Antennas belong to the most fundamental components of wireless communication systems. In the era of widespread electronics miniaturization and ever increasing requirements concerning access to the wireless medium, conventional antenna structures are often unsuitable for operation in modern systems. While compact radiators are of high interest from the point of view of their implementation within mobile terminals, they cannot guarantee sufficiently good performance compared to specifications imposed by the systems implemented in these devices. Traditional trial-and-error-based techniques are unsuitable for handling this problem, thus a comprehensive approach for compact antenna design is required. On the other hand, design techniques based on automated optimization of compact radiator input parameters are infeasible due to unacceptably high numerical cost (related to multiple computer simulations required for finding acceptable design solutions).

The proposed project aims at addressing the abovementioned challenges through explicit miniaturization of antennas sizes while satisfying requirements imposed on their performance characteristics. This goal will be achieved using variable-fidelity computer simulations, as well as fast approximation models constructed based on expensive computer simulations performed in the vicinity of the best design solution. The developed algorithms will be used to assess effects of topological changes implemented in antenna structures on their performance, as well as to design structures with complex performance characteristics. The proposed methods will be also adjusted to allow for their utilization in the design of multi-parameter antennas. Finally, a class of algorithms for direct multi-objective optimization of compact radiators will be developed. They will be important for obtaining comprehensive information on the design trade-offs between antenna dimensions and its performance characteristics.

It is expected that a major contribution of the project to the discipline development will be a set of unique, robust, and efficient techniques for fast design of compact antennas with unconventional performance characteristics. Realization of the project will also lead to categorization of topological modification of compact antennas in the form of a database (along with their effect on structures performance), which will be useful for making decisions related to the selection of the best topological changes from the point of view of obtaining desired antenna functionality (and dimensions). The results of the project will extend the knowledge on computer-aided design techniques. They should be of interest for academia as well as research institutes dealing with modeling and optimization of numerically expensive antennas. Particularly, the results should be of high value for researchers involved in the development of mobile systems and multi-band devices. It is expected that utilization of algorithms and design tools developed in the course of the project will substantially reduce design times of compact antennas (compared to direct optimization of their expensive computational models using conventional techniques).