Medical Electro-Thermal Imaging

Nevzat G. Gençer

Abstract

A hybrid system is proposed through the simultaneous utilization of thermal and electrical impedance imaging methods. The innovation of the approach relies on the frequency dependence of the tissue's electrical impedance. This facilitates the acquisition of multiple thermal images using medical infrared cameras with currents at different frequencies injected to the region of the body under inspection. The applied current and metabolic heat sources determine the temperature distribution on the body surface. The electrical currents increase the thermal contrast depending on the electrical properties of the tissues at the operation frequency. Consequently, the technique provides frequency dependent conductivity distribution data through thermal imaging which can be used as a basis for the detection of the breast carcinoma. Experimental aspects of this hybrid imaging modality are investigated using infrared cameras by applying sinusoidal currents in the 10 kHz-1 MHz frequency range to body phantoms. When the current injection frequency is increased to 1 MHz the image contrast is improved by 80%. Numerical simulations show that the depth-dependent imaging performance improves from 3 mm to 9 mm for a 1.5 mm tumor. The sensitivity of the technique can be further increased by an infrared camera with dual band imaging capability. The proposed approach has a potential to improve the sensitivity and accuracy of medical imaging over the standard thermography.

Correspondance

ngencer@metu.edu.tr; Department of Electrical and Electronics Eng., Middle East Technical University, 06800, Ankara, Turkey