1 Supplementary Figures

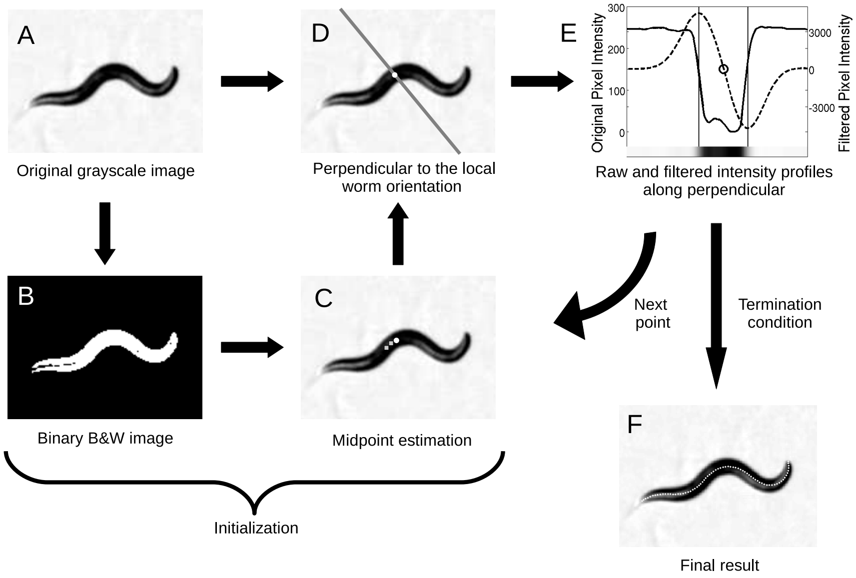

Figure 1: Schematic summary of the skeletonizer algorithm used to extract the body midline from each movie frame. a: A grey scale image. b: A rough binary image obtained by thresholding. c: During initialization, the first two midpoint estimates are obtained from the binary image (squares). The algorithm then loops through steps c-e. Further midpoints (circle) are estimated by linearly extrapolating the existing midline. d: The perpendicular to the local body shape is calculated from the grey scale image. e: The intensity profile (solid line) along the perpendicular is filtered by a derivative of a Gaussian kernel (dashed line). The peaks of the filtered signal (vertical lines) correspond to the two local body edges, and their midpoint (circle) replaces the initial estimate. The local cross-section of the worm is shown below. The process is iterated until the termination condition (crossing a lower threshold in the peak-to-peak amplitude of the filtered signal) is met.

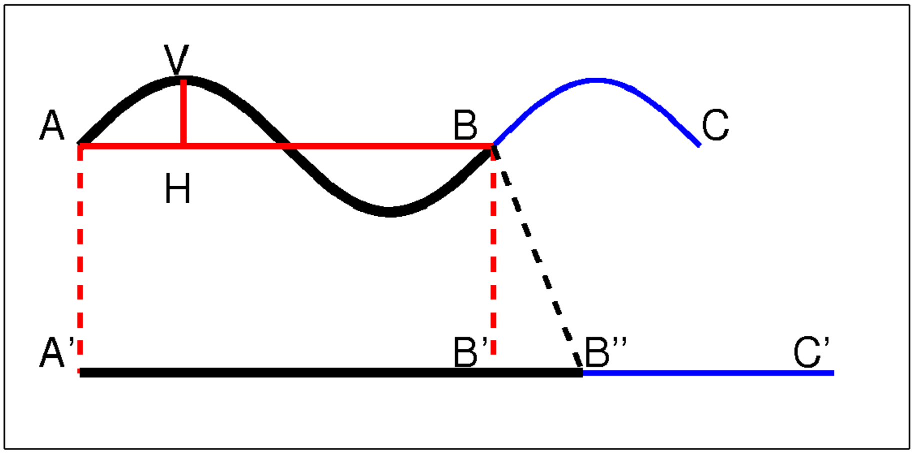

Figure 2: Algorithm for obtaining the wave amplitude and conventional wavelength. The example worm (the curve AC = A'C'), which is a perfect sinusoid for clarity, spans 1.5 periods. The wavelength is therefore 2/3 body length. To calculate the conventional wavelength (A'B'), the physiological wavelength (the black line AB = A'B") is used to obtain the point B along the body, and then the straight line distance (the red line AB). In cases where wavelength exceeds the body length, the half-wavelength is obtained and doubled. The amplitude HV is the maximum distance between any point on the body midline (black curve) and that point's projection onto the red line AB. Due to the head-tail asymmetry of real waveforms, both the conventional wavelength and amplitude are calculated twice, starting from both head and tail, and then averaged.

