Mathematical analysis of the Navier-Stokes equations for steady Magnetohydrodynamic flow

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Abstract

The objective of this paper is to solve the Navier-Stokes equations for a steady magnetohydrodynamic (MHD) flow between two parallel porous plates. The q-Homotopy analysis method is exercised to solve the non-linear differential equation and the derived dimensionless velocity is plotted for varying parameters that influence the flow. The impact of the dimensionless function obtained using Q-Homotopy Analysis method is compared with the numerical solution graphically.

Key words:

Navier-Stokes equation; Angular velocity; Non-linear differential equations; *q*-Homotopy analysis method.

1. Introduction

In recent years, the flow of magnetohydrodynamic fluid between two parallel porous plate has become an important topic because of its wide range of applications in oil industry, MHD generators, MHD pumps, refinement of petroleum and so on. [2] in his work elaborated the features of a electrically conducting fluid that is treated in a homogenous magnetic field. The effect of heat transfer and transverse magnetic field were described by [4]. The impact of an unsteady flow of the fluid between two parallel plates plays a vital role in engineering field. This phenomenon was analyzed by[3], [5] to [7]. The effect of suction and injection on the unsteady flow was studied by [9]. The hall effect of the MHD flow was taken into account by [8]. With the knowledge of earlier works [2] to [11], [1] developed a model which gives the Navier-Stokes equations for steady magnetohydrodynamic flow between two parallel porous plates.

The main objective searched in this work is to apply the most important method for highly nonlinear problems, the well-known Q-Homotopy Analysis method to solve the Navier-Stokes equation given by [1] analytically. A comparison between the analytical results thus obtained and the numerical solution is provided graphically.