Magnetic Resonance Elastography (MRE) is an exciting and non-invasive imaging technique that helps doctors identify different diseases by looking at the properties of our body tissues. It involves using special equipment that generates sound waves to create vibrations in the selected organs. These vibrations help us evaluate the stiffness and elasticity of our organs, which can provide valuable information about our health.

The quality and design of the equipment used in MRE, called passive drivers, are essential for a successful MRE examination. If the drivers do not adhere to the examined body part, or the vibrations they produce are not strong enough, the test may not give accurate results. For this reason, a commercially available passive driver, which was developed for liver examinations, cannot be used for assessing other organs. Besides, a single driver may be insufficient even to examine the liver, as sometimes the vibrations produced with only one driver are too weak.

This project aims to develop new passive drivers for MRE, with a focus on constructing drivers for the parotid and thyroid glands, as well as improving the way we examine the liver by using a special multi-source driver that covers the whole abdomen.

The research follows a step-by-step approach. First, I will plan and design the drivers using different non-magnetic materials like polyvinyl chloride (PVC) tubing and 3D-printed parts. I will also create special models that mimic human body parts to test the drivers. These models will be made of a substance called agarose gel, which behaves similarly to our organs. After testing the drivers on these models, they will be further validated through studies involving healthy volunteers and patients from the University Hospital.

Preliminary results have already shown that the proposed drivers for the thyroid and parotid glands will work well. However, there were some challenges with the space inside the MRI machine, where the exams are done. To make the drivers more comfortable for patients, I plan to use a special bent component that allows the tubes to be directed downwards, away from the tight space. They also revealed that the thyroid driver should have shorter and wider vibration pads, compared to the driver for parotid glands.

I will be also developing a one-piece whole-abdomen multi-source driver that can improve liver MRE results and enable the simultaneous examination of the liver, spleen, and pancreas, reducing the exam time. This driver uses a quilted design, with different sections acting as separate vibration sources. This makes it more convenient and easier to use and ensures better wave propagation through the body.

To build the drivers, I will use PVC tubing, 3D-printed plastic parts, and other safe materials that will not interfere with the magnetic fields in the MRI machine. I will also shape the vibration pads using techniques like heating and welding. The different components of the drivers will be connected using specially designed connectors and splitters to ensure the vibrations are transmitted effectively.

Ethical considerations are very important in this study, and the research has been approved by a respected Ethics Committee. Before participating, each person involved in the study will be fully informed about the procedures and asked to give their written consent.

In conclusion, this project has the potential to greatly advance MRE technology, leading to improved imaging and assessment of the parotid and thyroid glands, as well as several organs in the abdomen. The new designs and construction methods being developed can overcome the challenges faced in previous prototypes or commercially-available drivers. By using better materials and techniques, this research aims to make non-invasive evaluations of the parotid and thyroid glands feasible and accurate. It also aims to enhance the way we examine the liver and other abdominal organs, reducing the number of failed exams and improving patient comfort.