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Mathematical model of contractile ring-driven cytokinesis in a three-dimensional domain

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In this presentation, a mathematical model of contractile ring-driven cytokinesis is presented by using both phase-field and immersed-boundary methods in a three-dimensional domain. It is one of the powerful hypotheses that cytokinesis happens driven by the contractile ring; however, there are only few mathematical models following the hypothesis, to the author's knowledge. I consider a hybrid method to model the phenomenon. First, a cell membrane is represented by a zero-contour of a phase-field implicitly because of its topological change. Otherwise, immersed-boundary particles represent a contractile ring explicitly based on the author's previous work. Here, the multi-component (or vector-valued) phase-field equation is considered to avoid the emerging of each cell membrane right after their divisions. Using a convex splitting scheme, the governing equation of the phase-field method has unique solvability. The numerical convergence of contractile ring to cell membrane is proved. Several numerical simulations are performed to validate the proposed model.

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