NUMERICAL SIMULATION OF SPIROCHETE MOTILITY

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A spirochete is a bacterium with a characteristic helical, elastic body. We use the boundary integral equations to calculate the surface velocities of elastic structures in Stokes fluid from surface elastic forces. Similar to ideas used in [2][5], we approximate the initial intrinsic shape of the spirochete by a network of points and springs. This allows us to calculate elastic surface forces. Any disturbance of the shape of the spirochete from its intrinsic shape, as well as the action of internal motors, lead to a local change of elastic surface forces. We use boundary integral equations to calculate boundary velocities of the points of the network. The regularized Stokeslet method introduced by Cortez in [4] allows us to overcome difficulties related to the weak singularities of the boundary integral formulation. We present error estimates of this regularized Stokeslet method. Numerical approximation leads to system of stiff ordinary differential equations, which we solve by DUMKA3 -a fast explicit solver for stiff ordinary differential equations [1], [3].

To generate motion of the spirochete, we attach several motors which are modeled by a dynamic network of points and springs connected to the network points on the spirochete surface. When we turn motors on, surface forces arise, and lead to the characteristic screw-like turning of the spirochete.

We observe stable, steady state translation motion of the spirochete. Global and local characteristics of the coupled fluid/organism motion can be calculated.

References

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