

# Master Project

## Automatic coupling for robotic ultrasound

Chair for Computer Aided Medical Procedures, Technical University of Munich

### General Info

Project Title: Automatic acoustic coupling for robotic ultrasound imaging  
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### Project Abstract

Medical ultrasound (US) is already used today as the primary modality of choice for many clinical indications. Robotic ultrasound systems could potentially provide an automation of current ultrasound acquisitions, which would be especially helpful for interventional and screening applications. While the feasibility of automatized ultrasound imaging systems was shown by various research groups up to now, the application of ultrasound gel still needs to be performed manually today. This project focuses on ultrasound coupling and aims at overcoming this issue based on developments in other research areas to allow for automatic robotic ultrasound acquisitions.

### Background and Motivation

Ultrasonic waves are reflected at soft tissue interfaces (e.g. the interface between muscular and fatty tissue in the human body), which represents the foundation of modern medical ultrasound imaging. The strength of reflection is determined by the change in acoustic impedance between the different materials. Due to a too high difference in impedances between air and soft tissue, an appropriate acoustic coupling (matching impedance layer) needs to be employed for US imaging, to allow for medical acquisitions with high image quality. In clinical practice, ultrasound

coupling gel is applied manually by the operator. In view of trends to automatize ultrasound acquisition (e.g. by robotic ultrasound platforms), an alternative to ultrasound gel allowing for acoustic coupling of similar quality would facilitate an improved clinical acceptance of such developments.

### Project Description

The aim of this project is to develop an automatized method to match the impedances of the outer body to the inner body environment, allowing for US imaging without requiring manual gel application (see Fig. 1).



Figure 1 - Example for ultrasound coupling using conventional transducer gel.

The work will be developed on the foundation of various efforts in terms of ultrasound imaging in our group. In view of the project, there is a possibility to integrate a developed solution with the existing



robotic ultrasound platform developed by our chair. The project could either explore the possibility to use alternative materials for acoustic coupling, or develop an automatized application method. The project aims to provide the following:

- Exploration and evaluation of alternatives to acoustic coupling with medical ultrasound gel (e.g. research in other ultrasound applications).
- Development of a prototype for automatic gel coupling either by automatic gel application, or by developing an alternative method.

### Project environment

The project is located both in the interdisciplinary research laboratory at Klinikum rechts der Isar (<http://campar.in.tum.de/Chair/IFL>), as well as at the Chair for Computer Aided Medical Procedures in Garching.

Interested students will be immersed in our collaborative team working on ultrasound imaging, and the focus of the work can be adjusted to the specific scientific interests of the student.

### Technical Prerequisites

Interested students should have good knowledge in C++. Basic knowledge in ultrasound imaging and GPU programming is beneficial.

### If you're interested

Please get in touch with us, such that we can give you a more detailed overview of the project, and also show you our lab environment and running projects at our chair

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### References

[1] Navab, Nassir, Christoph Hennersperger, Benjamin Frisch, Bernhard Fuerst. "Personalized, Relevance-based Multimodal Robotic Imaging and Augmented Reality for Computer Assisted Interventions." *Medical Image Analysis* (2016).

[2] Esposito, Marco, et al. "Cooperative robotic gamma imaging: enhancing us-guided needle biopsy." *International Conference on Medical Image Computing and Computer-Assisted Intervention*. Springer International Publishing, 2015.

