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Dual-Direction Optical Measurement Instrument for Assisting X-Ray Mammography

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This study aims at developing an optical measurement instrument to implement a diffuse optical imaging system that is incorporated with the X-ray mammogram for the purpose of obtaining functional images for breast tumor detection. In this paper, a dual-direction scanning device to project illuminated near infrared (NIR) light with a multiple-channel switching for both sources and detectors was designed and constructed. The device operates to compress breastlike phantoms by two compression plates to reduce the distance between sources and detectors for enhancing the signal to noise ratio (SNR) of measurements and obtaining more reliable data. A dual-direction projection scheme was employed to obtain double information that can benefit image reconstruction. Besides, we also implemented an improved image reconstruction algorithm for a dual-modality imaging scheme by combining the functional images of diffuse optical tomography (DOT) with the structure information of X-ray mammograms. The enhanced computation scheme was validated by using designated cases including various size, contrast, and location of inclusions to background. As a comparison, both simulation and experiments were performed to reconstruct functional optical-coefficient images. A mean square error (MSE) was used for the quantitative evaluation on all reconstruction images.

Design and Implementation of Noncontact Measurement Device for Irregular Dental Osseointegration Detection

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The dental implantation has been a popular treatment for edentulous and partially dentate patients. To assess osseointegration and discriminate bone defects effectively is demanding for obtaining successful dental implantation. This study aims at developing noncontact a detection technique to measure the severity as well as to locate the orientation of imperfection around bone-implant interface based on resonance frequency analysis (RFA). To justify the effectiveness, both in vitro (artificial bone defects) and in vivo (animal tests) models were performed. A prototype design of an integrated excitation and detection transducer was proposed.

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