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Natural convection of a rotating-fluid sphere with axial gravity and uniform heat source GERARDO ANGUIANO, ININ, Mexico, RUBEN AVILA, SATYA ATLURI, Center for Aerospace Research and Education, UCI, USA
— The flow patterns and the heat transfer rate of a rotating-Boussinesq fluid sphere are presented. The convective flow is induced by (i) a gravity field acting axially downwards (ii) a homogeneous internal heat source in the fluid, and (iii) a uniform low temperature at the wall of the sphere. We show the influence of the Taylor number on the heat transfer rate for different Rayleigh numbers. The natural convection analysis is carried out from the subcritical steady state (pure conduction) regime to the supercritical non-steady state regime. The mesh based Spectral Element method (SEM) has been used to solve the fluid equations in a Cartesian coordinate system in a rotating reference frame. The fluid sphere is discretized by using non-regular hexahedra with straight sides macro elements. Using this approach the singularity that appears at the poles of the sphere, when the governing equations are formulated in the spherical coordinate system, is avoided. The flow patterns and the heat transfer rates for the considered Rayleigh numbers ($0 < Ra < 3 \times 10^7$) and Taylor numbers ($0 < Ta < 1 \times 10^4$) are in satisfactory agreement with results previously published in the literature.

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