Reasons for choosing the research topic. At the end of the 20th century, the medical community began to move from conventional "open" surgeries to minimally invasive procedures. The philosophy behind this procedures is to access the organs or tissues of interest through natural holes or small incisions in the body. Since direct visualization of the tissues or organs of interest is no longer possible, it is necessary to use small diameter endoscopes in order to obtain visual feedback. The approach proposed in the project is based on understanding the technological limitations present in the earlier endoscopic systems and our own technological limitations. We use technology that allows for designing and fabricating imaging bundles (IB) dedicated for the needs of a particular endoscopic system. This innovative approach will improve the quality of endoscopic systems that are currently available on market.

Objectives. The aim of the project is to develop and test optical properties of endoscopic systems based on ultra-high-density IB for visible and near-infrared range of wavelength. In particular, we will focus on the fabrication of an IB with the smallest possible size of a single core and the shortest possible distance between adjacent cores. The project will investigate both the technological limitations of the process of drawing IB structures, such as diffusion and repeatability of the obtained diameters, as well as the controlled change of shapes of individual cores. The impact of these limitations and optimization process on the crosstalk between the individual cores will also be determined. Optimal IB structures will be designed based on computer simulations to ensure the highest possible spatial resolution. The finished IB will be used to build various endoscopic systems to test the imaging and lighting capabilities of the bundles in particular in optical coherent tomography (OCT) systems by using coherent lighting.

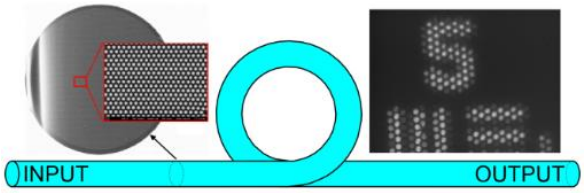

Fig. 1. Imaging bundle.

Expected results. We expect that our approach based on a complete technological process (from design geometrical optimized structure, glass melting and fiber drawing to building the final setups) is much more effective than existing approaches. Designing a dedicated IB and focusing on its imaging properties and/or its accurate illumination of the sample will significantly improve the quality of the endoscopic system. Therefore, the results of the project, when applied in practice, will lead to the design of innovative and/or unprecedentedly accurate endoscopic devices with a wide range of applications in both basic and fully applied research. In this way, the results of the project will be translated into applications with a high scientific impact (biological sciences) and a high social impact (medicine). First of all, we plan to use the acquired knowledge and technology, as well as the fabricated imaging bundles, to improve experimental systems operating in the research institutions collaborating with us in Poland (Institute of Experimental Biology named after M. Nencki, Polish Academy of Sciences, M. Mossakowski Institute of Experimental and Clinical Medicine, Polish Academy of Sciences). Patent protection of the developed solutions is also planned.