ABSTRACTS OF RECENT Ph.D. THESES PERTINENT TO MEDICAL PHYSICS

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On-line monitoring and PET imaging of the positron-emitting activity created in tissue by proton radiotherapy beams

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An imaging system was designed and tested to monitor the positron-emitting activity distribution created by proton radiotherapy beams during treatments. Decay data were acquired and imaged between beam pulses and after irradiation. The range of a 150 MeV proton beam may be verified after a single beam pulse to within the resolution of the imaging system, which was 1.2 cm. Over 80% of the initial positron-emitting activity is from ^{15}O while the remainder is primarily ^{11}C, ^{13}N, ^{14}O with traces of ^{18}F and ^{10}C. The dose delivered to the patient may also be monitored by observing the increase in the number of coincidence events detected between successive beam pulses. In some situations the width of the plateau region of a Spread-Out Bragg Peak may be inferred from the fall of activity at the distal end of the distribution. Radioisotopic imaging may also be performed along the beam path by fitting decay data collected after the treatment is complete. Using this technique, it is shown that variations in elemental composition in inhomogeneous treatment volumes may be identified and used to locate anatomic landmarks. Radioisotopic imaging also reveals that ^{14}O is created well beyond the Bragg peak, apparently by secondary neutrons.

[Copies of this dissertation are available from University Microfilms Inc., Ann Arbor, Michigan 48106-1346.]

Computer-aided diagnosis: Automatic detection of malignant masses on digital mammograms

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A computerized method to automatically detect malignant masses on digital mammograms based on bilateral subtraction to identify asymmetries between left and right breast images was developed. After the digitization, the breast border and nipple are automatically detected in order to align left and right mammograms. Images are corrected to avoid differences in brightness due to the recording procedure. Left and right mammograms are subtracted, and a threshold is applied to obtain a binary image with the information of suspicious areas. The asymmetries are extracted by region growing. Size and eccentricity tests are used to eliminate false-positive responses and texture features are extracted from suspicious regions to reject normal tissue regions. The scheme was tested in 70 pairs of digital mammograms and a true-positive rate of 71% with an average number of 0.67 false-positives per image was achieved. Computerized detection was evaluated by free-response operating characteristic analysis (FROC). An area under the AFROC (A1) of 0.667 was obtained. Our results show that the scheme could help radiologists as a second reader in mammographic screening. The low number of false-positives indicates that our scheme would not add confusion to radiologists, detecting normal regions as suspicious.

[Microfilmed copy is available from the author.]