Stress-mediated growth determines division site morphology of E. Coli

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Abstract

Bacteria are enveloped by a rigid cell wall and replicate by cell division. During the division, the cell wall needs to be drastically reshaped. It is hypothesized that the remodeling process is stress-mediated and driven by the constrictive force of a protein assembly, the Z-ring. We found that a simple large-strain morpho-elastic model can reproduce the experimentally observed shape of the division site during the constriction and septation phases of E. Coli. Our model encapsulates the multiple enzyme-dependent wall restructuring processes into a single modulus. Depending on this parameter, different
experimentally known morphologies can be recovered, corresponding either to mutated or wild type cells. In addition, a plausible range for the cell stiffness and turgor pressure was determined by comparing numerical simulations with experimental data on cell lysis and reported cell sacculus deformation experiments.

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