19th International Symposium of ISTU
5th European Symposium of EUFUS
Barcelona 2019 | 13th - 15th June

ABSTRACT BOOK
FAST SCANNING FOR HOLOGRAPHIC CHARACTERIZATION OF SOURCES

W. Kreider¹, C. Hunter¹, V.A. Khokhlova¹,², O.A. Sapozhnikov¹,²
¹Center for Industrial and Medical Ultrasound, University of Washington, Seattle, USA
²Physics Faculty, M.V. Lomonosov Moscow State University, Moscow, Russia
e-mail: wkreider@uw.edu; olegs2@uw.edu

OBJECTIVES
Acoustic holography provides an efficient and accurate way of reconstructing ultrasound fields in 3D based on 2D hydrophone scans. However, to characterize sources operating at megahertz frequencies with apertures on the order of 10 cm, holograms often include tens of thousands of measurement points. Typical measurement systems use a motorized positioner to scan a single hydrophone through the measurement region point-by-point, with measurement times in excess of 5 hours. Here we evaluate the potential for accelerating such measurements.

METHODS
A custom scanning program was developed to synchronize motion along one linear positioner axis with the excitation of a source and associated hydrophone measurements. The positioner comprised lead screws driven by stepper motors (Velmex, Inc., Bloomfield, NY); hydrophone signals were recorded using a 14-bit digitizer with deep memory (Gage Razor 14, DynamicSignals LLC, Lockport, IL). Positional uncertainties were evaluated by comparing point-by-point and continuous line scans in measuring the focal lobe of a 4.2 MHz source (aperture 4.5 cm, F-number 1).

RESULTS
Continuous scans at speeds up to 14 mm/s were tested and not found to introduce any measurable position uncertainty for movement in one direction transverse to the acoustic beam; scans in the other transverse direction introduced relative displacements on the order of 50 µm. Differences between these directions are related to both the geometry of fixturing used to hold the hydrophone and the tank orientation. Uncertainty appears to be related to compliance in the fixturing.

CONCLUSIONS
Although care must be taken with regard to fixturing, continuous scanning can be implemented with negligible loss of accuracy, thereby enabling accurate holograms to be recorded in less than an hour.

ACKNOWLEDGEMENTS
Supported by NIH R01EB025187 and R01EB007643.

**Caption:** Pressure magnitudes measured in the focal plane of a 4.2 MHz source. With the hydrophone supported by a vertical tube (2.5 cm diameter, 110 cm length) aligned with the y axis, no measurable uncertainty in position is introduced by recording measurements during continuous hydrophone motion in the y direction. In contrast, scanning transverse to the tube axis in the x-direction appears to cause a relative displacement.