

## Sources of Uncertainty in the Target Localization Based on a Statistical Analysis of Pre-treatment Ultrasound for Prostate Cancer Patients

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Organ motion is of particular concern when treating prostate cancer as the prostate is a mobile organ and its position can vary between radiotherapy treatment fractions. The goal of this work is to report and analyze the results of five years of use of a 2D ultrasound system based target localization (US) for the daily pre-treatment localization of the prostate gland in prostate cancer patients undergoing conformal radiotherapy at our facility. We have retrospectively analyzed US data from 387 patients treated between 2001 and the end of 2005 resulting in a total of 10,327 localizations, each comprising an isocenter shift in 3 directions: anterior-posterior, right-left, and superior-inferior. The mean shift and standard deviation (SD) for each direction for each patient was computed from daily treatment records, and a mean of the means was used in the analysis. The data was tested for normality using a Shapiro-Wilk test. The mean shifts required to shift the target to the planned position were 6.1 mm posterior (4.4 mm SD), 2.1 mm superior (4.5 mm SD), and 0.5 mm right (3.6 mm SD). The 6.1 mm shift posterior is indicative of a systematic uncertainty. There are several sources of this uncertainty, the major one being the difference in patient setup and procedures between the CT simulation and the treatment room. The obtained results support the use of a 15 mm PTV margin to encompass the CTV for 95 % of our sample if the ultrasound localization system were not used.

Keywords: Organ Motion, Prostate Localization, Ultrasound System Based Target Localization