AN EVOLUTIONARY ALGORITHM FOR ZERO-ONE NONLINEAR OPTIMIZATION PROBLEMS BASED ON AN OBJECTIVE PENALTY FUNCTION METHOD

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Received November 2010; revised March 2011

Abstract. In many evolutionary algorithms, as fitness functions, penalty functions play an important role. In order to solve zero-one nonlinear optimization problems, a new objective penalty function is defined in this paper and some of its properties for solving integer nonlinear optimization problems are given. Based on the objective penalty function, an algorithm with global convergence for integer nonlinear optimization problems is proposed in theory. As a further application of the objective penalty function, a simple novel evolutionary algorithm is presented for solving zero-one nonlinear optimization problems. Numerical results on several examples show that the proposed evolutionary algorithm seems effective and efficient for some zero-one nonlinear optimization problems.

Keywords: Evolutionary algorithm, Zero-one optimization problems, Objective penalty function, Fitness function

1. Introduction. It is well-known that evolutionary algorithms have been successfully applied to a variety of optimization problems, such as, constrained optimization problems [1], integrate linear programming [2] and mixed-integer bilevel programming problems [3]. Hu pointed out that evolutionary algorithms have many advantages [1]. Although the penalty function method is one of the most common approaches used in many evolutionary algorithms, the main drawback of the penalty function is that it is very difficult to control the penalty parameters which directly affect the efficiency and effectiveness of the algorithms [1]. 0-1 nonlinear programming is an NP-hard problem. To solve such a problem, a new simple evolutionary algorithm is proposed in this paper by introducing a new objective penalty function as a fitness function.

The problem to be considered in this paper is the following inequality constrained optimization problem:

(COP) \quad \min \quad f_0(x)
\quad \text{s.t.} \quad f_i(x) \leq 0, \quad i \in I = \{1, 2, \cdots, m\},

where \( f_i : \mathbb{R}^n \to \mathbb{R}, \ i \in I_0 = \{0, 1, 2, \cdots, m\} \). Its feasible set is denoted by \( X = \{x \in \mathbb{R}^n \mid f_i(x) \leq 0, \ i \in I \} \).