Purpose: This study investigated how object speed affects 3D speckle tracking accuracy and precision in the azimuthal and elevational directions when using a mechanically swept 3D ultrasound probe.
Methods: A 3D probe was used to acquire B-mode volumetric ultrasound images of a homogenous tissue-mimicking ultrasound phantom. Object motion was simulated by moving the probe in the azimuthal and elevational directions using a translational stage with 3-axis of motion whilst volumetric images were continuously acquired. To form volumetric images the transducer was mechanically swept back and forth and therefore object motion was prograde or retrograde to the transducer's sweep motion. Displacement between volumes was estimated using 3D correlation-based speckle tracking of a region of interest (ROI) located at various positions within the phantom. We investigated tracking accuracy and precision for speed of 0 to 35 mm s-1 for fixed displacements of 2mm and 4mm, for prograde and retrograde motion and as a function of depth.
Results: For the azimuthal direction, both accuracy and precision were better than 0.1mm and 0.15mm for 2mm and 4mm displacements respectively and no significant correlation was found between accuracy and speed and between accuracy and depth. For the elevational direction and 2mm displacement, accuracy was 0.25mm and 0.3mm for prograde and retrograde motion respectively. Accuracy and precision were greatest at the elevational focus (60mm). For a 4mm elevational displacement with retrograde motion, accuracy and precision reduced with speed and tracking failure was observed at speeds > 14mms-1, this was not observed for prograde motion.
Conclusion: For mechanically swept 3D probes tracking in the elevational direction is poor for retrograde motion at speeds of greater than 14mms-1. Thus for inter-volume displacements greater than 2mm only prograde motion should be tracked which will decrease temporal resolution by a factor of 2.