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A CLASS OF INCREASING POSITIVELY HOMOGENEOUS FUNCTIONS FOR WHICH GLOBAL OPTIMIZATION PROBLEM IS NP-HARD

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Abstract. In this paper we focus on one of the elements of monotonic analysis - Increasing Positively Homogeneous functions of degree one or in short IPH functions and show that finding the solution and ϵ-approximation to the solution of the global optimization problem for IPH functions restricted to a unit simplex is an NP-hard.

Keywords. IPH, global optimization, abstract convexity, monotonic analysis.

1 Introduction

It is well known that global optimization (GO) problems are, generally speaking, infeasible. In certain cases, for example, when objective functions and constraints are convex, it is possible to construct a feasible algorithm for solving global optimization problem successfully. Convexity, however, is not a phenomenon to be often expected in the applications. Nonconvex problems frequently arise in many industrial and scientific areas. Therefore, it is only natural to try to replace convexity with some other structure at least for some classes of nonconvex optimization problems to render the global optimization problem feasible. The attempts to carry this out developed into a theory of abstract convexity and the first book on the subject was published in 1976 by A. Rubinov and S. Kutateladze [5].

Monotonic analysis is a branch of abstract convex analysis that uses a special choice of elementary functions. The term monotonic analysis for this theory was introduced in [9].

Monotonicity is exhibited by many functions arising in various areas of mathematics. Thus, many problems of nonconvex optimization encountered in applications can be described in terms of monotonic functions. These problems include multiplicative programming [11], Lipschitz optimization [6], fractional linear programming [10], etc.

A large scope of approximation algorithms have been developed that work quite well for some special classes of monotonic optimization problems. For