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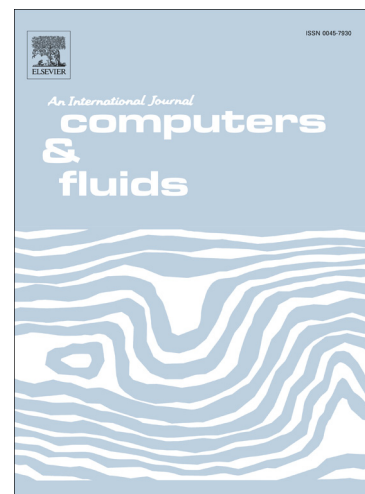
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# A family of hybrid cell-edge and cell-node dissipative compact schemes satisfying geometric conservation law

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## 9 Abstract

10 Growing evidences show that the Symmetrical Conservative Metric Method (SCMM) is essential in preserving  
11 freestream conservation and orders of accuracy for high-order finite difference schemes to simulate flows with  
12 complex geometries. In this paper, a new family of Hybrid cell-edge and cell-node Dissipative Compact  
13 Schemes (HDCSs) has been developed for geometry-complex flows by fulfilling the SCMM as well as by  
14 introducing dissipation according to the concept adopted in the construction of the high-order Dissipative  
15 Compact Schemes (DCSs). The resolution and dissipation properties of HDCSs are investigated by the  
16 Fourier analysis, and the stability property of HDCSs is also investigated by asymptotic stability analysis  
17 and amplification factor analysis. HDCSs are validated by computing several benchmark test cases. The  
18 vortex convection test case demonstrates that the orders of accuracy of the HDCSs are preserved unless the  
19 GCL is satisfied. Although high resolution of HDCSs is observed in the test of acoustic wave scattering of  
20 multiple cylinders, the solutions can be contaminated if the GCL is not satisfied. Moreover, the numerical  
21 solutions of flow past a high lift trapezoidal wing demonstrate the promising ability of the newly developed  
22 HDCSs in solving complex flow problems.

23 *Keywords:* High-order compact scheme, Hybrid cell-edge and cell-node Dissipative Compact Scheme,  
24 Geometric Conservation Law, Dissipative scheme, High lift trapezoidal wing

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## 25 1. Introduction

26 Nowadays, compact high-order finite difference schemes have been widely used for a broad range of  
27 problems with multiple spatial and temporal scales such as turbulence and aeroacoustics [1]. The advantages  
28 of compact schemes using a compact stencil over traditional explicit finite difference schemes are mainly  
29 regarded as the relatively higher order of accuracy and higher resolution [2]. Although much advance has been  
30 achieved in constructing high-order compact schemes, applications of these schemes are still challenged by  
31 complex geometry. When the accurate numerical simulation of a broad spectrum phenomena is performed by

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