The 2D Euler-Coriolis fluid: Theory and Illustration.

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Abstract

We start from a canonical Hamilltonian, Clebsch like, formulation of inviscid, compressible and rotational , charged or neutral fluids and establish their equations of motion including Euler equations for the velocity fields satisfying Helmholtz decomposition. We consider next the simplest example of a 2D perfect fluid in a rotating frame of reference, called the Euler-Coriolis fluid. Then, we take up the problem of describing the dynamics of a single cylindrical vortex immersed in an infinite compressible medium by means of the method of characteristics. A variational principle is evoked to qualify the nature of the solutions, regular and/or singular. Results of numerical analysis showing the spiraling motions of a test particle and the coupling between dilatation and vorticity in the fluid density are lastly presented.