

The main objective of the research project is to investigate analytical properties of differential equations from a geometric viewpoint. We shall concentrate on integrable system coming from mathematical physics. It turns out that solutions of wide classes of differential equations can be described in terms of geometry, for example by interpreting them as geodesics of a certain metric, or by associating them with differential manifolds with an additional geometric structure. Such a geometric description allows to study differential equations in a way that in many cases gives new, unexpected results that cannot be obtained by classical methods of analysis. In other cases, a significant simplification of previously known proofs can be obtained.

One of the main tasks in the project is to understand the notion of integrability in geometrical terms. The proposed approach may shed a new light on the classical problems.

The techniques exploited in the project include methods of differential geometry and mathematical physics such as parabolic geometry, Penrose's twistor theory and theory of bi-Hamiltonian systems as well as methods of the geometric control theory having origins in the Pontryagin Maximum Principle. The methods will be combined and then generalized in a way that they can be applied in new areas of mathematics.