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Lagrangian vs. Dirac constraints for ideal incompressible fluids and magnetofluids[1] P. J. MORRISON, Department of Physics and Institute for Fusion Studies, The University of Texas at Austin, Austin, Texas 78712-1060, USA, T. ANDREUSSI, EP Technology Development, SITAEL S.p.A., Pisa, Italy, F. PEGORARO, Universitaá di Pisa, Dipartimento di Fisica E. Fermi, Pisa 56127, Italy
— In his famous work [1], Lagrange used Lagrange multipliers in the Lagrangian variable description of the ideal barotropic fluid to impose the incompressibility constraint. In modern (although no more rigorous) terminology this is referred to as geodesic flow on the group of volume preserving diffeomorphisms. An alternative approach for enforcing constraints was introduced by Dirac, one that was adapted to the Eulerian variable description of the fluid by a generalization of Dirac's constraint method [2,3] using noncanonical Poisson brackets [4]. It will be shown how Lagrange's method is equivalent to geodesic flow and how it compares to Dirac's method in terms of canonical Poisson brackets. The pros and cons of the various methods will be discussed for both finite- and infinite-dimensional examples. In addition the definition and use of energy for stability will be described with application to magnetofluid dynamics.

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