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A dynamic model to solve the absolute value equations

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Abstract

In this paper, the analytic solution of the absolute value equations (AVE) is investigated. As far as we know, there are some numerical methods to obtain the solution of the AVE. However, there is not a study on exact solution of the AVE. Here, we try to obtain the exact solution of the AVE based on a dynamical system model constructed by the projection function. Finally, the simulation results show the effectiveness and the accuracy of the method.

Keywords: Absolute value equations, Linear complementarity problem, Dynamical system, Globally stable in the sense of Lyapunov, Globally convergent.

1. Introduction

In this paper, we discuss the absolute value equations (AVE) [3, 1, 2] of the following form:

$$Ax - |x| = b, \tag{1}$$

where $A \in \mathbb{R}^{n\times n}$, $b \in \mathbb{R}^n$, $x \in \mathbb{R}^n$, and $|x|$ denotes the absolute values of x. Notice that, the AVE (1) is a non-smooth non-linear equation due to the non-differentiability of absolute value function. The significance of absolute value equation (1) arises from the fact that the general NP-hard linear complementarity problem (LCP) [4, 5, 6], which subsumes many mathematical programming problems, can be formulated as an AVE (1). This implies that, the AVE (1) is NP-hard in its general form [7, 1, 2]. By utilizing this connection with LCPs we are able to give some simple existence results for (1) such as that all singular values of A exceeding 1 implies the existence of a unique solution for any right-hand side b [1]. Wu and Guo [8] discussed the unique solvability of the absolute value equation.

Recently, to efficiently solve the AVE, some numerical methods have been developed [9, 10, 11, 12, 13, 14, 15]. Caccetta et al.[9] gave the smoothing Newton method and also

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