Sociedad de Estadística e Investigación Operativa Top (2002) Vol. 10, No. 1, pp. 125–145

## On the Solution of NP-hard Linear Complementarity Problems

## Joaquim J. Júdice\*

Departamento de Matemática, Universidade de Coimbra, Coimbra, Portugal e-mail: judice@dragao.it.uc.pt

Ana M. Faustino and Isabel Martins Ribeiro\*\*

Faculdade de Engenharia, Universidade do Porto. Porto, Portugal e-mail: afausti@fe.up.pt iribeiro@fe.up.pt

## Abstract

In this paper two enumerative algorithms for the Linear Complementarity Problems (LCP) are discussed. These procedures exploit the equivalence of the LCP into a nonconvex quadratic and a bilinear programs. It is shown that these algorithms are efficient for processing NP-hard LCPs associated with reformulations of the Knapsack problem and should be recommended to solve difficult LCPs.

**Key Words:** mathematical programming, complementarity, global optimization, enumerative algorithms.

AMS subject classification: 90C33, 65K10.

## 1 Introduction

The Linear Complementarity Problem (LCP) consists of finding vectors  $z \in \mathbb{R}^n$  and  $w \in \mathbb{R}^n$  such that

$$w = q + Mz$$
  
 $z \ge 0, \quad w \ge 0$   
 $z^T w = 0$ 

for a given matrix  $M \in \mathbb{R}^{n \times n}$  and a vector  $q \in \mathbb{R}^n$ . This problem has originally appeared in the sixties for the solution of bimatrix games and convex quadratic programs. Since then, it has received an increasing interest,

 $<sup>^*</sup>$  Support for this author was provided by Instituto de Telecomunicações and by FCT under grant POCTI/35059/MAT/2000

<sup>\*\*</sup> Support for this author was provided by PRODEP under grant 4/5.3/PRODEP/00

Manuscript received: September 2001. Final version accepted: June 2002.