

UNIVERSITY of HOUSTON

Department of Mathematics

Scientific Computing Seminar

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**Efficient numerical methods for incompressible multiphase flows
and applications to magnetohydrodynamics**

Thursday, April 6, 2023
1 PM- 2 PM
Room 646 PGH

Abstract:

The modeling and approximation of incompressible flows with variable density are important for a large range of applications in biology, engineering and geophysics. Our main goal is to develop and analyze numerical methods for incompressible flows with variable density and viscosity. We will introduce novel numerical methods that are suitable for high order finite element and spectral methods. Moreover, for computational efficiency, the stiffness matrices of the methods considered are made time independent. First, we present a semi-implicit scheme based on projection methods and the use of the momentum, equal to the density times the velocity, as primary unknown. We analyze the stability and convergence properties of the method and establish a priori error estimates. A fully explicit version of the scheme is then proposed. Its robustness and convergence properties are studied with a pseudo spectral code, named SFEMaNS, over various setups involving large ratio of density, gravity and surface tension effects. Then we present a novel method based on artificial compressibility technique and we compare its robustness with the above projection-based method. Applications to magnetohydrodynamics instabilities in industrial setups such as liquid metal batteries and aluminum production cell will be also presented shortly.

This seminar is easily accessible to persons with disabilities. For more information or for assistance, please contact the Mathematics Department at 743-3500.