

Real time Impedance Tomography to monitor pulmonary oedema IMPETOM

Franco Simini¹

Paula Machado², Pablo Sánchez¹, Florencia Navarro³ and Fernanda Blasina⁴

¹ NIB, Universidad de la Republica

² Fac. Veterinaria, Universidad de nla República

³ Fac. Veterinaria, Universidad de la Republica

⁴ Neonatología, Universidad de la Republica

Real time Impedance Tomography to monitor pulmonary oedema: IMPETOM-Vet

F. Simini¹, P. Machado², P. Sánchez¹, F. Navarro², F. Blasina³

¹Núcleo de Ingeniería Biomédica, Universidad de la República, URUGUAY

²Veterinary Faculty, Universidad de la República, URUGUAY

³Neonatal Department, Faculty of Medicine, URUGUAY

Pulmonary Oedema is fluid occupation of pulmonary parenchyma, which can be detected by simple bio-impedance measurements. To monitor the extent and location of oedema, the patient is usually transported to imaging departments for periodic X ray evaluation. The cost of imaging, the inconvenience of patient transport or portable X ray machines moved to the patient bedside and the resulting ionizing radiation dosis inflicted to the patient have spurred the development of a novel instrument based on impedance, called IMPETOM (1).

Sixteen equidistant electrodes are arranged around the thorax of the patient to be sequentially used in pairs to inject a known current (5 mA e.g. @ 30 KHz) and to measure the resulting voltage in the remaining 13 pairs. A matrix of resulting voltages is obtained for inverse problem processing.

Multiplexing of the current source allows to simplify the prototype as well as to insure the same current is injected in all electrode pairs.

Impedance modulus as seen from all other electrode pairs is used to populate a matrix to obtain the impedance estimation for every pixel of the axial section defined by the electrodes around the thorax. The EIDORS routines were used (2).

For animal use (8 to 15 Kg dogs) a special IMPETOM version was developed to obtain impedance thorax sections. Custom made electrodes are used consisting of arrays of 16 "pin wiring" pins sown onto a belt.

Results: The images obtained by IMPETOM-Vet allow to distinguish liquid free areas from oedema, which can be selected with a Region of Interest (ROI) within which the number of pixels with low impedance can be counted and displayed as a time series, defining the oedema extent over time. The original "pin wrapping" electrodes easily adapt to dog hair, obtaining a good skin contact to both inject current and to measure voltage with the same circuits used for human IMPETOM.

References

1. Barreiro M, Sánchez P, Vera J, Viera M, Morales I, Dell'Osa AH, et al. [346] "Multiplexing Error and Noise Reduction in Electrical Impedance Tomography Imaging." *Frontiers in Electronics* 2022;3(848618).

2. EIDORS: *Electrical Impedance Tomography and Diffuse Optical Tomography Reconstruction Software 2023* <https://eidors3d.sourceforge.net>