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**Weakly nonlinear stability analysis on a chemotaxis system with deformed free surface** SYMPHONY CHAKRABORTY, TONY WEN-HANN SHEU, National Taiwan University, No. 1, Sec. 4, Roosevelt Road, Taipei 10617, Taiwan (R.O.C) — Chemotaxis-convection-diffusion(CCD) have significant roles in medical, industrial, and geophysical areas, that is why research effort has been performed to understand the dynamics of the bacterial motility in suspension, studies through analytical, experimental, and numerical attempts previously were only for a flat free-surface of a suspension of chemotaxis bacteria in a shallow/deep chamber. We consider now a 3D CCD flow system with a deformed free-surface to explore the nature of instability by performing detailed stability analyses. Weakly nonlinear stability analysis has been carried out to determine the relative stability of the pattern formation at the onset of instability where Rayleigh number $Ra_\tau$ is the nonlinear control parameter. Nonlinear convection terms dominated the system beyond a critical $Ra_\tau$, which also depends on the critical wavenumber $k$ and Nusselt number $Nu_\tau$ as well as other parameters. We have investigated the issue of how the critical $Ra_\tau$ in this system varies with three different sets of parameters. Using the method of multiscales, a Ginzburg-Landau equation is derived from the Lorenz model (derived under the assumption of Bossinesq approximation), the solution of which helps to quantify the energy transport through $Nu_\tau$.

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