AbstractID: 9228 Title: Alignment error due to speed artifact in Stereotactic ultrasound image guidance

Introduction

US image guidance systems which are calibrated for soft tissue applications will introduce errors in depth-from-transducer representation when used in media with a different speed of sound propagation (e.g. fat). In this study we utilized a standard US phantom to demonstrate the existence of the *speed artifact* when using a commercial US image guidance system to image through simulated layers of body fat, and compared the results with calculated/predicted values.

Method and Material

A General Purpose Ultrasound Phantom (speed of sound-SOS = 1540 m/s) Model ATL 040 (CIRS, Norfolk, VA) was imaged on a LightSpeed RT CT scanner (GE Health Care, Waukesha, WI) at 0.625-mm slice thickness and 0.5mm pixel. Target-simulating wires inside the phantom were contoured and later transferred to the BAT Sxi unit (Nomos Corp., Cranberry, PA). Various thicknesses (1-8cm) of fat simulating material (SOS = 1435 m/s), manufactured by CIRS, were placed on top of the phantom to study the depth-related alignment error. In order to demonstrate that the speed artifact is not caused by adding additional layers on top of the phantom, we repeated these measurements in an identical setup using tissue simulating material (SOS=1540 m/s) for the top layers.

Result and Discussion

For the fat simulating material used in this study, we observed the magnitude of the depth-related alignment errors resulting from this speed artifact to be 0.73 mm per cm of fat imaged-through. The measured alignment errors caused by the speed artifact agreed with the calculated values within measurement uncertainties for the five different thicknesses of fat simulating material studied here.

Conclusion

We demonstrated the depth-related alignment error due to speed artifact when using US image guidance for radiation treatment alignment. When possible, care should be taken to avoid imaging through a thick layer of fat for larger patients in US alignments.