Available online at www.sciencedirect.com
SCIENCE DIRECT®
Journal of Computational Physics 194 (2004) 632–658
JOURNAL OF COMPUTATIONAL PHYSICS
www.elsevier.com/locate/jcp

Power ENO methods: a fifth-order accurate Weighted Power ENO method

Susana Serna *[,1], Antonio Marquina [1]

Applied Mathematics, University of Valencia, Dr. Moliner, 50 Burjassot 46100, Spain

Received 4 December 2002; received in revised form 24 September 2003; accepted 24 September 2003

Abstract

In this paper we introduce a new class of ENO reconstruction procedures, the Power ENO methods, to design high-order accurate shock capturing methods for hyperbolic conservation laws, based on an extended class of limiters, improving the behavior near discontinuities with respect to the classical ENO methods. Power ENO methods are defined as a correction of classical ENO methods [J. Comput. Phys. 71 (1987) 231], by applying the new limiters on second-order differences or higher. The new class of limiters includes as a particular case the minmod limiter and the harmonic limiter used for the design of the PHM methods [see SIAM J. Sci. Comput. 15 (1994) 892]. The main features of these new ENO methods are the substantially reduced smearing near discontinuities and the good resolution of corners and local extrema. We design a new fifth-order accurate Weighted Power ENO method that improves the behavior of Jiang–Shu WENO5 [J. Comput. Phys. 126 (1996) 202]. We present several one- and two-dimensional numerical experiments for scalar and systems of conservation laws, including linear advections and one- and two-dimensional Riemann problems for the Euler equations of gas dynamics, comparing our methods with the classical and weighted ENO methods, showing the advantages and disadvantages.

AMS: 65M06; 35L65; 76N15

Keywords: Conservation law; ENO; Weighted ENO; Total variation bounded

1. Introduction

In this paper, we shall consider numerical approximations to nonlinear conservation laws of the form:

$$\frac{\partial \mathbf{u}}{\partial t}+\sum_{i=1}^{d}\frac{\partial \mathbf{f}_i(\mathbf{u})}{\partial x_i}=0, \tag{1}$$

* Corresponding author. Tel.: +34-96-354-4358.
E-mail addresses: susana.serna@uv.es (S. Serna), marquina@uv.es (A. Marquina).
[1] Research supported by DGICYT project BFM2001-2814.

0021-9991/$ - see front matter
doi:10.1016/j.jcp.2003.09.017