Short Courses

SC 5

PET Instrumentation-Basic and Advanced Technologies

Modulators: **Hideo Murayama, Hee-Joung Kim**

1. Overview of PET- Basic and Historical scopes

Dr. Jae Sung Lee (Dept. of NM, Seoul National Univ.)

2. Sicntillators

Dr. Hiroyuki Ishibashi (Hitachi Chemical Co.)

Detection efficiency for the gamma-rays with an energy of 511 keV emitted from positron tracers in the body is one of the most important issues for the improvement of PET. In order to achieve better detection efficiency, single crystal scintillators for PET are required to have high density and short decay time. Inorganic single crystals that satisfy the above requirements are being used as gamma-ray detectors in modern PET. Focusing on the improvement of the detection efficiency for PET, the requirements and development history of the scintillation crystals are described in this chapter. Recent developments of new scintillation crystals for next-generation PET are also explained.

3. Photomultiplier tubes

Mr. Masaki Nakamura (Hamamatsu Photonics)

The basic function of Photomultiplier Tubes (PMTs) and PMTs for nucldarmedecine.

PMT basic

- choice of window material
- choise of photocathode
- choise of dynode
- Characteristics of PMT

PMTs for nuclear medicine

- position sensitive PMTs for radiation imaging
- fast timing PMTs for time of flight PET

4. Signal Processing

Dr. Eiji Yoshida (Nat. Inst. Radiol. Sci.)

1).Detector

2).Coincidence

3).Data acquisition

4).DOI PET

5).Data correction

Dr. Keishi Kitamura (Shimadzu Co.)

In order to obtain high quality and quantity PET images, it is important to use appropriate data correction methods to reconstruct data affected by attenuation, scatter, random coincidence, detector sensitivity variation etc. This chapter describes the principle and practice of these correction methods.

6. Image reconstruction

Dr. Taiga Yamaya (Nat. Inst. Radiol. Sci.)

Many kinds of image reconstruction methods such as FBP and OS-EM are practically used in PET. In this lecture, first we will categorize image reconstruction methods in terms of system modeling. In a realistic PET imaging, objects (i.e., spatial distribution of RIs) are represented in a continuous space while measurement data are represented in a discrete space. We refer to this model as continuous-discrete mapping model. However FBP method is based on continuous-continuous mapping model and OS-EM method is based on discrete-discrete mapping model. Next, we will describe our

recent results on development of image reconstruction software for the state-of-the-art "jPET-D4" scanner. The jPET-D4 achieves not only high spatial resolution but also high scanner sensitivity by measuring 4-layer depth-of-interaction (DOI) information. In order to reduce data dimensions without significant loss of spatial resolution, the DOI compression (DOIC) method was proposed. The DOIC method combines deep pairs of DOI layers into the nearest shallow pairs of DOI layers with native detector samplings (i.e., without any interpolation).

SC 8

Intensity-Modulated Radiation Therapy-State of the Art

Drs. Bortfeld, Mackie, and Palta

The 4-Hour short course will consist of 4-5 lectures on topics that will cover the whole spectrum of issues in IMRT (For example; IMRT PROCESS OVERVIEW, ACCOUNTING FOR UNCERTAINTIES IN IMRT, MOTION AND IMRT, IMRT OPTIMIZATION, IMRT TREATMENT PLANNING, AND IMRT QA).

Learning Objectiv• Understand the process of IMRT.

• Recognize the importance of the team approach in IMRT.

• Identify appropriate target volumes and learn strategies for target volume and organ-at-risk expansion to account for geometric variations and uncertainties.

• Get familiar with plan optimization process for creation of the best IMRT plans.

• Get familiar with clinical implication and potential pitfalls of IMRT.

• Acquire the practical information on execution of these optimal plans, their verification, and quality assurances: