BIOMED group

DESIGN AND DEVELOPMENT OF A PORTABLE EIT-BASED MEDICAL DEVICE FOR REAL-TIME STROKE TYPE DIFFERENTIATION IN AMBULANCES

1 Supervising staff

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2 Context

The rapid and accurate identification of stroke types—ischemic or hemorrhagic—during the prehospital phase is a critical medical challenge[1]. Early and targeted treatment greatly improves clinical outcomes, yet current diagnostic tools such as CT or MRI are only available in hospital settings. As a result, paramedics must rely on clinical scales that are insufficient for stroke type differentiation, often leading to treatment delays due to inter-hospital transfers.

To address this gap, a previous master's thesis[2] explored the use of Electrical Impedance Tomography[3–5] (EIT) for stroke type differentiation. That project validated the feasibility of using EIT with machine learning classifiers on simulated data and developed a first functional hardware prototype. However, signal acquisition on physical phantoms remained a challenge due to hardware limitations and test bench constraints.

a) b)

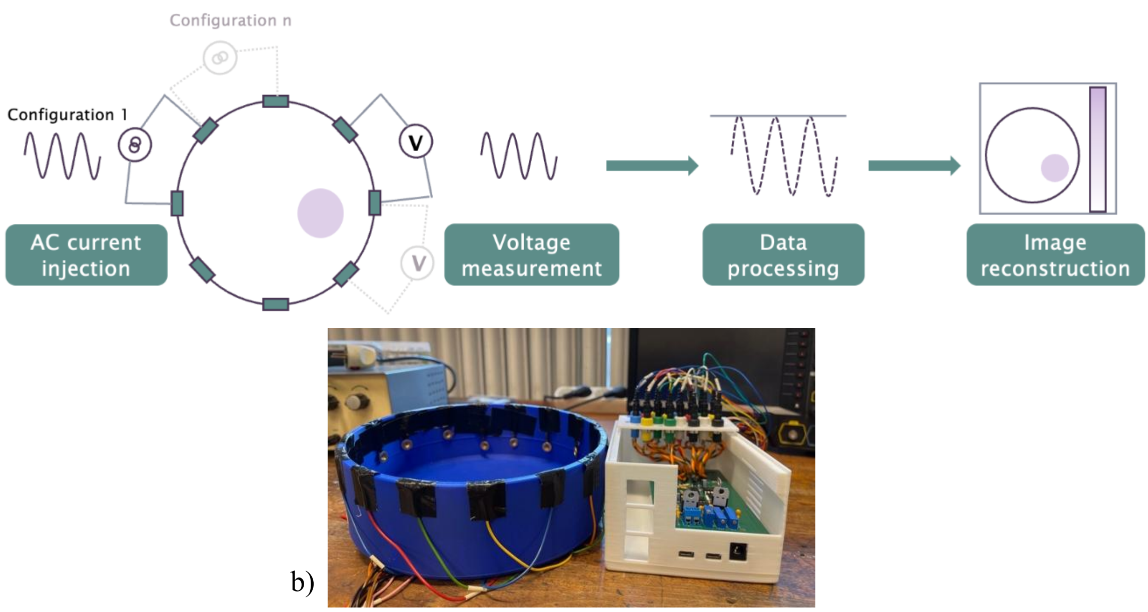

Figure 1. a) Illustration of the EIT workflow[2]. b) Experimental setup.[2]

3 Work

This master thesis aims to reach a functional proof of concept demonstrator operable under realistic conditions. It includes an hardware and a software development and validation, including three technical objectives:

A. Hardware Prototype Improvement

The first step will be to optimize the current test bench. This will involve improving the contact between the electrodes and the conductive medium, potentially by exploring different electrode materials, stabilizing the saline solution, and improving measurement reproducibility.

Variants of the device could also be explored, including testing different injection frequencies and electrode configurations to enrich the measured data and potentially improve classification accuracy.

B. Software and Classification Enhancement

Another important step would be to improve the current algorithms, test new classification models, and build a complete system that goes from signal acquisition to automated diagnosis (nice to have, not mandatory).

C. Experimental Validation

The device will need to be tested on more complex phantoms that better represent physiological reality. This will involve moving from a homogeneous medium to multilayer structures mimicking the different layers of the human head (skin, bone, brain), either by layering gels and conductive materials or by using a 3D-printed anatomical model. Simulated lesions will be introduced to assess the device's sensitivity and precision under near-clinical conditions.

4 References

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