Breast Cancer diagnosis study along with the introduction of new detection technology

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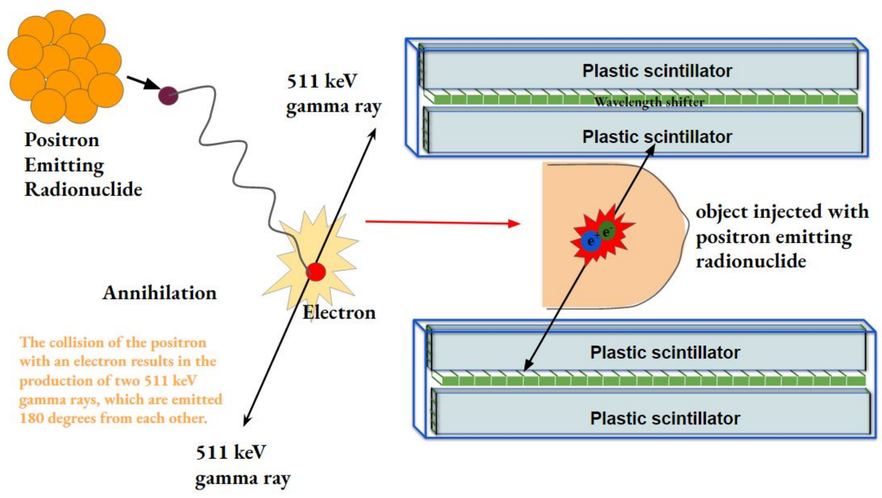
Introduction

- In both developing and developed countries, breast cancer is the top cause of mortality among women.
- Medical imaging plays an important role for breast cancer screening, for classifying and examining indistinct breast abnormalities, as well as for defining the extent of breast tumors [1].
- Positron Emission Mammography is one of the most widely used imaging modalities today (PEM).
- The goal of the J-PET group is to develop, build, and test the J-PEM (Jagiellonian Positron Emission Tomography), which is based on a novel concept using plastic scintillators[2,3,4,5] and a wavelength shifter (WLS) [6,7].



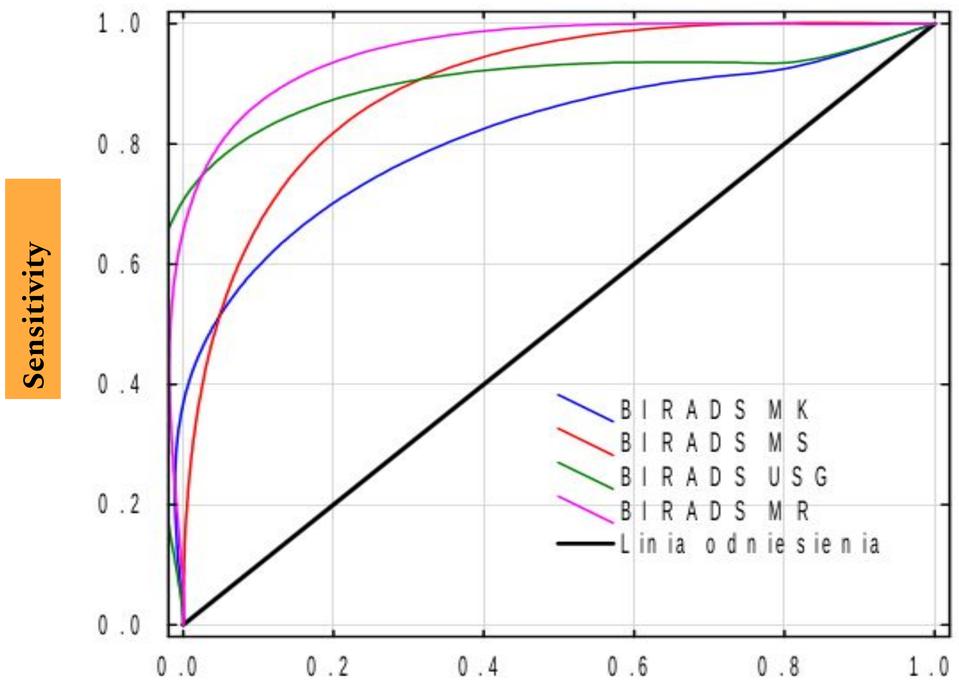
Hospital Data analysis

The analysis included 131 lesions. All patients underwent mammography and ultrasonography examinations. The cases pertained to 114 patients, among whom 98 had one lesion, 14 had two lesions and one patient had three lesions detected. The lesions were cancers in 92 cases (70%) and the remaining 39 cases (30%) appeared to be benign. The results of the diagnostic test based on BI RADS are presented below, including the assumption that the value >=4 is interpreted as malignant while BI RADS<4 is benign.

