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On Unsteady Natural Convection Between Spherical Shells[1] YURI FELDMAN, TIM COLONIUS, Division of Engineering and Applied Science, California Institute of Technology — Natural convection between two concentric spheres is investigated with three-dimensional numerical simulations. Buoyancy is achieved by preserving a temperature difference between the internal hotter and the external colder boundaries of the spherical shell. The numerical simulations were performed for the two basic configurations characterized by external to internal radius ratios of 1.2 and 1.5. Slightly supercritical laminar regimes characterized by the Rayleigh numbers of order Ra $\sim O(10^4\text{-}10^5)$ were simulated by utilizing a Direct Numerical Simulation (DNS) approach while a Large Eddy Simulation (LES) was used for investigation of turbulent regimes for Ra $\sim O(10^8\text{-}10^9)$. We discuss the topological characteristics of the both laminar and turbulent flows. One of the possible scenarios of steady-unsteady transition is proposed as well. Implications of the results for the design of a double-walled Montgolfiere aerobot for the exploration of Titan's atmosphere are discussed.

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