



## Technology Offer

### Apparatus and method for creating a holographic ultrasound field in an object

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## Background

Ultrasound is being used in many fields ranging from medical imaging and therapy to non-destructive testing, contact-free particle handling or spatially selective heating in industrial settings. Often, those applications require shaping (including focusing) of an ultrasonic field. Compared to existing transducers with fixed lenses or phased array transducers (PATs) the present invention allows much more sophisticated sound fields to be generated using much simpler and cheaper technology.

## Technology

We offer a new way to structure acoustic fields in a simple and cost-efficient way by means of acoustic holograms. These holograms encode any arbitrary field in a thin monolithic plastic plate and the acoustic fields are reconstructed using a single transducer. We successfully demonstrated transmission and reflection holograms. Such holograms offer wave-front manipulation over large areas and - depending on the method of fabrication - can reach  $10^5$  individual pixels, several orders of magnitude higher than PATs. Arbitrary pressure distributions can therefore be generated using only one single piezoelectric transducer. Acoustic holograms offer highly defined ultrasound fields at low-cost and low system complexity compared to existing transducer arrays. We use 3D printing to produce our holograms, where the typical materials and achievable resolution offer acoustic holograms for waterborne applications up to 10 MHz. Fig. 1 shows the proposed approach.

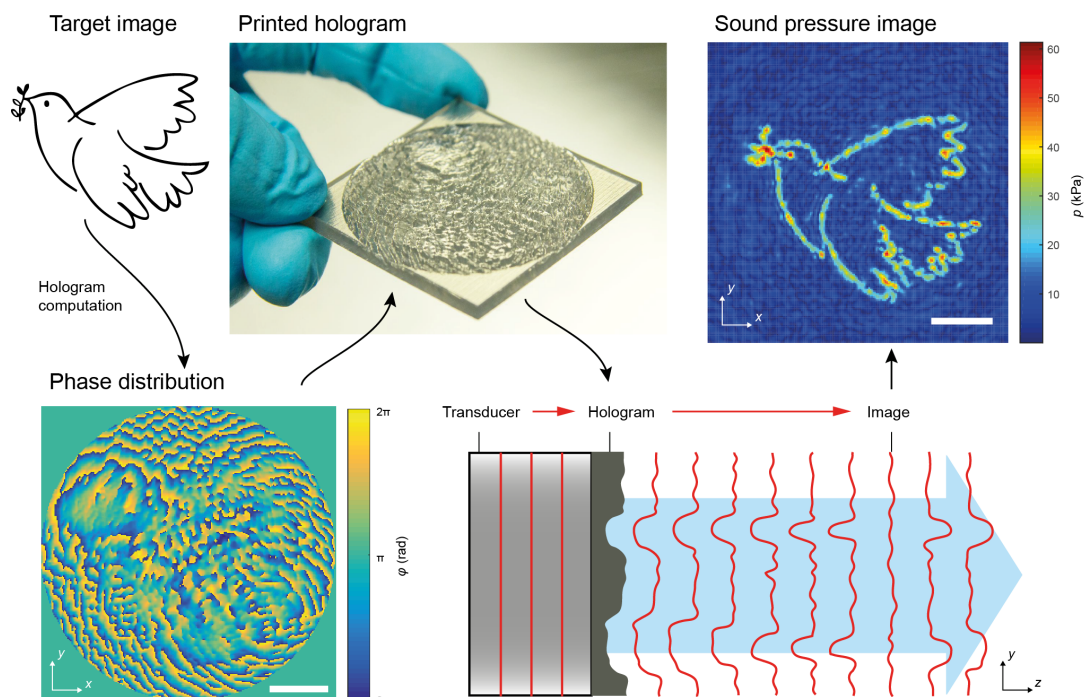


Fig.1: Workflow for creation of a transmission hologram from an image, followed by 3D printing and image reconstruction using a single element transducer.



We imagine applications in medical imaging, therapy, and surgery. We also see potential use in contact-free particle handling, energy transfer and non-destructive testing.

### Advantages

- Generation of arbitrary sound pressure and phase distributions using a single transducer. Similar to a lens a hologram is inserted into the beam path to shape the field. Therefore no modifications to the transducer are necessary.
- Fast and easy fabrication by means of 3D printing
- Readily scalable to large area and high pixel number without adding cost or complexity
- Diffraction-limited resolution in the near field for up to 10 MHz ultrasound in water-based environments.
- Applicable in the fields of ultrasound treatment, especially ultrasound-based energy transmission or ultrasound imaging
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### Literature

Melde, K., Mark, A. G., Qiu, T. & Fischer, P. Holograms for Acoustics, *Nature*, doi: 10.1038/nature19755 (2016)

### Patent Information

EP patent application filed in December 2015.