Engineering Applications of Computational Fluid Mechanics
Volume 9, Issue 1, 2015, Pages 50-65

Open Access

A numerical investigation of explicit pressure-correction projection methods for incompressible flows (Article)

Hafiz, U.A.[a], Hoda, A.[b], Asrar, W.[a]

View additional authors

[a]Department of Mechanical Engineering, Kulliyah of Engineering, International Islamic University, P. O. Box 10, Kuala Lumpur, Malaysia
[b]Department of Mechanical Engineering, Jubail University College, Jubail, Saudi Arabia

View additional affiliations

Abstract

A numerical investigation is performed on an explicit pressure-correction projection method. The schemes are fully explicit in time in the framework of the finite difference method. They are tested on benchmark cases of a lid-driven cavity flow, flow past a cylinder and flow over a backward facing step. Comparisons of the numerical simulations have been made with benchmark experimental and DNS data. Based on the results obtained, several numerical issues are discussed; namely, the handling of the pressure term, time discretization and spatial discretization of convective and diffusive terms. The fully explicit projection method is also compared with the fully implicit SIMPLE algorithm. It is observed that the SIMPLE algorithm performs better (faster and produces more accurate results) for laminar flows while the projection method works better for unsteady turbulent flows. Although there have been much research performed using the higher-order pressure incremental projection method, this research work is novel because the schemes employed here are fully explicit, developed in the framework of a finite difference method, and applied to turbulent flows using k-- model. The major difficulty and challenges of this research work is to identify the sources of instability for the higher-order pressure incremental projection method scheme. © 2015 The Author(s). Published by Taylor & Francis.

Author keywords

Explicit schemes Finite difference method Incompressible flows Navier-Stokes equations Projection method

ISSN: 19942060
DOI: 10.1080/19942060.2015.1004810
Source Type: Journal
Document Type: Article
Original language: English
Publisher: Taylor and Francis Ltd.

Asrar, W.; Department of Mechanical Engineering, Kulliyah of Engineering, International Islamic University, P. O. Box 10, Kuala Lumpur, Malaysia; email: