The effect of couple stresses on stability analysis of magnetized rotating ferrofluid heated from below

Akanksha Thakur[a], Sunil*[a], Reeta Devi[b]

[a] Department of Mathematics and Scientific Computing, National Institute of Technology Hamirpur, Hamirpur, (H.P.), 177005, India

[b] Department of Mathematics, Government College Nagrota Bagwan, Kangra, (H.P.), 176047, India

ABSTRACT

This work aims to inspect the impact of couple stress forces on the convective stability of rotating magnetized ferrofluid by considering three different bounding surfaces. Both linear and nonlinear analyses are conducted to obtain eigenvalue problems. Normal mode analysis is used for linear analysis, while normal mode analysis and the energy method are used for nonlinear analysis, and a generalized energy functional is introduced. For solving eigenvalue problems, the Galerkin method is employed. It is observed that a subcritical region exits and this subcritical region decreased as the magnetic parameter increased, whereas an increase in the couple stress parameter increased the subcritical region. Meanwhile, rotation was found to have a stabilizing effect. It is also observed that fluid confined in the rigid-rigid bounding surface is more thermally stable for lower values of the rotation, whereas, for higher values of rotation free-free bounding surfaces are more stable.

Further author information: (Send correspondence to Sunil)

A. T.: E-mail: akankshathakur47@gmail.com

S.: E-mail: sunilnitham@gmail.com, Telephone: 09418156759, Address: Department of Mathematics and Scientific Computing, National Institute of Technology Hamirpur, Hamirpur, (H.P.), 177005, India

R.D.: E-mail: reetamaths6@gmail.com