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Breast cancer detection using low frequency bioimpedance device

Sofiene Mansouri, Yousef Alharbi, Jamel Nebhen and Anwar Alshrouf

Prince Sattam Bin Abdulaziz University, Saudi Arabia

Abstract

Introduction: Early detection of breast cancer saves lives. Existing detecting techniques are invasive. Electrical bioimpedance is a noninvasive technique and has a high diagnostic potential.

Methods: An impedance value different from the normal can predict a physiological abnormality. Malignant breast tumors have lower electrical impedance than surrounding normal tissues. The use of low frequency current (1 KHz, 0.9 mA) has permit to focus only on the breast the extracellular resistance. The difference of the measured resistances of the right and left breast is a pertinent parameter to early detect the presence of a cancer. A difference greater than 50 Ω is sufficient to decide whether to visit a cancer center for further investigations. In this case, the lowest resistance value (RR or RL) can provide information on the breast affected by the cancer (Right or left). The idea is to use a designed bio impedance device to early detect breast cancer. A low frequency current is injected to each breast to measure the extracellular resistances. The resistances of the two breasts are then measured and if there is a significant difference warning is displayed. The performance was tested on a set of reference resistors and the validation was done in-vitro on (Na+Cl-) solutions and in-vivo on a group of forty volunteer women.

Results: The results confirm that electrical conductivity of an ionic solution is proportional to its concentration. The concentration and the resistance are strongly correlated (correlation coefficient of 0.97). The accuracy and the repeatability of the measures were satisfactory. Early detection means that we can detect small extracellular concentrations variations into the breast (from 0.6 g/l). In-vivo measurements made it possible to set the threshold at 50 Ohm. If the difference between the two measured breasts resistances is greater than this threshold, we advise the patient to consult a doctor promptly.

Conclusion: The difference between measured resistances of the right and left breast is a pertinent parameter to early detect the presence of a cancer. The lowest resistance value (RR or RL) can provide information on the breast affected by the cancer (Right or left). Various improvements in the system are possible but already the results are encouraging. In the future, this system could be integrated into a bra. In order to improve our work, we will first carry out a measurement campaign on subjects suffering from breast cancer as well as on normal subjects. This measurement campaign will help us to improve our system and choose the best threshold. Then, we will increase the number of electrodes to accurately locate the tumor in the affected breast and to create an image that will be displayed on the smartphone. Tests on digital phantoms are promising. Future work will allow us to complete this ambitious project. This will allow having a smart mammograph by the electrical bio impedance method.

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Biography

Sofiene Mansouri was born in Ain Drahem Village, TUNISIA in 1967. He becomes an engineer in electronics engineering from University Mentouri of Constantine, Algeria and M.S. degrees in biomedical engineering from the University of Technology of Compiegne, France, in 1991 and the Ph.D. degree in electronics from AL-Manar University, Tunis, Tunisia, in 2011. From 2005 to 2011, he was a teaching assistant in biophysics and biomedical engineering Higher Institute of Medical Technologies of Tunis – ISTMT, Tunisia. From 2011 to 2018, he has been an Assistant Professor. Since 2018 he becomes assistant professor with College of medical applied sciences, Prince Sattam bin Abdelaziz University, Saudi Arabia. He is the author of one book, and coauthor of three books, more than 30 articles. Member of the research laboratory in biophysics and medical technologies.

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