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Determination of steady plane viscous motion in multiply-connected domains by means of potential flow and spline functions. (English) Zbl 0714.76041

Summary: The subject of this paper is to present a general concept of a new method for determining the steady motion of the viscous incompressible fluid in multiply-connected domains - both infinite and finite. The domain of solution is transformed into a new one, wherein the contours are represented by parallel slits: the transformation is performed by conformal mapping of the given domain onto an auxiliary circular one and afterwards - by determination of potential flow in the circular domain. The determination of viscous motion is based on integration of a quasi-linear fourth order equation for the stream function, which can be linearized by using the expansion of the solution into power series or the Newton’s methods of successive approximations. The transformed problems governed by the quasi-linear or linearized fourth order equations for the stream function are solved by means of the collocation method based on application of the bicubic spline functions. This approach allows to obtain a system of equations for unknown coefficients of the spline function. The unknown values of the stream function, at every contour, result from the condition concerning uniqueness of the pressure.

MSC:
76D10 Boundary-layer theory, separation and reattachment, higher-order effects
35Q30 Navier-Stokes equations

Keywords:
steady motion; viscous incompressible fluid; multiply-connected domains; conformal mapping; Newton’s methods of successive approximations