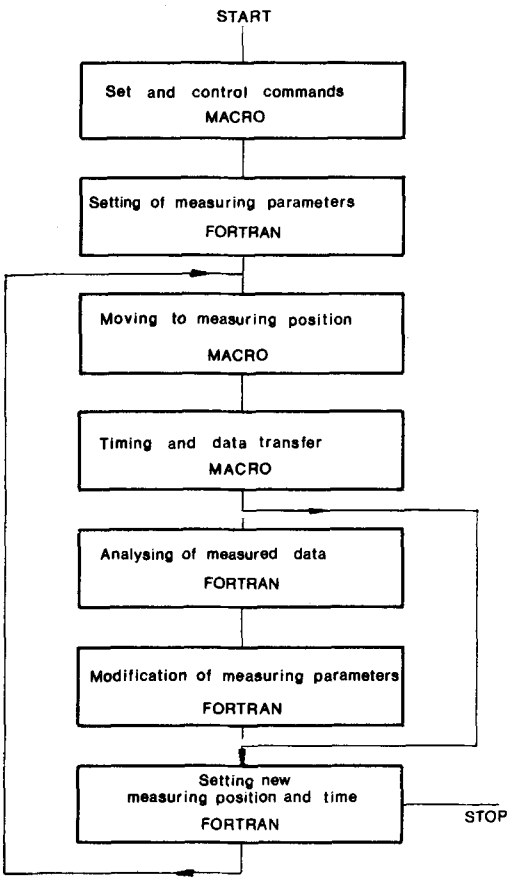

Fig. 3. Functional flow-chart of a measurement

Before starting any measurements, set and checking commands /MACRO/ are necessary; these are followed by the input of initial measuring parameters /FORTRAN/. The movement of the detector/bed to the measuring position, and the timing and data transfer are controlled by MACRO routines.

During the operative control there are two possible modes, viz. either to let the program run according to the initially given parameters, or by continually modifying these parameters in accordance with the measured data /FORTRAN/. This latter procedure, is being further developed.

The main features of the controlled monitoring system are as follows:

- detector positioning and continuous detector position display
- speed selection in the range 0.6-20 mm/s
- one- or two-detector whole body scanning with selectable speed and length
- one- or two-detector whole body scanning-end-stop method with selectable ratio of the measuring time at the end position to that during the run
- continuous profile scanning by one- or two-detectors with selectable speed, length and collimators
- discontinuous /stepwise/ profile or rectilinear scanning using one- or two-detectors with selectable step distance, measuring time, energy range /up to four ranges/,observed area and collimators.

The minimum activity needed for quantitative distribution measurements on humans is a few kBq, the maximum achievable spatial resolution is about

3 cm /FWHM/ depending on the radionuclide and on the distribution pattern. The measured distribution can be characterized by displaying either the count rate data belonging to each measuring position or the isocount rate curves. An example is shown in Fig. 4 where both profile and rectilinear scanning measurement are illustrated.

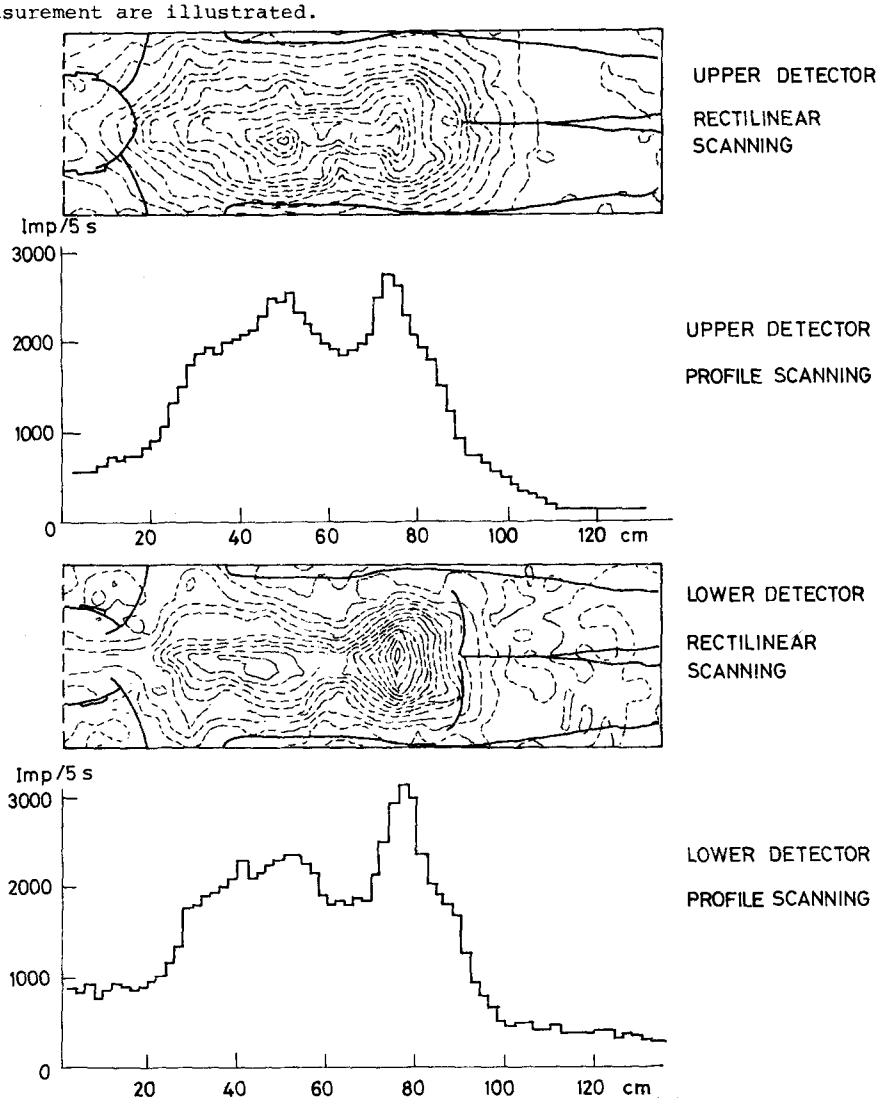

Fig. 4. Count rate distribution pattern of 0.5 MBq ^{59}Fe radioisotope 6 hours after i.v. administration

References

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2. J. Urbán, /in Hungarian/ KFKI Report 1985-16.