



Contribution ID: 117

Type: Oral

## Molecular Breast Imaging system with dual asymmetric detection heads for early breast cancer diagnosis

Thursday 11 July 2019 14:40 (15 minutes)

### ABSTRACT

**Introduction:** Breast cancer is the most common cancer in women. Early detection of breast cancer is a crucial aspect for an effective therapy. Mammography (MMG) is the most used technique for screening, able to identify small-size tumours at the early stage; nevertheless MMG showed reduced performance in case of dense breast. Magnetic Resonance Imaging, Ultrasound and Molecular Breast Imaging (MBI) techniques have been proposed as complementary to MMG. MBI, based on the use of radionuclides and gamma camera, provides functional, specific informations, particularly appropriate to dense breast [1]. It may represent a promising support to mammographic screening, thanks to its potential better sensitivity and specificity.

**Materials & Methods:** In order to maximize the Signal to Noise Ratio (SNR) and spatial resolution in a MBI image, a new compact system (figure 1), consisting of a two asymmetric (different geometries and collimations) detectors, has been developed [2]. The two detector heads face each other in anti-parallel viewing direction, either mildly compressing the breast between them and allowing spot compression, to increase efficiency and SNR, or performing Limited-Angle Tomography (LAT).

**Figure 1.** The MBI prototype. Spot-compression (A): PMMA breast-phantom (C, inside tumoral lesions) is resting on the big detectors (LH) and the small one (SH) points the lesion moving on the phantom. LAT (B): MBI system is vertically arranged, the LH and phantom are fixed and the SH rotates around them over an arc. A full scale prototype based on matrices of Position Sensitive Photo-Multiplier Tube (PSPMT), coupled to segmented NaI(Tl) scintillators with parallel and pin holes optics has been constructed to test different design solutions, and evaluate the expected performances. Monte Carlo (MC) simulations using the GATE (Geant4 based) framework have been performed to evaluate the best detector configuration, in terms of sensitivity and spatial resolution, and to evaluate data and image processing solutions; the detectors provide somehow complementary planar images that shall be properly combined (fused) to get enhanced, diagnostic information with high specificity and sensitivity. A dedicated breast-phantom (figure 1.C) simulating a woman breast, with up to four, moveable, spherical tumours of different sizes, was used.

**Results and Outlook:** Preliminary outcomes on lesion detectability shows approximative 5 mm diameter as lower limit, confirmed by MC. Good correspondence of reconstructed and real tumor depth was found in LAT modality: trade off between larger span and number of view, clinical session time and complexity need to be evaluated. The analysis of simulated and real data is ongoing with the aim to optimally exploit the MBI images in the different procedures and eventually combine them to the mammographic/tomographic outcomes. In parallel, the migration from PSPMTs to segmented Silicon PhotoMultiplier has recently started. After a description of the system, we will present the results of the performed measurements, in different modalities, including comparison with MC simulations and the LAT, at different lesions positions and with a diagnostic range of uptakes. Status of the analysis of the optimal MBI and mammographic image fusion as well migration to SiPM will be also reported.

### REFERENCES

- [1] C. Hruska et al., Medical Physics, June 2012, 39(3466-3483)
- [2] Garibaldi F. et al., Nuclear Instruments and Methods in Physics Res. A, May 2010, 617 (227–229)
- [3] Marcucci A. et al., <https://arxiv.org/abs/1810.12820>, Pre-print, October 2018

**Authors:** POMA, Gaetano Elio (INFN - National Institute for Nuclear Physics); CISBANI, Evaristo (INFN Rome Gruppo Sanità); GARIBALDI, Franco (Sezione Sanita(ISS)); Mr GIULIANI, Fausto (INFN Rome Gruppo Sanità); Dr INSERO, Teresa (Ospedale Pediatrico "Bambin Gesù" Roma); Mr LUCENTINI, Maurizio (INFN Rome Gruppo Sanità); Dr MARCUCCI, Adriana (Aeronautica Militare Italiana); MUSICO, Paolo (INFN e Università Genova (IT)); Prof. NUYTS, Johan (KU Leuven - Nuclear Medicine & Molecular Imaging Unit); Mr SANTAVENERE, Fabio (INFN Rome Gruppo Sanità); SUTERA, concetta (INFN)

**Presenter:** POMA, Gaetano Elio (INFN - National Institute for Nuclear Physics)

**Session Classification:** Software, chair: Daniele Passeri

**Track Classification:** general