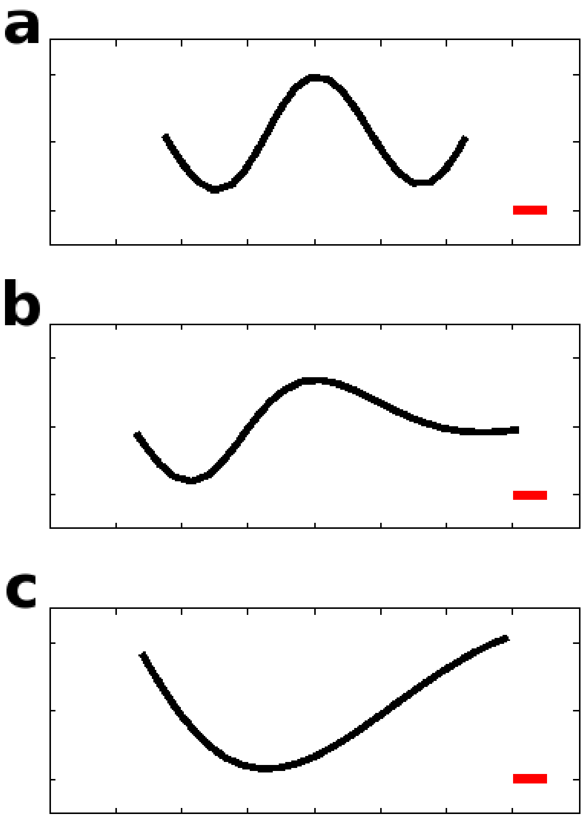

Figure 3: Examples of artificial skeletons used in comparing our simulator to the theory. a: Purely sinusoidal crawling waveform of realistic amplitude, b: more realistic crawling waveform with head-tail asymmetry (λ increases and A decreases towards tail) and c: swimming-like waveform where the body spans less than a full period. The scale bar is 0.1mm.

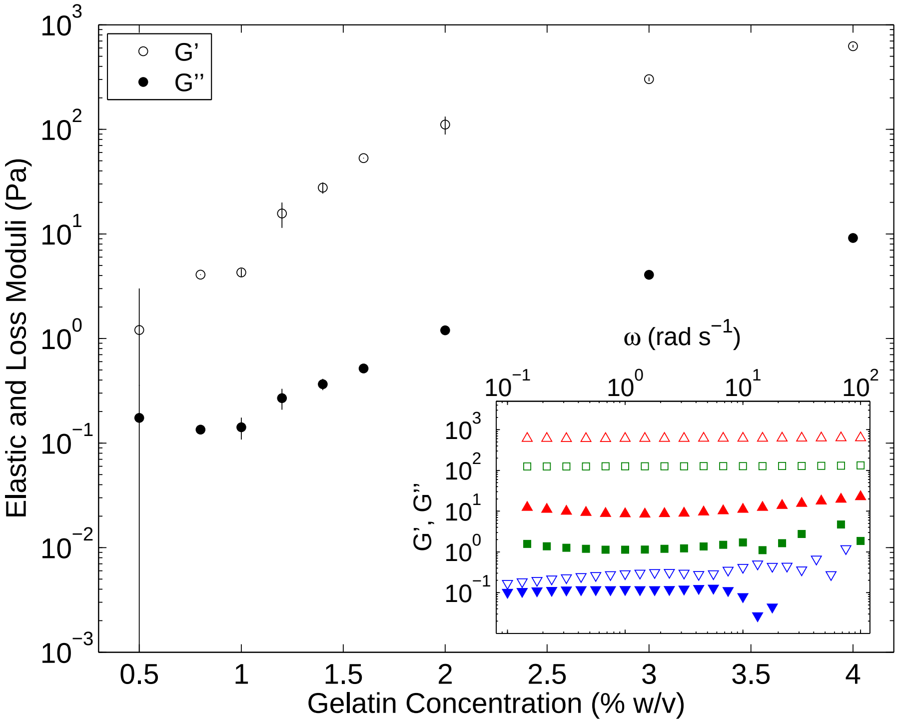

Figure 4: Elastic (G', open symbols) and loss (G'', filled symbols) moduli (measured at 1 rad/s) vs. gelatin concentration. Error bars show standard deviations. The inset shows the frequency dependence of the moduli for three gelatin solutions at concentrations of 4% (up-triangles), 2% (squares) and 0.5% (down-triangles). The nearly frequency independent moduli for gelatin solutions of 0.8%w/v or greater is indicative of well entangled gel-networks (solid-like behaviour, $G' > G''$).