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Analysis of Float-Zone Crystal Growth Instabilities Through Linear Stability Analysis and 3D Spectral Element Simulations BRENT HOUCHENS, KENNETH DAVIS, Rice University, YUE HUANG, ExxonMobil — In the optically-heated floating zone crystal growth process, a region of polycrystalline rod is melted and resolidified as a single crystal. Increased heat flux causes the axisymmetric base flow to transition to a fully three-dimensional flow, leading to various defects in the grown crystals. Here we use linear stability analysis to determine the point of initial instability and to compute the eigenfunctions corresponding to the unstable growth modes. In addition, three-dimensional, time-dependent spectral element simulations are computed and the results for the initial bifurcation point as well as the flow field are then compared to the results from linear stability theory. Simulations beyond the initial instability show competition between two stationary modes, which mimic a quasi-periodic mode. Additionally, the melt region is subjected to an axial magnetic field to resist velocities in the radial and azimuthal directions, stabilizing the base state. Simulations and linear stability analyses are compared for cases with the applied magnetic field and both confirm the desired stabilization.

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