3355

The Development of a Real-Time Respiratory Motion Compensation and Simulated Gated-Radiotherapy System

Yoon Jong Kim[1,2] Y. H. Ji[1], and S. H. Hong[2]

[1] Radiological & Medical Sciences Research Center, KIRAMS, Seoul, Korea, [2] Dept. of Electronic Eng., Inha University, Incheon, Korea

yooma@yooma.com

To reduce the error by the respiration-induced organ motion is one of the most important points for an efficient treatment among many errors occurring when a tumor is treated by radiation. In this study, the apparatus can compensate the respiratory motion and can be simulated the respiratory gated radiotherapy is developed. The apparatus consists of two sections. One is the compensation planning part and the other is motion compensation treatment part. This is composed of a image board and a camera to detect the abdominal motion, a pair of tungsten gate to open and close the irradiation and servo motors and controllers to control the gates. That is composed of two image boards, a camera and the fluoroscopy system. Software interfaced to a camera and fluoroscopy tracks the internal anatomy target and abdominal surface induced by respiration simultaneously, using only image processing without any additional physical markers. The respiratory-gated radiotherapy system was evaluated based on the optical density and penumbra area according to the respiratory period, motion distance and duty cycle. The optical density averaged 89 levels under the condition of no motion and 60MU dose, and averaged 27 levels under 12MU, 20% of 60MU. The penumbra was 6.1mm and 5.1mm at a dose rate 60MU and 12MU, respectively. The optical density was lessened linearly according to the duty cycle when the target was sinusoidally moving at a period of 2 seconds and 3 seconds, respectively. Density errors were less than 5. The penumbra was 20.7mm under 2cm motion distance and no gating, and lessened linearly according to duty cycle, 5.6mm, 6.3mm under a 20% duty cycle and a respiratory period of 2 seconds and 3 seconds, respectively. That penumbra value approximates the value under no motion. At the evaluation according to motion distance, the optical density was lessened linearly according to duty cycle with a respiratory period of 3.5 seconds, which was a basic respiratory period under normal conditions. The penumbra changed from 14.3mm with a motion distance of 1cm and duty cycle of 100% to 6.8mm with a duty cycle of 20%. And, with a motion distance of 3cm, penumbra improved from 29.3mm with a duty cycle of 100% to 6.8mm at a duty cycle of 20%. Precise and effective radiotherapy can be performed because of the internal margin around the tumor near the important organs can be lessened using this respiratory compensated system and data when the treatment field is planned.

Keywords : Gated-Radiotherapy, Respiratory-Motion, Motion Compensation