The goal of the inPHASE project is to use novel inference algorithms (based on deep learning and Bayesian methods) to retrieve the measurand encoded in the intensity distribution of the fringe pattern recorded in Quantitative Phase Imaging techniques (i.e., interferometry, holographic microscopy, moiré techniques and fringe projection profilometry). These are one of the most accurate techniques for measuring objects at the nano-, micro- and macro-scale and have the great advantage of being precise and non-contact. Due to the fact that in quantitative phase imaging methods the measurand is encoded in the registered intensity distribution (the phase of the registered fringe pattern), they additionally require a special phase demodulation method, which accuracy directly affects the accuracy of the performed measurement. The research and improvement the fringe pattern analysis algorithms (decoding the information about measurand) is an extremely important issue which is the subject of active research work of many international scientific groups. When deciding to undertake the research subject related to the development of phase estimation numerical algorithms, it has been noted that in the case of classical methods, although each of those methods has a specific range of applications, there is still lack of one universal solution, which would be advised to use for all types of fringe patterns. Additionally, in the case of novel methods based on neural networks, they are dedicated to specific measurement systems and generally ensure accurate results only if the analyzed fringe pattern is similar to the data from the training dataset. The defined gap in the state-of-the-art is going to be filled by inference algorithms, universal and independent from? the fringe pattern origin. The inPHASE project is going to use outstanding computational possibilities of versatile convolutional neural networks applied together with a novel approach to the definition of training dataset based on the expertise of an interferometric community and an improvement of training capabilities. As a result of collaboration between principal investigator Maria Cywińska and project scientific supervisor Dr Maciej Wielgus from the Black Hole Initiative at Harvard University, the problem of phase function estimation in optical interferometry will be solved using a dynamic nested sampling algorithm already successfully implemented for radio interferometry (e.g., by Dr Wielgus team). Many concepts from optical interferometry easily translate to radio interferometry, as the underlying physical phenomena are essentially the same (wave interference, optical waves in quantitative phase imaging and mainly radio waves in astronomy). The final verification of the implemented algorithms will be carried out based on experimental data received from the inPHASE project partners (national: the Institute of Micromechanics and Photonics, Warsaw University of Technology, and international: Arctic University of Norway, University of Valencia, Nanjing University of Science and Technology and University of Munster). The numerical algorithms developed within the inPHASE project will find applications in many fields of science, e.g.,in biomedicine for the analysis of biological cells, in optics for measuring optical elements, in physics of fluids research (analysis of droplet shape), in experimental mechanics for the analysis of deformations or vibrations of microsystems, 3D shape measurements for cultural heritage etc. (Fig. 1). All developed techniques will be publicly released to increase the project impact.

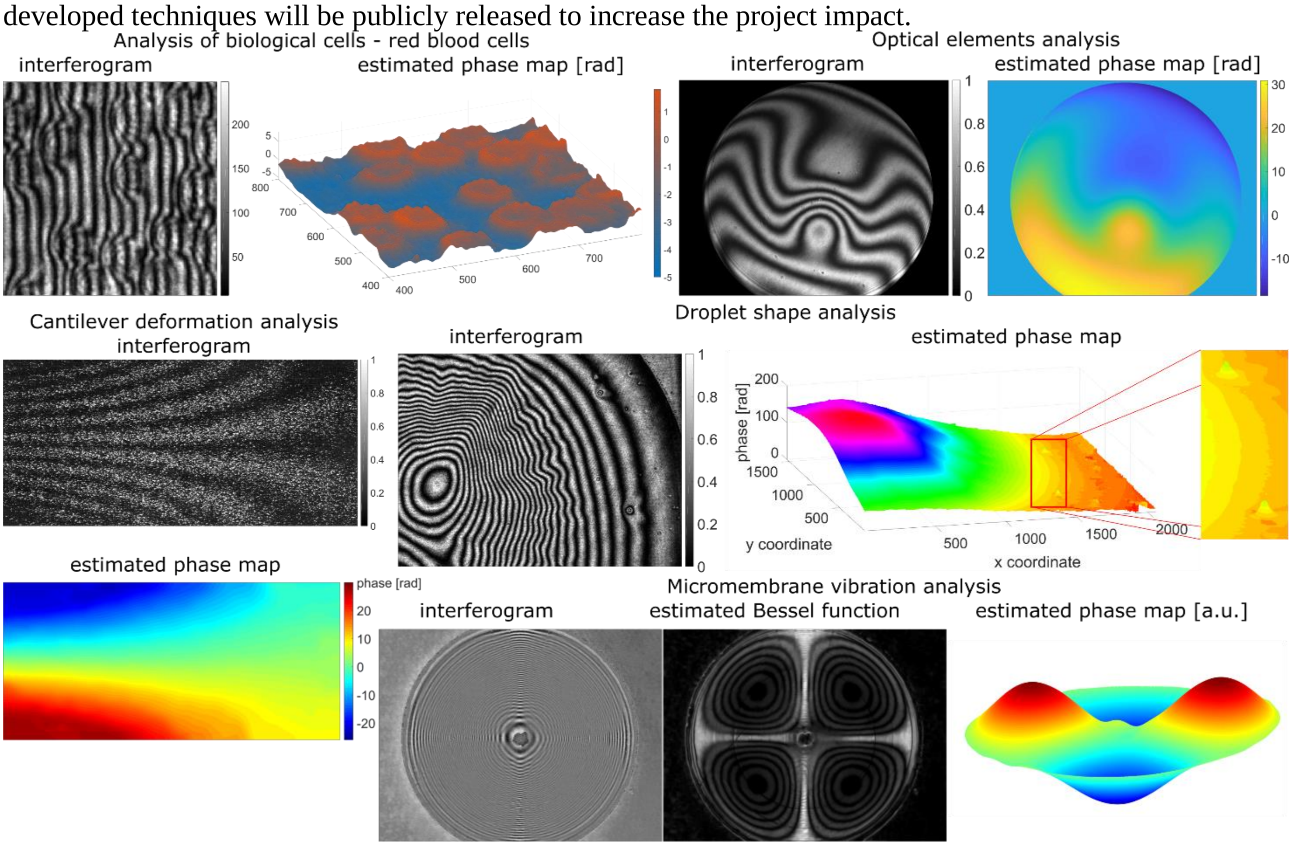

Fig. 1. Exemplfying results of fringe pattern based measurements.