PREFACE AND SUMMERY

One of the most important topics in computational Fluid Dynamics is the study of shock and rarefaction waves. In most practical applications, the relevant equations are coupled and non-linear and numerical methods must be used to solve these equations. Moreover, additional techniques (Artificial Viscosity)are needed to get rid of the non-linear oscillations that take place in treating shock waves numerically.

The aim of this thesis is to study such techniques and introduce it in the numerical solutions without adding it explicitly.

In chapter I, we discuss physical and mathematical pictures of shock waves and the Rankine-Hugoniont relations. The Eulerian, Lagrangian approaches and discretization in Computational Fluid Dynamics are also discussed.

In chapter II, we express the quasi-linear hyperbolic system, that describe the unsteady compressible flow of a polytropic gas, in a non-dimensional Eulerian form. We also review some of the explicit, first, second, third and fourth order accurate method, that are frequently used to solve the system numerically. The stability of

some of these methods, using both Hirt and Von-Neumann approaches is also discussed. In the last part of chapter II, we review the different artificial viscosity forms that are used to eliminate post shock oscillations.

In chapter III, we modified an iterative scheme, originally devised by Abarbanel and Zwas in 1969, as a replacement to the artifical viscosity. The same scheme was used by El-Fayoumi and Fkirin (1978) to iterate first order numerical solutions of the quasi-linear system that represent the compressible one dimensional flow of a polytropic gas in cartizian coordinates.

Here, we iterate second order Lax-Wendroff solution of the system that represent the compressible one dimensional flow of a polytropic gas in cylindrical coordinates. Chapter III has been puplished in the preoceeding of fifth international congress for statistics, computer science, social and demographic research (pp. 433-448) organized by Ain Shams University. 29 March-3 April 1980.

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