MULTI-FREQUENCY HIGH IMPEDANCE CURRENT SOURCE WITH 16-BIT RESOLUTION FOR EIT

By

Shun Yao

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Approved:

Prof. Gary Saulnier, Thesis Adviser

Rensselaer Polytechnic Institute
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ABSTRACT

This thesis explores the possibility of realizing a current source with more than 64 MΩ output impedance in the frequency range of 3 kHz to 1 MHz for Electrical Impedance Tomography (EIT) system. A calibration based system topology is proposed followed by a detailed analysis to determine appropriate circuit parameters. Op-amp non-idealities and noise distributions are discussed in depth to ensure 16-bit accuracy and precision. Special care is given to the load conditions presented by the electrodes and the patient to understand the stability problems. Realistic models are used in the circuit simulation to guarantee the feasibility and realizability of the proposed system. Comprehensive simulations are performed to investigate the op-amp stability and the output impedance, as well as the functionality of the DC attenuation circuit. This thesis provides a complete design flow from the system level to the component level, addresses all the considerations in the circuit design, and presents a practical system with satisfactory performance. Simulation results show that the proposed current source system can achieve more than 64 MΩ output impedance upon calibration over the whole frequency range of 3 kHz to 1 MHz, and provide only AC-coupled current to the subject under test.