

## LAMINAR AND TURBULENT FLOWS IN HOMOGENEOUS AND STRATIFIED ROTATING FLUID

A.I. Feonychev, N.V. Bondareva

Research Institute for Applied Mechanics and Electrodynamics of  
Moscow Aviation Institute, Moscow (riame@sokol.ru / Fax: 7.095.1580367)

Flows of rotating fluid with free cylindrical surface are studied by the mathematical simulation method. The rotation of fluid is created by rotating magnetic field. Isothermal fluid and fluid with stable and unstable stratification of temperature relative to vector of gravity are considered. For study of interaction between rotating fluid and the surrounding medium tangential tension on free fluid surface is simulated by thermocapillary effect. A finite difference scheme of the third order of precision is used for numerical solution of the Navier-Stokes equations.

Calculations of laminar and turbulent flows had been carried out for fluids with the Prandtl number is equal to 7 and 0.7, which corresponds to rotating flows in ocean (long-lived vortices) and atmosphere (tornados). The transition boundaries from laminar to oscillatory (turbulent) regime of fluid flow had been obtained for different aspect ratio of cylindrical volume with free lateral area (nature conditions) and solid body (usual laboratory conditions). Oscillations in rotating fluid arise close to solid end-walls bounding fluid owing to large gradient of radial velocity. This hinders the use of data obtained in laboratory experiments for analysis of nature phenomena.

It was shown that flow stability and characteristics of oscillation regimes (amplitudes and frequencies of oscillations) depend on type of fluid stratification. To analyze the oscillation spectra for convection in closed fluid volumes we advanced previously the concept about fundamental frequency of convective cell and proposed methods for determination of these frequencies [1]. According to this idea, discovered oscillations of the beating type are attributable to composition of two close fundamental frequencies. It should be noted that this regime is highly unstable and transforms to harmonic oscillations (nearby transition boundary, one convective cell) or inharmonic oscillations, when flow pattern is complicated and there are several convective cells. Tangential tension on free fluid surface changes flow pattern and oscillation parameters. Flow pattern and oscillations depend on the quantity and the direction of tangential tension.

1. Feonychev A.I. et al. Collected articles of 3rd International Conference "Identification of Dynamics Systems and Inverse Problems". Moscow – Sankt-Peterburg, Russia. 30 May – 5 June 1998, 110 – 126.