Table 1: Comparison between the cM, sM, US and MRI

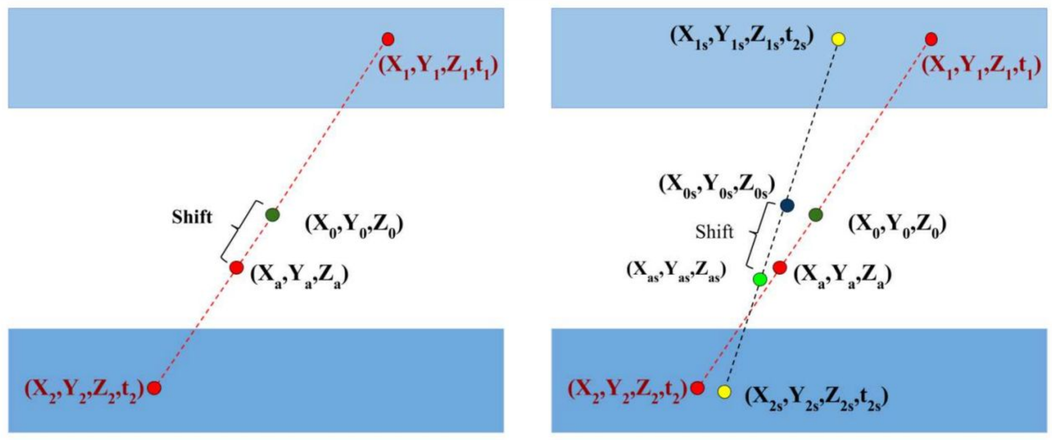
Specification	cM	sM	US	MR
Sensitivity	91.3%	100.0%	93.5%	100.0%
Specificity	28.2%	25.6%	23.1%	20.5%
ACC	72.5%	77.9%	72.5%	76.3%
PPV	75.0%	76.0%	74.1%	74.8%
NPV	57.9%	100.0%	60.0%	100.0%

ROC chart comparison

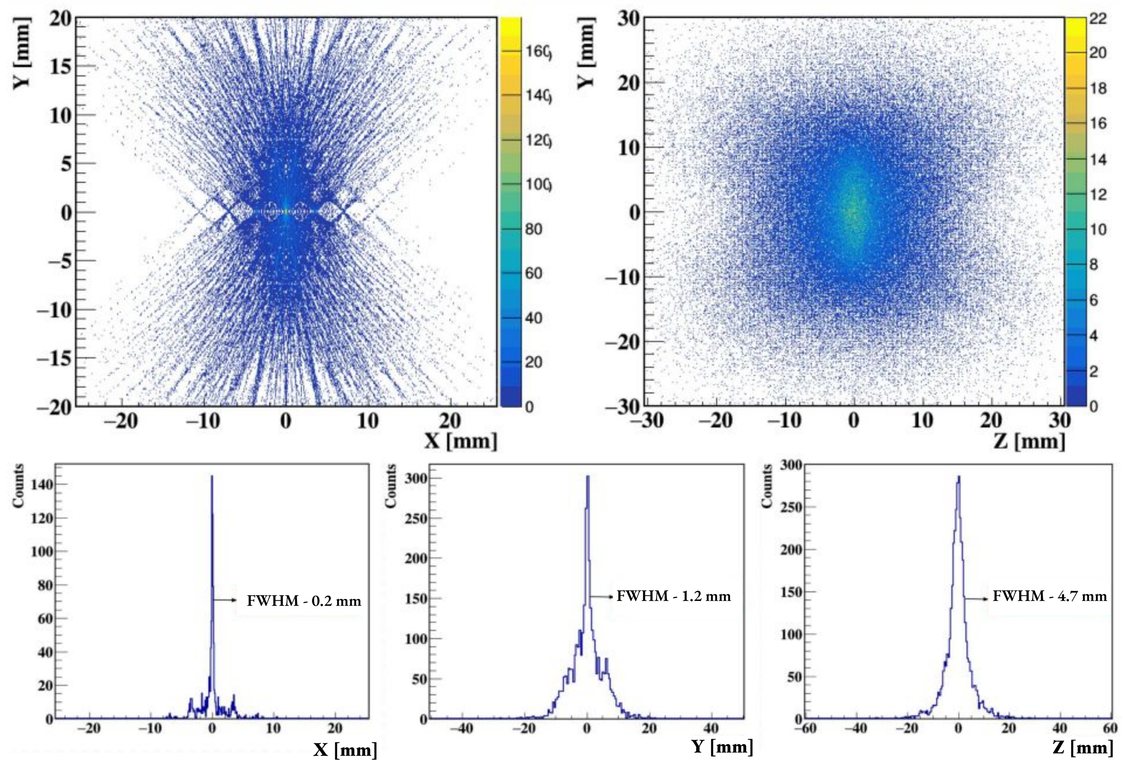


The results of examinations MS, US and MRI obtained on the ROC basis do not statistically differ, while the difference between cM examination and the other show that cM is less effective in cancer detection.

Simulation Results



The pictorial representation of estimation of annihilation point, where X_0 is the vector representing the middle of LOR, X_a is the annihilation point vector calculated. The (X_i, Y_i, Z_i, t_i) is the hit position and time of interaction of back to back gamma. Right: The X_s denotes interaction points after applying smearing simulating experimental resolution.



Top plots show the distribution of annihilation point in the XY and the ZY plane. Bottom plots indicate the projection of X, Y, and Z, performed for the cross section including the highest counting bin

Conclusion

1) There has been a lot of efforts made for detection and diagnosis the breast cancer in its early stage.
2) The analysis of the hospital data was done. Which shows that the MRI has the highest sensitivity but the lowest specificity out of cM, sM and USG.
3) Simulations results shows that PSF for X, Y, and Z are 0.2 mm, 1.2 mm, and 4.7 mm respectively are achievable.
4) We have constructed the J-PEM using the plastic scintillator and wavelength Shifters. First prototype is ready for the measurement and is under the stage of analysis.

References

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Acknowledgements:
The authors acknowledge support by the TEAM POIR.04.04.00-00-4204/17 program, the NCN grant no. 2021/42/A/ST2/00423 and the SciMat and qLife Priority Research Areas budget under the program Excellence Initiative - Research University at the Jagiellonian University.