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# Eulerian Derivation of Non-Inertial Navier-Stokes and Boundary Layer Equations for Incompressible Flow in Constant Pure Rotation

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**Abstract**

The paper presents an Eulerian derivation of the non-inertial Navier-Stokes equations as an alternative to the Lagrangian fluid parcel approach. To the best knowledge of the authors, this is the first instance where an Eulerian approach is used for such a derivation. This work expands on the work of [1] who derived the incompressible momentum equation in constant rotation for geophysical applications. In this paper the derivation is done for the full set of Navier-Stokes equations in incompressible flow for pure rotation. It is shown that the continuity equation as well as the conservation of energy equation are invariant under transformation from the inertial frame to the rotational frame. From these equations the non-inertial boundary layer equations for flow on a flat plate subjected to rotation is derived in both the Cartesian and cylindrical co-ordinate systems.

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