

## **Goal of the project.**

The theme of this research project is related to the problem of searching graph-like structures, with special attention to several research directions which are interesting from the theoretical and practical point of view. Among the goals of the project are:

- achieving a better understanding of connections between graph searching problems and structural graph theory;
- obtaining algorithmic results in the area of online and distributed computations;
- the analysis of the impact of the amount of information on the possibility of construction of efficient strategies, or more generally, the possibility of designing a more efficient behavior of mobile agents in the lack of complete information on the explored environment;
- improvement of bounds on the number of guards/searchlights in geometric structures.

Among expected outcomes of our research are results of algorithmic nature, i.e., efficient search strategies in investigated theoretical models, and of structural nature, i.e., providing bounds on the investigated parameters and including theoretical connections between searching problems and other optimization problems.

## **Description of the proposed research.**

Within the project we plan to conduct research in several directions. These directions include e.g. searching geometric structures modeled usually with graphs, investigation of non-classical optimization criteria in the context of graph searching and developing selected distributed models.

The distributed computation with mobile agents is currently an extensively studied branch of theoretical computer science, which is due to potential applications and the need of understanding distributed models that go beyond the classical sequential computations. Among specific tasks planned to be investigated in the project we point out the problems of amount of information in graph searching and construction of efficient distributed strategies. The problem of amount of information that is given to a distributed algorithm, and the related question on the impact of this information for the possibility of performing tasks efficiently, lies in the core of this field of research. Our research will focus on the impact of knowledge from the point of view of widely understood graph searching problems.

The amount of information is not the only crucial question in the context of distributed problems. Another interesting research direction is the analysis of classical graph searching models from the point of view of their adaptation to the distributed setting in order to obtain efficient searching algorithms. There exist results indicating that for some graph searching models one does not obtain efficient methods of searching in a distributed way, while other models lead to non-trivial and interesting results in the distributed setting.

## **Research motivation.**

Pursuit-evasion problems find numerous, often surprising, theoretical and practical applications. Among obvious ones, we mention the design of movements of mobile agents (robots) navigating in real terrain. In this context we find a strong motivation for considering geometric structures and distributed models, which reflects the potential practical fact of the lack of complete knowledge on the explored terrain. In other words, an interesting task is design of algorithms which allow mobile robots perform tasks in the environment which is not known to them a priori. Such an approach requires performing in parallel the processes of searching and learning of the environment.

Second strong motivation for analyzing the above-mentioned problems lies at the foundations of the guaranteed graph searching: it turns out that many graph parameters are equivalent to the corresponding optimization parameters in graph searching problems. Examples of such graph parameters include pathwidth, treewidth, bandwidth, cutwidth, edge ranking number, fill-in, graph profile and many others. The development of graph searching theory led to many elegant and deep results on those classical graph parameters.