

## Several topics on the linear transport equation

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The linear transport equation (LTE), arising from fluid dynamics, governs evolution of the density of incompressible fluid or evolution of the level-set function that gives a material interface of two immiscible fluids, where the coefficient in LTE is the velocity field derived from Navier-Stokes (type) equations. If regularity of the velocity field is Sobolev, which is quite natural in terms of analysis of Navier-Stokes equations, LTE turns out to be non-trivial; even if the velocity field is smooth, LTE in computational fluid dynamics exhibits some difficulty in regards to numerical calculation of geometric quantities of the level-set. In this talk, I will speak about roles of LTE in fluid dynamics and mathematical analysis on (1) Finite difference methods for DiPerna-Lions weak solutions to LTE with Sobolev velocity fields; (2) Global weak solutions to LTE-Navier-Stokes type model with mass diffusion; (3) Nonlinear modifications of LTE as the level-set equation and their solvability (classical & viscosity solutions).