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Strain Rate Signatures of Plumes in Rayleigh Bénard Convection PRAFULLA P. SHEVKAR, Department of Applied Mechanics, Indian Institute of Technology Madras, Chennai, India, R. VISHNU, Department of Aerospace Engineering, Indian Institute of Technology Madras, Chennai, India, SANAL K. MOHANAN, Department of Applied Mechanics, Indian Institute of Technology Madras, Chennai, India, MANIKANDAN MATHUR, Department of Aerospace Engineering, Indian Institute of Technology Madras, Chennai, India, BABURAJ A. PUTHENVEETTIL, Department of Applied Mechanics, Indian Institute of Technology Madras, Chennai, India — We study the distribution of eigenvalues of the 2D strain rate tensor in a horizontal plane close to the hot plate in Rayleigh Bénard Convection (RBC). The regions of negative dominant eigenvalues are shown as attracting Lagrangian Coherent structures that govern material folding in the instantaneous limit. Deriving the relation between horizontal divergence, total strain and eigenvalues, we show that these regions are also the regions with negative horizontal divergence. We propose these regions to be thermal plumes, arguing based on earlier visualisations that fluid elements transform from dominant extension to dominant compression in a horizontal plane as they traverse from boundary layers to plumes. We thereby propose two alternate, equivalent, velocity based criteria - namely regions with negative dominant eigenvalues and regions with negative horizontal divergence - to detect thermal plumes in a horizontal plane close to the hot plate in RBC. We then compare the extent of these regions with available theoretical relations and with the regions detected by different temperature based plume detection criteria.

Prafulla P. Shevkar
Department of Applied Mechanics, Indian Institute of Technology Madras, Chennai, India

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