Accepted Manuscript

A numerical study of the local monotone polynomial edge detection for the hybrid WENO method

Jingyang Guo, Jae-Hun Jung

PII: S0377-0427(17)30094-8
DOI: http://dx.doi.org/10.1016/j.cam.2017.02.029
Reference: CAM 11031

To appear in: *Journal of Computational and Applied Mathematics*

Received date: 28 April 2016
Revised date: 20 February 2017

Please cite this article as: J. Guo, J.-H. Jung, A numerical study of the local monotone polynomial edge detection for the hybrid WENO method, *Journal of Computational and Applied Mathematics* (2017), http://dx.doi.org/10.1016/j.cam.2017.02.029

A numerical study of the local monotone polynomial edge detection for the hybrid WENO method

Jingyang Guo and Jae-Hun Jung*

Department of Mathematics, State University of New York at Buffalo, Buffalo, NY 14260-2900, USA.

Abstract

The weighted essentially non-oscillatory (WENO) method is a high order numerical method that can handle discontinuous problems efficiently. The hybrid WENO method adopts the WENO reconstruction in the region where the jump discontinuity exists, while other high order reconstruction is adopted in the smooth region. Thus for the hybrid WENO method, the jump location should be identified before the adoption. Various edge detection methods have been developed mostly focusing on finding edges as accurately as possible utilizing as many stencils as possible. However, if the reconstruction in the smooth area is obtained with the fixed and finite number of cells, it would suffice to examine whether the considered stencils need to adopt the WENO reconstruction instead of finding edges in a global manner. In this note, we compare the multiresolution analysis with the local monotone polynomial method for the 5th order hybrid WENO method. The monotone method uses the cell information within the given stencil only to decide whether to adopt the WENO reconstruction or not. In this sense, the local method is optimal. We provide a detailed numerical study and show that the monotone polynomial method is efficient and accurate.

Keywords:
Weighted essentially non-oscillatory method, Edge detection, Monotone polynomial interpolation, Hybrid methods.

1. Introduction

The weighted essentially non-oscillatory (WENO) method [8, 11] is a powerful algorithm for solving partial differential equations (PDEs) whose solution contains local discontinuities. Once the solution becomes discontinuous, the Gibbs phenomenon occurs and the high order approximation to the solution becomes oscillatory. The WENO method reduces the Gibbs oscillations and yields

*Corresponding author
Email address: jguo4@buffalo.edu, jaehun@buffalo.edu (Jingyang Guo and Jae-Hun Jung*)