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Investigation on finite volume method for solving diffusion equation

M. C. S. Fernando[1] And M. K. Abeyratna[2]
Department of Mathematics, University of Ruhuna, Matara, Sri Lanka
[1]Chathu29@yahoo.com, [2]abeyratn@maths.ruh.ac.lk

The Finite Volume Method (FVM) is a discretization method which is well suited for the numerical simulation of various types of (elliptic, parabolic or hyperbolic for instance) conservation laws. It has been extensively used in several engineering fields, such as fluid mechanics, heat mass transfer or petroleum engineering. It may be used on arbitrary geometries, using structured or unstructured meshes that lead to robust numerical schemes.
The most compelling feature of the FVM is that the numerical flux is conserved from one discretization cell to its adjacent cells. The locally conservative means that it is based on balance approach. That is the flux entering a discretization cell, which is often called control volume, is identical to the flux leaving from the neighboring cells. This feature makes FVM quiet attractive when modeling problems for which the flux is an important property.
Here, we have explored the finite volume strategy for solving PDEs numerically. A control volume technique for solving a representative diffusion equation in an isotropic medium with dirichlet boundary conditions in two dimensions is considered. An approximation to the solution function is calculated at discrete spatial mesh points, proceeding in discrete time steps. We first transform the partial differential equation into a finite volume equation, which can be used to compute the approximation for the solution. Then we apply the discretized equation for each node point in order to obtain a system of equations. Finally, the approximate solutions which are obtained using MATLAB codes are compared with the analytical solutions by decreasing the size of the control volume in order to estimate the error propagation.

Key words: Finite Volume Method, Discretization, Isotropic medium, Diffusion equation.