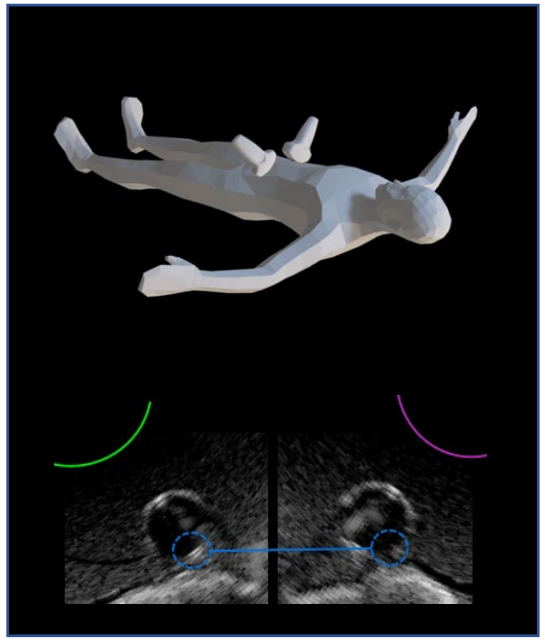
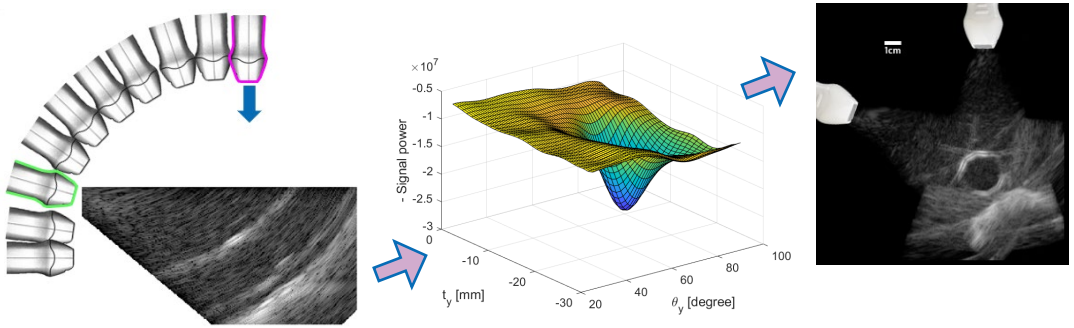
A deep learning based registration model for 3D multi-aperture ultrasound

Multi-aperture ultrasound



Currently, the image quality of ultrasound imaging is strongly limited by the small transducer size. Multi-aperture ultrasound solves this problem by combining different transducers to receive their own and each other's reflections.
A great step towards the clinical translation of this approach would be the possibility to automatically register the images from different transducers. But, in ultrasound, traditional registration is difficult, because looking from different directions, we see different edges of the imaged structures.

Idea



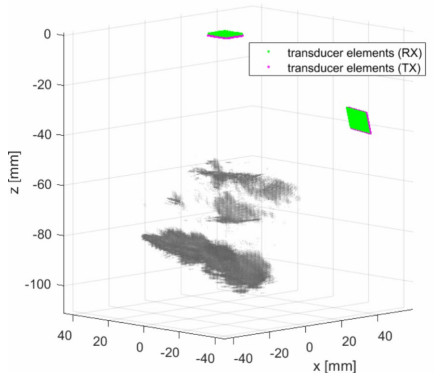
In a previous Master project, we found a way to use the waves that are reflected from one transducer to another to find the correct registration by an optimization of the reconstructed signal power. However, an optimization of all 6 degrees of freedom that are necessary to register volume ultrasound images was not yet possible.
In this new project, you will explore in how far we can use deep learning to overcome this issue and to automatically generate volume images that combine all the signals from different transducers, which were freely positioned on the patient's body.

Your tasks

This project is a collaboration of the IMAG/e and the PULS/e group. The novelty about your work lies in the fact that this is not a traditional registration approach, but rather a smart combination of reconstruction and registration.

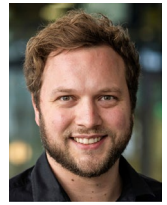
Your tasks will be to:

- Perform ex-vivo / in-vitro experiments with two synchronized 3D ultrasound transducers
- Develop a deep learning model that
  - either directly finds the transducer locations from trans-probe data
  - or improves the optimization metric to iteratively find the transducer locations



PULS/e LAB
Laboratory for Photoacoustics and Ultrasound Eindhoven

Hans-Martin Schwab (PULS/e)
h.schwab@tue.nl



Maureen van Eijnatten (IMAG/e)
m.a.j.m.v.eijnatten@tue.nl