

**Purpose:** To correct speed of sound (SOS) aberrations in ultrasound (US) imaging systems for quantitative image guided radiotherapy (IGRT) applications. US waves travel at different speeds in different human tissues. Conventional qualitative US-based imaging systems assume instead that the SOS has the constant value 1540 m/s, which is an accepted average value for soft tissues. This assumption is a systematic source of errors and image distortion in quantitative US imaging, whereas in qualitative diagnostic imaging it is usually unimportant.

**Methods:** In 3D US IGRT applications, at the simulation stage along with the computerized tomography (CT) scan an US scan is performed, in the same coordinate system. A relationship between the physical density information, provided by the CT scan, and the SOS can be experimentally established and used to transform the CT scan of the patient in a SOS map of the tissues. According to the local values provided by the latter, every US voxel is resized along the radial direction to the dimension correspondent to the distance traveled by sound at the correct speed.

**Results:** Measurements on phantoms and on clinical patients show that differences in distance up to 6 mm are expected after SOS aberration correction has been applied, restoring a more precise match between the positions of reference structures in US scans and their real positions.

**Conclusions:** Significant SOS corrections were found. Their application improved accuracy in the position of reference structures in phantoms and in direct US–CT comparisons. The correction also yields an improved image quality (reducing defocusing and geometric distortion) and more accurate outline of regions of interest. This error has probably affected several previous US-CT studies reported in the literature, especially in cases of patients where significant changes occurred between simulation and treatment stages.