Supplemental information

A mechanism for sarcomere breathing: volume change and advective flow within the myofilament lattice

Julie A. Cass, C. David Williams, Thomas C. Irving, Eric Lauga, Sage Malingen, Thomas L. Daniel, and Simon N. Sponberg
Supplementary Information for

A mechanism for sarcomere breathing: volume change and advective flow within the myofilament lattice

Cass, Williams, Irving, Lauga, Malingen, Daniel and Sponberg

Simon Sponberg & Tom Daniel.
E-mail: sponberg@gatech.edu, danielt@uw.edu

This PDF file includes:
  Fig. S1
  Captions for Movies S1 to S3

Other supplementary materials for this manuscript include the following:
  Movies S1 to S3
Supplemental Figure 1: Advective advantage as a function of sarcomere size. (A) Sarcomere size was defined by the radius, $R$, and the half-sarcomere length, $L$, as in the main document. (B-E) Timeseries of change in ATP during periodic contractions for five different sarcomere sizes. Values were taken at the M-line ($z/L = 0$) and 60% of the radius ($r/R = 0.6$) as in Fig. 2.
Movie S1. Time dependent sarcomere flow field. A cross-sectional slice of the vector flow field in the sarcomere interior is shown in normalized radial \((r/R)\) and axial \((z/Z)\) coordinates. Vector lengths are scaled such that the amplitude of the flow field at the z-disk is 3.75 \(\mu m\) s\(^{-1}\). Note the presence of a radial jet at the midline (M-zone) of the sarcomere. Interestingly, this is the region of the thick filament that is not decorated with cross-bridges.

Movie S2. Time-dependent flow field through the model sarcomere surface. The sarcomere is modeled as a cylinder, shown in light red in normalized coordinates. Here, we show the time-dependent flow field along the radial periphery of the sarcomere. Our field of view rotates, so that we can visualize this field from various spatial perspectives. Vector lengths are scaled such that the amplitude of the flow field at the z-disk is 3.75 \(\mu m\) s\(^{-1}\).

Movie S3. Advection-diffusion model results. Top panel: This video shows the time-dependent concentration results from the diffusion-advection (orange) and diffusion-only (blue) models. The concentration is shown on the y-axis, radial position is along the x-axis, and the video frames display the change over time. The diffusion-advection model oscillates around the diffusion-only line, as advection pumps ATP into and out of the model sarcomere periodically. Bottom panel: This section of the video displays a bar chart of the cycle-averaged advective advantage for each cycle as each cycle completes in the top panel. The advective advantage here is summed across radial position to make each bar. After each successive cycle completes, the cycle-averaged advective advantage for the that cycle appears as a new bar.