

# Heuristic Algorithms for solution of non-convex optimal control problems with parallelepipedic contingencies

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Algorithms, which are the basis of known program package for solving optimal control problems (OPCs), have a local character. They are used only for search of local extremum. A search of global extremum in OPCs remains one of the most urgent problems of optimization. The approaches to the solution of considered problem are discussed. This approaches helps us to construct the efficient algorithms. We considered two methods, which are used to the search of global extremum of functional in non-linear controlled system of ordinary differential equations.

The problem solution are divided into two stages: "global stage" (it consists in wide scan of variable space) and "local stage" (it is directed to local updating of obtained solution), in the most known approaches to construction of non-convex optimization methods (for example [1]). The combination of different methods on each stage and sequence of changing stage define the specific calculating algorithm.

The method of "curved search" presents simple scheme of successive variation in control space. It uses the quadratic method of integration record and subsidiary controls with projection on the admissible set. The variations of control project in terminal phase space like curved lines covering the set of attainability. To construct one-dimensional space of search two quasi-random subsidiary controls of relay type are used in each iteration of algorithm. New modification of parabolic method is employed for solution of subsidiary problem of global extremum search for univariate function. It allows to take into consideration available data and to make tests in local neighbourhood of record control. The accuracy check of local extremum finding is performed by standard algorithm after given a number of iterations of considered method. The sample combination of method of adjoint gradient and reduced gradient method is used as standard algorithm.

The other approach based on successive use of local algorithms is a tunneling method [1]. They consist of sequence of two phases: the phase of minimization

and tunneling phase with increase tunneling parameter. The sense of tunneling phase is the search of less value point when we have local extremum.

The test's collection of the non-convex nonlinear optimal control problems has been created for testing of efficiency the proposed approaches. The comparison of efficiency of algorithms is performed with convexification methods and the method of random multi-start [2]. The realized computations confirm an efficiency of the proposed algorithms.

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## References

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