On the conservation of the energy for incompressible flow interacting with solid bodies/particles

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Abstract

This paper is interested in the relation between the mathematical model describing the mutual interaction of incompressible flow, and the motion of several solid bodies/particles. Particularly, we shall focus on the two-dimensional interaction between the flow and flexibly supported airfoil, cf. [1], and between the flow interacting with several particles transported by it. The considered system shall be studied with respect to the approximation point of view, we shall focus on the variational formulation of the coupled problem. Particularly, we shall discuss the several possible variational formulations of the incompressible Navier-Stokes equations given in the computational domain Ω_t by

$$\frac{\partial(\rho \boldsymbol{u})}{\partial t} + \rho(\boldsymbol{u}\cdot\nabla)\boldsymbol{u} + \nabla p - \mu\triangle\boldsymbol{u} = \boldsymbol{f}, \nabla\cdot\boldsymbol{u} = 0,$$

where $\boldsymbol{u}$ denotes the flow velocity, p denotes the pressure, ρ denotes the constant fluid density, μ denotes the constant viscosity coefficient. Let us note that the computational domain Ω_t is time dependent, due to the motion of the interacting bodies, whose position is unknown a priori.

Keywords: incompressible flow, Navier-Stokes equations

References

[1] P. Svacek, M. Feistauer *Application of a Stabilized FEM to Problems of Aeroelasticity* Numerical Mathematics and Advanced Application, 796–805, Berlin, 2004. Springer.