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A Delayed-Projection Neural Networks to solve Bilevel Programming Problems

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Abstract

Projection-type methods are a class of simple methods for solving mathematical programming problems. In this paper we proposed a new neural network model, delayed-projection neural network, to solve bilevel optimization problems. The properties of the neural network are analyzed and the conditions for Lyapunov stability, global convergently are presented. Simulation experiments on numerical examples demonstrated to show the applicability and validity of the network.

Keywords: Bilevel programming problem, Delayed-projection neural network, Lyapunov stability, global convergently
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1 Introduction

Bi-level programming (BLP) is a hierarchical optimization problem in which the constraint region is implicitly determined by another optimization problem. In this paper, we will consider BLP as follows:

$$\begin{aligned} (UP) \quad & \min_{x,y} \ F(x,y) \\ s.t \quad & H(x,y) \leq 0, \\ (LP) \quad & y \in \begin{cases} \min_y \ f(x,y) \\ s.t \quad a \leq x \leq b \\ \qquad c \leq y \leq d \end{cases} . \end{aligned} \tag{1}$$

where $x \in \mathbb{R}^n$, $y \in \mathbb{R}^m$, $F : \mathbb{R}^{n\times m} \to \mathbb{R}^1$, $f : \mathbb{R}^{n\times m} \to \mathbb{R}^1$ and $H : \mathbb{R}^{n\times m} \to \mathbb{R}^1$ are continuous differentiable functions. The term (UP) is called the upper-level problem and (LP) is called the lower-level problem. This problem arises in numerous areas of applications such as resource allocation, nance budget, price control, transaction network. In modern science and technology, real time solutions of optimization problems are desired. However, usual numerical methods may not be efficient in such occasions, specially in large scale problems, because of stringent requirements on computing time. The most important advantages of the neural networks are massively parallel processing and fast convergence. According to these points, in past two decades, applications of neural networks have been

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