Abstract

The motivation for research presented in this dissertation was to provide new, efficient tools for analysis of higher order variational problems in General Relativity Theory. A novel version of the theory of the connection on a manifold is presented here as well. In this framework the notion of *higher order curvature tensor* arises in a natural way. Curvature tensor of order $k = 1$ is equivalent to the conventional Riemann tensor. Curvature tensors up to order k are equivalent to the Riemann tensor and its covariant derivatives up to order $k - 1$. The information regarding curvature can be now encoded as a list of independent geometric objects, which is necessary for correct formulation of higher order variational problems and for the proof of their equivalence with the conventional General Relativity Theory. It has been proven here that a gravity theory based on a Lagrangian density, which depends in a nonlinear way upon the entire curvature tensor and also upon its covariant derivatives up to a fixed order n, is equivalent to the standard Einstein theory of a gravitational field, interacting with additional matter fields.