Dynamic graph algorithms are designed to answer queries about a given graph property (for example, the existence of a path between the query vertices), while the underlying graph is subject to updates, such as inserting or deleting a vertex or an edge. Obviously, the time that a dynamic algorithm needs to adapt its state to an elementary graph change should be considerably smaller than recomputing the required information *from scratch*, using a *static* algorithm run on the updated graph. Dynamic graph algorithms are most often studied per se, but they are also practically significant, since they are applicable to real-life networks, which almost always constantly undergo changes.

For many of the classical graph problems, very efficient dynamic algorithms have been developed. However, many of the state-of-the-art algorithms are randomized, and hence might make mistakes with some small probability. What is more disturbing, many of these randomized algorithms work only if additional, strong assumptions about the adversary (i.e., the entity that chooses the sequence of updates to be performed) are made.

The assumption of so-called *oblivious adversary* is particularly popular. Under this assumption, the sequence of updates to the graph has to be fixed beforehand and not depend on the answers given by the algorithm. This makes a dynamic algorithm requiring this assumption useless in certain scenarios, even when the adversary is not particularly malicious, but simply does not exactly know (possibly by making choices based on the output of the algorithm) how the graph is going to be changed in the future. As one might expect, such situations are in fact not very rare in applications.

Consequently, in recent years there has been observed an increasing effort in the dynamic graph algorithms community to search for deterministic algorithms for the problems for which the only known non-trivial results required strong assumptions about the adversary. Such results have been obtained for a few dynamic graph problems related to connectivity and approximate shortest paths, but only for *undirected* graphs.

The general objective of this research project is to obtain, for certain variants of classical problems for *directed* graphs related to:

- computing reachability information,
- finding distances and shortest paths,

more efficient dynamic algorithms that tolerate adversarial update sequences. Ideally, we are interested in obtaining deterministic algorithms. However, finding randomized algorithms that make either very mild or no assumptions about the adversary is also an important goal of this project.

We hope that our results will significantly contribute to the area of dynamic graph algorithms. We insist that our research is strictly theoretical. However, since algorithms that solve fundamental dynamic graph problems and additionally perform well against adversarial update sequences are important in applications, our results may eventually lead to faster static algorithms for some more sophisticated graph problems.