Analysis on mathematical problems appearing in fluid dynamics

Taku YANAGISAWA [Mathematics Course]

$$\begin{cases} \dfrac{\partial}{\partial t}\mathbf{u} + (\mathbf{u} \cdot \nabla)\mathbf{u} = \nu \Delta \mathbf{u} - \nabla p, \\ \operatorname{div} \mathbf{u} = 0. \end{cases}$$
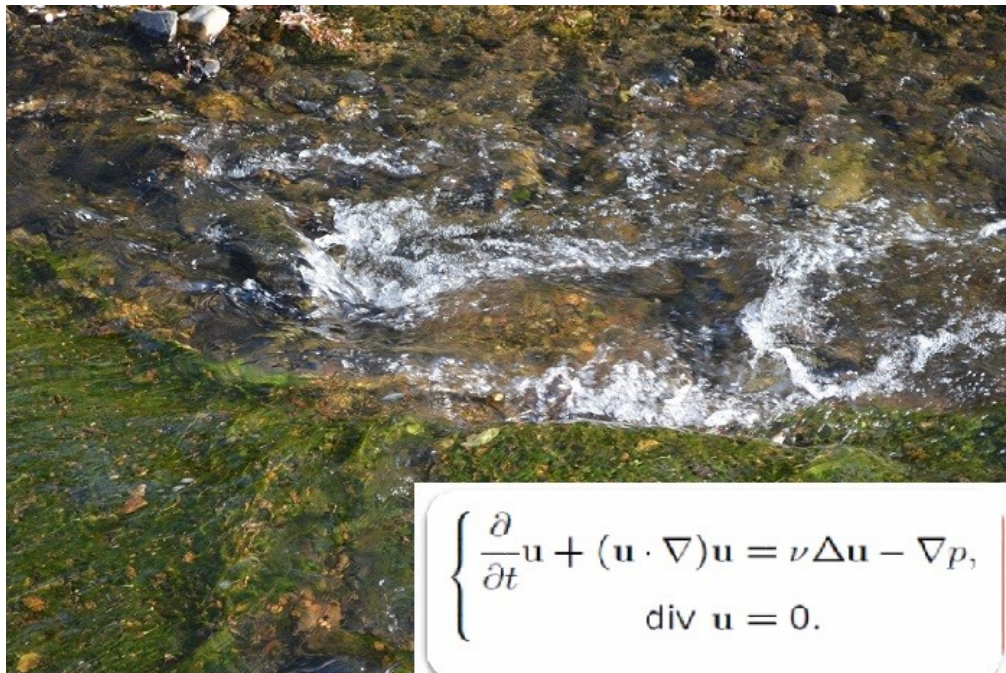
The flow of the river and Navier-Stokes equations

I study the analysis on mathematical problems relating to various phenomena of the fluids (the air and the water), by applying the techniques of functional analysis, asymptotic analysis, real analysis, calculus of variations and so on. Several topics of my recent researches could be listed as follows:

1. Research on Helmholtz-Weyl decomposition in bounded or exterior domains.
2. Research on the existence and stability of solutions to the boundary value problems of stationary Navier-Stokes equations. In particular, I am trying to figure out the relations between the existence and stability results for the solutions and the toplogical properties of the domain.
3. Research on the singular perturbation problems appearing in fluid dynamics.

Keywords : Nonlinear partial differential equations, Boundary value problems, Fluid dynamics