Topic: MS Thesis Defense - Suryansh Prakhar
Time: Dec 4, 2020 01:00 PM Central Time (US and Canada)
Committee: Andrea Prosperetti, Rodolfo Ostilla Monico, Kamran Alba

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Thesis title: Linear Theory of Particulate Rayleigh-Benard Instability

Abstract:
The stability threshold of the Rayleigh-Benard problem is studied for a two-phase situation in which particles are introduced uniformly at the upper plate with a prescribed temperature and velocity. The particles exert a drag force on the fluid, which has the effect of enhancing the stability of the of the system. In other words, the critical Rayleigh number for the onset of convection increases and larger temperature differences are required between the plates for the buoyancy force on the fluid to increase sufficiently to overcome the particle drag forces. The critical Rayleigh number for the onset of convection is calculated numerically by solving the mass, momentum and energy equations for the fluid and the particulate phase under the point-particle approximation. The effect of the particles is explored by varying the number density, the mechanical and thermal Stokes numbers and other parameters. Although the principle of exchange of stability is not applicable in this case, the numerical evidence shows that, at onset, the eigenvalue with the largest real part is purely real. This circumstance permits a simplified analytical solution based on a Fourier series expansion which is found to be close to the numerical results.