

# Super-resolution ultrasound imaging using structured insonification

## Description

Ultrasound imaging is the most commonly used medical imaging technique: it is non-invasive, real-time, safe, portable, and inexpensive. However, the resolution of ultrasound images is diffraction-limited. In deep tissue, into which only low ultrasound frequencies can penetrate, this limit is on the order of a millimetre. This is insufficient to detect small lesions that are crucial for early diagnosis of diseases.

Structured illumination is a super-resolution technique that has proven successful for optical imaging [1]. It relies on superimposing a periodic pattern on the illuminating field to retrieve higher frequency information from the image using k-space reconstruction. Its ultrasound analogue, structured insonification, is mostly unexplored.

## Assignment

You will use a state-of-the-art research ultrasound system and a multi-element transducer to generate structured waves. These waves will be used to image a calibrated phantom. You will process the acquired images in the frequency domain to obtain super-resolved images. Depending on your interest, you may also use computer simulations to facilitate this task.

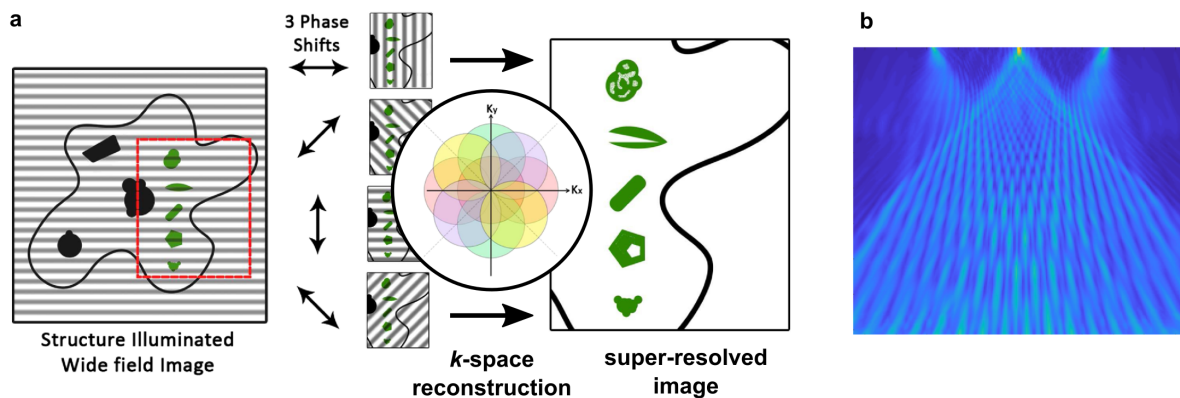


Figure 1: **a** Concept of structured illumination in optics. Modified from [1]. **b** Simulated structured pressure field of a medical transducer. Image credit: Valentin dal Bello.

Supervision	E-mail	Tel.	Office	Project room
Nathan Blanken	<a href="mailto:n.blanken@utwente.nl">n.blanken@utwente.nl</a>	053 489 8857	Meander 114a	Meander 207a
Guillaume Lajoinie	<a href="mailto:g.p.r.lajoinie@utwente.nl">g.p.r.lajoinie@utwente.nl</a>	053 489 4213	Meander 214c	Meander 207a
Jelmer Wolterink	-	-	-	-
Michel Versluis	-	-	-	-

## References

- [1] M. Saxena, G. Eluru, and S. S. Gorthi, "Structured illumination microscopy," *Adv. Opt. Photonics*, vol. 7, no. 2, p. 241, 2015