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SPECIAL SOLUTIONS TO THE FLOW OF INCOMPRESSIBLE FLUIDS COUPLING WITH MAGNETIC FIELD

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Abstract: To provide the extensive mathematical analysis, we have considered the ideal Magnetohydrodynamics (MHD) equations, which represent the flow of fluid in the atmosphere or ocean in the presence of a magnetic field. Alternatively, we can say that it represents the flow of electromagnetic fluids. We followed the procedure of Majda [4] that was implemented to find special solutions of the rotating stratified Boussinesq equations and found the exact solutions of an initial value problem as well as we provided a local analysis of incompressible electromagnetic fluids in the neighborhood of the origin. Further, we reduce these ideal MHD equations into a system of six-coupled ordinary differential equations, and we conclude that it is a completely integrable system. Hence, through the quadrature, we find its solutions. Thereby, we determine the critical point of a reduced system and which is a degenerate critical point. Finally, we obtained special solutions to the initial value problem. While providing examples of special solutions to ideal MHD equations, we come across the fact that, Mathematically, it is possible to find a flow of an ideal fluid in the presence of a magnetic field such that there is no pressure at every point of the fluid. But practically it is impossible because of zero pressure at a point, implying that there is no movement of fluid molecules. Whereas in the second example the pressure varies with space variable $\boldsymbol{x}$.

Keywords and Phrases: Ideal MHD equations, Special Solutions, Incompressible inviscid fluids, Stratified Boussinesq equations, Completely Integrable Systems.