

The aim of the project is to determine *in vivo*, physical and structural properties of the cancerous tissue, using data collected by ultrasonic scanner with the option of recording RF signals (Radio Frequency). In particular, we are interested in the tissue of breast cancer, which is the most commonly diagnosed cancer and the second cause of cancer death of Polish women. Currently, already almost a quarter of cancer diagnoses among Polish women is breast cancer. Close to 70 thousand people were diagnosed with this cancer in the last 5 years. Every year there are more than 16.5 thousand of new cases, and in the next 10 years the number of women who become sick every year, will grow and exceed 20 thousands per year. Medical objective of the project is to provide a doctor who performs breast examination additional objective information about the characteristic features of breast tumor.

The study will use analysis of the ultrasonic wave scattered backward in the tissue to determine the local properties of the interesting areas of tissue. An additional scientific challenge is the answer to the question, which features and morphological elements of neoplastic tissue give the main contribution to the received signal and how important is their role in neoplasia. Answering these questions will help in the construction of new ultrasonic biomarkers of neoplasia. The new biomarkers will operate on three levels of the tumor; at the cellular and microvessels level, at the level of groups of cells and microvessels aggregations, and the level of the stroma and micro-calcifications. Also new and important idea is to isolate two areas in tumor lesions, the area of diffuse scattering of ultrasound and area where the waves are reflected. The properties of these areas will be investigated by different methods and the results will bring complementary information about the morphological differences of tissue "seen" by ultrasound. Biomarkers will be determined separately in each of these areas, according to the assumptions used in the model of biomarker. We will assess the suitability of determined biomarkers to distinguish between malignant and benign breast lesions and to evaluate their degree of malignancy.

We expect that the results of the project will support the doctor's diagnosis so that it allows for differentiation of benign and malignant breast lesions without the use of invasive diagnostic methods. The results of the project will help to explore deeper the interaction of ultrasound with the structure of soft tissue and the formation of the signals used for medical ultrasound imaging. Knowledge of the physics of image formation and simulation results will translate into better interpretation of ultrasound images and will create a basis for obtaining more complex information on cellular tissue structure. Summarizing, the project can significantly increase chances of survival of patients with breast cancer.