

Flows of Incompressible Fluid with Pressure Dependent Material Coefficients

Miroslav Bulíček

Charles University in Prague, Faculty of Mathematics and Physics,

Mathematical Institute of Charles University,

Sokolovská 83, 186 75 Praha 8, Czech Republic

E-mail: mbul8060@karlin.mff.cuni.cz

Lecture 1-2:

Flows of incompressible fluid with pressure dependent material coefficients

In many applications, it is important to take into account the dependence of the fluid parameters on the pressure. The first natural choice is to model the fluid as the compressible and keep all coefficients pressure (and consequently also density) dependent. This however leads to extreme difficulties in the mathematical and also numerical analysis of the problem. On the other hand, in many fluids under the high pressure, the variation of the density is almost negligible but the variation of the material parameters can be even exponential. Therefore, it seems to be reasonable to consider and investigate the incompressible fluids with the pressure dependent material parameters.

In the lectures, we present an overview of available mathematical theory for the Darcy, Forchheimer, Brinkman and Navier-Stokes problem in which the viscosity and the drag coefficient heavily depend on the shear rate and the pressure. We shall show what are the natural assumptions on the viscosity and the drag terms, which allows one to establish the existence theory in simplified geometries or for simplified problems and then we summarize the available results in the full generality and present general newly developed tools, that are used for the existence theory for these models.