INTERNSHIP/FINAL THESIS – HHH: Developing a Robust Ultrasonic Weld Seam for a Soft Robotic Heart.

Are you interested in medical textiles and enjoy prototyping? Join us in the groundbreaking Holland Hybrid Heart project, where we collaborate with 18 partners to develop an artificial, biocompatible, soft-robotic heart that closely mimics a living heart. This project aims to create the first-ever permanent solution for end stage heart failure.

The Hybrid Heart features a soft robotic textile shell equipped with artificial muscles and sensors, enabling natural motion. It also includes a tissue-engineered inner lining to ensure biocompatibility with blood-contacting surfaces. Currently, a first prototype of the soft robotic heart uses heat sealing, but this method faces challenges with seam weld fatigue and failures at sealing lines. The primary challenge is to create robust air and watertight seams, crucial for the heart's functionality and longevity.

TASK DESCRIPTION

Let's look at the numbers: Heart failure affects an estimated 23 million people worldwide, with a projected 25% increase by 2030. Many of these patients end up in intensive care, anxiously awaiting a donor heart that, unfortunately, often doesn't arrive in time due to the limited availability of donor organs. In collaboration with a multidisciplinary consortium, we are pioneering a groundbreaking approach to HF treatment. Our mission is to create a soft robotic heart, the hybrid heart.

A soft robot is a movable structure with deformable parts, actuated by moving pressurized air or liquid into volumes that can change shape. Ultrasonic welding has emerged as a cutting-edge method for joining thermoplastic, innovative, and technical materials. This technique ensures optimal seam strength, durability and airtight and watertight seals. By combining machine parameters and material composition, we aim to optimize the mechanical performance of the prototypes. Insights from this work could influence the materials used in medical implants.

You will explore the factors influencing weld seam strength, including welding parameters such as welding wheel type, pressure, speed, power, gap, and dimensions. Your task is to test and validate the strength and integrity of weld seams in soft robotic hearts and provide strategies for optimizing these parameters to meet medical device regulations. The purpose of this assignment is to explore the principles, techniques, and challenges involved in creating a robust ultrasonic weld seam for a soft robotic heart. This will involve understanding the materials used, the ultrasonic welding process, and the specific requirements for medical and soft robotic applications. Discuss potential innovations that could further enhance the reliability and performance of the seams in medical devices.

The HybridHeart project will be carried out by an interdisciplinary group of (academic) researchers and high-tech SMEs, with experience in cardiac surgery, TE, soft robotics and engineering. The technology underlying the HybridHeart will be applicable to a range of soft robotics-based artificial organs, including the bowel, lung, or muscle structures (limbs). You'll work closely with material experts, textile engineers and experts on soft robotics, in the textile lab in the Epy Drost building in Enschede.

PRACTICAL INFORMATION

- **Student profile:** You are a BSc/MSc Technical Textile student with an interest in medical textiles and prototyping, looking for a challenging internship or graduation assignment. You have experience in working with different textile structures and have knowledge about relevant technologies (such as ultrasonic welding, adhesive bonding, coating...)
- We are looking for a student that can connect different fields of expertise, who is hands-on in his/her approach. You will mainly work independently in the lab, but you're pro-active in including relevant partners in your research, as a group we work together to achieve the best results in our projects.
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