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**Fluid dynamics of confined polymer solutions:mechanisms and methods**

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Micro- and nanofluidic implementations of DNA characterization methods provide a motivation to understand the dynamics of solutions of linear polymer molecules in flow fields at length scales where the polymer and process scales overlap. In this regime a number of effects come into play, particularly the steric interactions between polymer segments and microchannel walls and the segment-segment and segment-wall hydrodynamic interactions. Using theory and simulations, we describe and analyze the dynamics of DNA during flow in simple channels, where chain-wall hydrodynamic interactions lead to migration, as well as channels with a corrugated wall, where steric effects are important. (In both situations, phenomenological arguments based on the free energy of stretched vs. coiled chains would predict behavior opposite to what is actually observed.) Finally, we use simulation of chains near the dilute/semidilute crossover to illustrate how chain migration changes at finite concentration. These last computations are performed with a new O(N) particle-particle/particle-mesh method for calculation of hydrodynamic interactions between N point (or regularized point) particles in an arbitrary geometry.