

Algorithm to detect polymer persistence length using an automated trace

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In polymer physics, the bending rigidity of a polymer, quantified as the persistence length, can provide valuable insight to the behavior of the polymer itself as well as the type of method used to analyze this polymer behavior. Current software requires that for an image of a polymer, a user must manually trace the line at the central position for each polymer to be analyzed in order to calculate a result. Testing images were obtained using a simulated z-scale image of polymers generated to an exact and user specified persistence length. This simulation program was created by using a Monte Carlo based method to generate coordinates of a polymer chain consistent with the Worm-Like Chain(WLC) model. Then the polymer traces were converted from nanometers to pixels and placed randomly throughout a binary image where 0 was the value of the image background, and 1 was a polymer backbone coordinate. Following this, the user is prompted for a chain width. Using the equation for a complex paraboloid, each point along the polymer chain is swelled to the specified width. Then simulated images are passed into the persistence length algorithm. This program begins with a 3D surface thinning algorithm that leaves a single-pixel chain of the polymer backbones. Particles within the image are then separated, and measurements are taken along the chain contour. With these measurements, a persistence length is obtained with statistical analysis using the WLC model. The results suggest a simple method to obtain a precise calculation of polymer persistence length down to a subpixel level.