

**Doctoral School of Information and Biomedical Technologies Polish Academy of Sciences, TIB PAN**

**Subject:**

*AI-based, recognition and quantification methods of tumor-infiltrating lymphocyte evaluation in the breast cancer tumor microenvironment based on multicenter standardized stained tissue section images to verify its role as a prognostic factor of relapse.*

**Supervisors, contact, place of research**

Dr. hab. Anna Korzyńska, prof. IBIB PAN ([akorzynska@ibib.waw.pl](mailto:akorzynska@ibib.waw.pl), phone. 226597030 ext. 224, room 123)

and prof dr hab. Dorota Pijanowska ([dpijanowska@ibib.waw.pl](mailto:dpijanowska@ibib.waw.pl), phone 226597030 ext.141)

Nalecz Institute of Biocybernetics and Biomedical Engineering PAS, ul. Trojdena 4, 02-109 Warsaw, Laboratory of Processing and Analysis of Microscopies Images (PiAOM) and Laboratory of Biosensors and Analytical Microsystems (PBMiA).

**Project Description**

The project intends to use the transformative potential of Artificial Intelligence (AI) in improving and understanding health and medicine research, particularly in the breast cancer (BC) domain according to the multidisciplinary and multicenter project BosomShield (BS).

The main objective of the project part developed in Nalecz Institute of Biocybernetics and Biomedical Engineering PAS is to develop (semi-)automated methods for the recognition and quantification of tumor infiltrating lymphocytes (TILs) in the BC tumor microenvironment. The presence of TILs has been recognized as a prognostic factor of relapse in some types of BC. The obtained results will be used to examine the quantitative description of various types of lymphocytes in a stoma area in triple-negative patients with BC to confirm or deny role of particular type of lymphocyte as a prognostic factor of relapse.

At first, the studied methods should be able to imitate the current way TILs manual evaluation guidelines [1, 2], based on the evaluation of the percentage of an area of TILs to the area of stroma. Such evaluation is the only way possible to be done manually, but when using digital slides, further quantitative variables could be identified that might provide some additional information (e.g. number or density of the TILs).

The investigation will be done using stained tissue sections from biopsies of patients in the form of anonymized Whole Slide Images (WSI) - large-scale digital images of glass slides coming from cooperating hospitals.

The hematoxylin-eosin (H&E) stained samples are the main target to localize TILs but lymphocyte-specific markers using immunohistochemistry (ICH) will be also investigated if it will be needed. The investigation will start from semi-automated and then towards the automated assessment of TIL using H&E or H&E supported by ICH.

The proposed method and prepared software will be used by a cooperating group of researchers to find correlations of quantitative description of TIL pattern in WSI with other features collected from the radiological images proposed by cooperators. To obtain suitable results: - of segmentation and classification methods involved in TILs investigation and - of the examination of the correlations between various AI-generated features, physician-proposed features and various clinical features, for example, the presence of the relapse the method of the suppression of color variability in digitalized by various WSI scanners images will be investigated and proposed (as research deal with multicenter data).

Finally, the proposed methods and prepared software will be a part of a comprehensive CAD system based on radiologic- and pathologic- image biomarkers for diagnosis and relapse prognosis of BC developed in the BS project.

Financing and rules for carrying out the doctoral student's tasks are consistent with the project BS nr 10107322 which is funded from the European Union's Horizon Europe Programme under the funding scheme of "HORIZON-TMA-MSCA-DN HORIZON TMA MSCA Doctoral Networks (DN)".

### **Bibliography**

1. Mohamed Amgad et al. "Report on computational assessment of Tumor Infiltrating Lymphocytes from the International Immuno-Oncology Biomarker Working Group" *npj Breast Cancer* (2020) 6:16; <https://doi.org/10.1038/s41523-020-0154-2>,
2. WHO Classification of Tumours Editorial Board "WHO classification of Tumours – 5<sup>th</sup> Edition, Breast Tumours" World Health Organization, December 2018

### **REQUIREMENTS FOR CANDIDATES:**

1. MSc in Biomedical Engineering or Computer Science;
2. Experience in AI methods applied to breast cancer investigation based on pathological images of tissue slides;
3. Knowledge of research and statistical methods;
4. Good reading and writing skills in English;
5. Authorship of journal papers or conference presentation or posters.

According to BS project assumptions the candidate must not have resided or carried out his/her main activity (work, studies, etc.) in the country of the host organization for more than 12 months in the 3 years immediately prior to the deadline for submission of proposals (a relaxed rule for Career restarting and Reintegration) what in this situation means between 2020-2022.

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