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

Research domain: Informatyka Techniczna i Telekomunikacja

Topic: 1.4 Uczenie maszynowe – zagadnienia specjalne

Modern machine learning methods in medical imaging

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Scope

Medical imaging is a very important field of practical research in modern medicine. Properly and relatively early diagnosed disease allows in many cases to completely cure the patient or to significantly reduce the often chronic complications of untreated ailment. A very important aspect of correctly performed diagnostics is the quality of diagnostic images and the possibility of early recognition of pathologies visible on ultrasound or X-ray images of examined organs and tissues in the human body. Computed tomography, magnetic resonance imaging or positron emission tomography - PET (positron emission tomography) are known invasive methods that can negatively affect the patient's health. In addition, they often require manual calibration of the device parameters. Non-invasive methods are more secure and effective, but they involve the processing of large data sets saved in the DICOM format.

Machine Learning (ML) methods are successfully applied as binary classifiers of medical images. The problems that arise in the implementation of these methods are a multitude of parameters defining the symptoms of diseases and the characteristics of organs and tissues in the human body. In such cases it necessary to train many models for specific areas of the body. Classification and learning processes require significant computing power or intelligent scalable tools for the extraction of the features of images relevant to the particular disease. The use of ML methods in imaging diagnostics as binary classifiers is an additional limitation. Identification of the sick and healthy patients is not enough. It is also necessary to determine e.g. the phase of the disease, which will allow for a proper diagnosis and selection of the appropriate treatment method.

The aim of the research is to develop, implement and pre-validate new complex innovative tools based on ML methods, which will be effective in multi-class and multi-label classification of medical images. The implementation of the planned research tasks will additionally include a comprehensive comparative analysis of the developed classifiers with a hierarchical model in which the binary classifier correlates with the local multi-label classifier implemented within each of the two classes created. The research will be conducted in cooperation (consultations) from the Maria Skłodowska-Curie Oncology Clinic in Warsaw, which is the important research partner of NASK in recent years.

Requested skills:

- MSc degree in computer sciences telecommunication or similar discipline,
- Backgrounds in image processing and machine learning,
- Advanced practical knowledge of C/C++, Python, Java, Matlab
- Advanced Level in English (speaking and writting).

References

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