1. Research project objectives/ Research hypothesis.

   The aim of the research is to develop a new type of numerical imaging element with an extended depth of focus and nonlinear distribution of light intensity along focal segment giving equal image quality for the every focal segments.
   As a result of these studies we will design new type of imaging optical elements as a modification of an existing Light Sword Lens element.
   This element is a lens which optical power increases with the polar angle.

   Numerical investigations and experiments confirmed the assumption that the element may be used to illustrate the extended depth of focus - close distances (high values of defocus) and for long (small values of defocus). The study noticed that the LSL provides a very good quality imaging for close distances (up to 1m). For further distances imaging quality is worse. In the case of long distance image quality is slightly degraded, which may cause a degree of imperfection. The aim of the planned research will be to develop modification of LSL type element, using which the quality of imaging for each imaging distance will be the same.

2. Research project methodology.

   The applicant in previous studies surrendered the simulations of the LSL element (Light Sword Lens). Imaging using this element allows to obtain high-contrast, and allows to increase the depth of focus without changing the size of the element aperture. Using the LSL we can improve the quality of the imaging system in real time.

   The first stage of the study will consist on testing elements such as LSL with different phase transmittance. The applicant will seek to obtain the LSL type elements with different phase distributions and to compare the results of imaging using these elements. In all the cases studied are identified and examined summarizes the MTF (Modulation Transfer Function) and PSF (Point Spread Function). It will also be performed using imaging simulation designed elements. Quality imaging will be defined by specifying numerical coefficients of image quality (average standard deviation and correlation). Based on these results it will be possible to determined when the image is recognizable.

   After modeling and testing by computer simulations the best element will be planned to carry out experimental studies. The results of the experiments are intended to be basis for the execution of the LSL optical element, enabling to improve imaging quality as much as possible.

3. Expected impact of the research project on the development of science, civilization and society.

   The positive results of this studies will conclude that it is possible to modify the structure of the Light Sword Lens in such way that the imaging quality using this element will be the best (based on the calculated quality parameters).
   The long-term effect of this project can be a numerical development a new type of corrective element with increasing efficiency of view in the daily functioning of the presbyopic person. The planned range of presbyopia correction with such element will be possible in the range of defocus from 0 to 4D.