Measurements of form deviations of 3D elements can be conducted with the use of various strategies, differing in a number and distribution of sampling points located on an investigated surface. Low number of sampling points or measured sections can lead to the situation that some surface irregularities are not detected by a measuring system. An application of higher density of sampling points, in turn, results in significant lengthening of measurement time, which is undesirable, if one takes into account requirements of modern manufacturing processes.

This is the reason why one of the main research objectives of this project is to develop a novel, adaptive measurement strategy.

Proposed adaptive strategy consists of two stages: a preliminary measurement and additional measurements. During the preliminary measurement an investigated area is scanned along preselected trajectory. In this project authors propose to apply three strategies of preliminary scanning: along the spiral trace, in preselected cross-sections and in preselected longitudinal sections. Let us assume that we conduct preliminary scanning along the spiral trace. If measurement results show that there is significant change of sensor readings in a certain fragment of an investigated surface, then we conduct additional measurements in the cross-section and in the longitudinal section that go across the area where the change of sensor readings occurred. If we apply preliminary scanning in cross-sections or in longitudinal sections, then the whole measurement procedure can be defined as follows:

- we conduct preliminary measurements in a few preselected cross/longitudinal sections of the workpiece,
- we study coincidence between measured profiles, for example by calculation of a correlation coefficient between them,
- if the correlation coefficient is lower than presumed/threshold value then we conduct additional measurements in higher number of sections.

Application of the new strategy will allow accurate investigating local irregularities of the surface along with significant reduction of measurement time.

Within the framework of proposed project it is planned to develop a mathematical model of the adaptive strategy for 3D measurements of such elements as: cylinders, spheres and elements whose shapes are untypical or irregular (for example rotary elements whose diameter is not constant). Developed model, in order to allow accurate calculating of form deviations, should respect such problems as: correct calculation of a reference feature, filtering of measurement data and non-uniform sampling. On the basis of formulated equations computer procedures will be developed to allow qualitative (visual) and quantitative (with the use of suitable parameters) evaluation of form deviations of measured workpiece.

Within the framework of the project it is planned to compare results of measurements of form deviations obtained with the use of developed adaptive strategy with ones that were obtained with the use of point strategy, which is typical for coordinate metrology.

Proposed adaptive strategy is novel, and it has not been discussed nor described in the scientific literature so far. Moreover, even leading manufacturers of modern metrological equipment do not offer similar options in software packages of their measuring instruments. Proposed strategy changes existing approach to measurements. So far measurement strategy has been unchangeable and it has been defined by a user before the measurement. Adaptive strategy allows users to fit number and location of sampling points to an investigated surface. It permits achieving high measurement accuracy and reduction of measurement time when comparing it to strategies that are currently applied. Additionally, authors propose to apply the new strategy to 3D measurements of elements, whose shape is untypical or irregular. Problems of measurements of form deviations of such elements has neither been well recognized nor discussed in the international scientific literature.

Within the framework of the project it is planned to use developed procedures to process measurement data obtained from coordinate measuring machines. This way implementation of the project will contribute to expanding measuring abilities of these machines and to increasing an accuracy of measurements of form deviations that are performed with the use of coordinate measuring machines. Since the main objective of the project is formulation of relevant mathematical formulas, it will contribute to development of the basic research.