In Greek mythology creature called chimera was a fire-breathing hybrid composed of the parts of multiple animals. Nowadays the word chimera refers to anything what is composed of inharmonious parts, or anything that seems fantastical.

In the theory of dynamical systems, mathematics is used as a tool, which enables description of many phenomena in: physics, biology or technical sciences. Mathematicians search for patterns and such a spatiotemporal pattern is, without a doubt, a chimera state. Reference to mythical creature suggests a certain coexistence. This coexistence is simultaneous occurrence of two entirely different states: coherence and incoherence.

Chimera state was originally discovered in the network (i.e. the system with many coupled individual nodes) of phase oscillators. Since then it has attracted a great deal of firstly theoretical and next experimental interest. In real life systems, chimera states play significant role in understanding of complex behavior in biological (modular neural networks, the unihemispheric sleep of birds and dolphins, epileptic seizures), engineering (power grids) and social systems.

Lately, it was discovered that chimera states can also be observed in small networks. A state called a weak chimera state was defined as a trajectory, in which at least two oscillators are frequency synchronized and one or more are not. Chimera states of this type have been recently observed in experiments.

The main aim of the research project is to deeply investigate different kinds of both: chimera states and weak chimera states, which might be found in the systems with inertia. In our studies we want to closely examine possible scenarios of creation of chimera states. Our target is to analyze chimera's elementary and complex properties. One of the main objectives of the research is to find parameter regions of occurrence of chimera behavior in both: systems of few coupled oscillators and networks. Another issue, which is very important is multi-headed chimera states and their occurrence. The number of heads of chimera state is the number of incoherent clusters. We would like to correctly interpret and to thoroughly understand described objects. All the results that will be obtained may extend our knowledge on dynamics of nonlinear problems.

In order to accomplish the project aims different numerical algorithms will be applied. Numerical integration allow us to obtain system's trajectory. Continuation of periodic solutions will show how chimera states evolve with varying of parameter values, while the basins of attraction will be used to identify initial conditions for which chimera state is reached. What is more, the Lyapunov exponent analysis will allow to determine the kind of motion of obtained solutions, which can be periodic, quasi-periodic or chaotic.

Weak chimera states and chimera states in dynamical systems are promising and constantly developed. The emergence of self-organized patterns of coherence and incoherence appears to be universal behavior for coupled inertial oscillators. Therefore, the complex investigation of chimera state in such systems may become a breakthrough in understanding the nature of real world coupled elements. Complete examination of this kind of behavior would surely enrich the theory of dynamical systems, which is one of the fastest developing branch of applied mathematics. Not to mention the fact that theory of dynamical systems is applied in nearly every area of science.

Tackling the proposed scientific problem would expand the knowledge about chimera state. We are sure that our investigations will give better understanding of dynamics of coupled inertial oscillators thanks to: mathematical analysis of the models, performing numerical simulations and drawing conclusions from the results. We assume that the generalization of obtained results to larger class of nonlinear system will be possible. We believe that the presented research project is innovatory and its future results may play an important role in development of the science.