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Incompressible fluid dynamics: Some fundamental formulation issues. (English)

[Zbl 0717.76006](#)

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Most of this review is directed toward the careful description of a well-posed problem, with special emphasis on boundary conditions (BCs) and initial conditions (ICs). Regarding the former, it is interesting to observe that terminology is often both loose and misdirected regarding the most common and important of BCs - solid, no-slip walls. Whereas the single most inviolable BC is “no-penetration” ($u \cdot n$ specified, in general), the fully specified velocity BC ($u = w$ on Γ , where w is given) is often simply referred to as the “no-slip” BC (which is actually $n \times u = n \times w$), and it is this part of the BC that is violable and that frequently occurs. (No-slip is easy to say...)

Although most of this review is directed toward time-dependent flows, many of the issues discussed are also applicable to steady flows, provided that each is considered to have evolved from a transient flow that attained a steady state. Amplification of many issues summarized herein and some additional issues (such as time integration) may be found in the author’s forthcoming articles [Some interesting issues in incompressible fluid dynamics, both in the continuum and in the numerical simulation. Adv. Appl. Mech. (in press). and: Some current CFD issues relevant to the incompressible Navier-Stokes equations. Comput. Methods Appl. Mech. Eng. (in press)], as spatial constraints preclude their inclusion here. To conclude this introduction, we recall a sentence from the classic book by *G. K. Batchelor* [An introduction to fluid dynamics (1967; [Zbl 0152.444](#)): “I regard flow of an incompressible viscous fluid as being at the center of fluid dynamics by virtue of its fundamental nature and its practical importance.” Hopefully, this review will add a small amount of useful information to that which Batchelor and others have already amassed and disseminated.

MSC:

- 76-02 Research exposition (monographs, survey articles) pertaining to fluid mechanics
- 76D05 Navier-Stokes equations for incompressible viscous fluids

Cited in **106** Documents

Keywords:

[boundary conditions](#); [initial conditions](#); [time-dependent flows](#)