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The Geometry and Velocity of Propagating Fronts in Complex Flow Fields[1] SAIKAT MUKHERJEE[2], MARK PAUL[3], Virginia Tech, PAUL RESEARCH GROUP TEAM[4] — We numerically investigate the velocity and geometry of propagating fronts in a range of complex flow fields generated by Rayleigh-Bénard convection. The fronts are computed using a reaction-advection-diffusion equation with a Fischer-Kolmogorov-Petrovskii-Piskunov (FKPP) non-linearity. We explore the fronts in rectangular and cylindrical convection domains for a range of flow fields including straight-parallel rolls, concentric rolls, and patterns where the rolls exhibit spatiotemporal chaos. We are interested in the low Damköhler number regime where the fluid dynamics plays an important role. We study the geometry of the front and compute its box counting dimension. The front is found to be fractal for the chaotic flow fields we explored. We also compute the variation of the front speed with the magnitude of the underlying fluid velocity. We connect with analytical results where possible and build a description of the propagating front using local geometric features of the convective pattern that include the local wavenumber, angle, and curvature of the convection rolls.

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