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New Insight into Fluid Mechanics of Lorenz Equations

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Abstract : New physical insights into the nonlinear Lorenz equations related to flow resistance is discussed in this work. The chaotic dynamics related to Lorenz equations has been studied in many papers, which is due to the sensitivity of Lorenz equations to initial conditions and parameter uncertainties. However, the physical implication arising from Lorenz equations about convectional motion attracts little attention in the relevant literature. Therefore, as a first step to understand the related fluid mechanics of convectional motion, this paper derives the Lorenz equations again with different forced conditions in the model. Simulation work of the modified Lorenz equations without the viscosity or buoyancy force is discussed. The time-domain simulation results may imply that the states of the Lorenz equations are related to certain flow speed and flow resistance. The flow speed of the underlying fluid system increases as the flow resistance reduces. This observation would be helpful to analyze the coupling effects of different fluid parameters in a convectional model in future work.

Keywords : Galerkin method, Lorenz equations, Navier-Stokes equations, convectional motion
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