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Investigation of conditions, hydrodynamic structures in the form of Taylor whirlwinds in rotating fluid arise under, and analysis of their dynamics on basis of attractor representing

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A system of ordinary differential equations for functions, determining temporal dependence of velocity components in the case of coaxial cylinders, inner of which is rotating, has been obtained on basis of Navier-Stokes and continuity equations in Reynolds number's region, close to number corresponding with flow change from laminar to turbulent form. The chaotic dynamics mode has been revealed and for the first time attractor of the system has been built theoretically also. The results were compared with the strange attractor and phase variables behavior of the Lorenz system [1]. Firstly, the system of ordinary differential equations for regarding problem is similar to the system describing Lorenz system behavior. Secondly, in result of fact above, form of the attractor for rotating cylinders problem is like the Lorenz one. Further, temporal dependence of phase variables of the system have been built also. They confirm chaotic behavior of the system in Reynolds number's region considered. One of the dependences shows that chaotic change of Taylor whirlwinds [2] rotation direction may be observed under some values of system parameters, that is, geometrical dimensions of cylinders, fluid viscosity, rotation speed of inner cylinder. The similar whirlwind structures may be observed in surface layer in the case of flow along concave wall [2].

References

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