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Classical Leray problems on steady-state Navier–Stokes system: recent advances and new perspectives

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In recent years, using the geometric and real analysis methods, essential progress has been achieved in some classical Leray’s problems on stationary motions of viscous incompressible fluid: the existence of solutions to a boundary value problem in a bounded plane and three-dimensional axisymmetric domains under the necessary and sufficient condition of zero total flux; the uniqueness of the solutions to the plane flow around an obstacle problem in the class of all D-solutions, the nontriviality of the Leray solutions (obtained by the “invading domains” method) and their convergence to a given limit at low Reynolds numbers; and, more generally, the existence and properties of D-solutions to the boundary value problem in exterior domains in the plane and three-dimensional axisymmetric case, etc. A review of these advances and methods will be the focus of the talk. Most of the reviewed results were obtained in our joint articles with Konstantin Pileckas, Remigio Russo, Xiao Ren, and Julien Guillod, see, e.g., the recent survey paper [\[KR23\]](#).

[KR23] M. Korobkov and X. Ren, *Stationary solutions to the Navier–Stokes system in an exterior plane domain: 90 years of search, mysteries and insights*, *Journal of Mathematical Fluid Mechanics* **25**:3 (2023), p. 55.