SUPPORTING INFORMATION

Art Advancing Science: Filmmaking Leads to Molecular Insights at the Nanoscale

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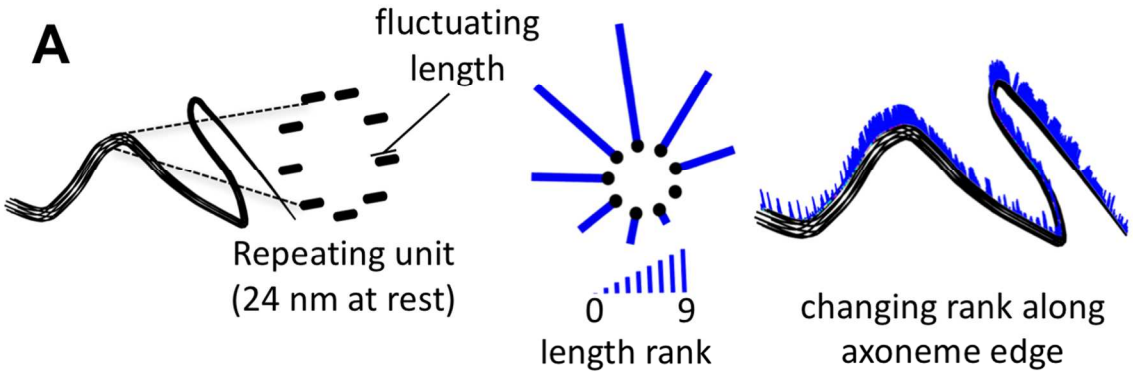
A
fluctuating
length
Repeating unit
(24 nm at rest)
0
9
length rank
changing rank along
axoneme edge

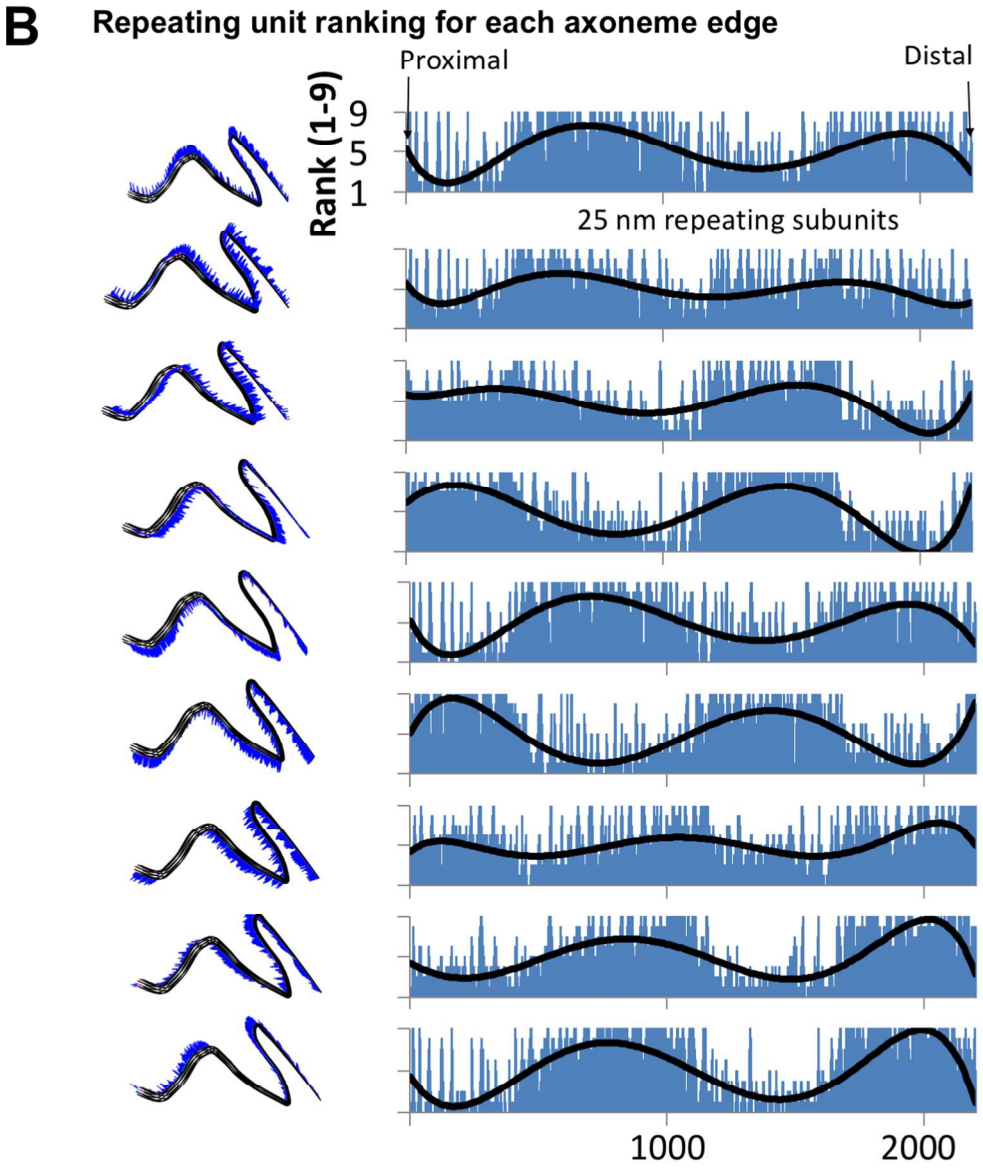
B
Repeating unit ranking for each axoneme edge
Proximal
Distal
Rank (1-9)
9
5
1
25 nm repeating subunits
1000
2000

Figure S1. Conformation mapping within subregions of the axoneme. (A) Diagrams showing a simulated axoneme (left) and a magnified cross sectional view depicting the 24 nm periodic repeats that correspond to spaces between adjacent dyneins on the surface of the microtubules at rest. The relative change in length of each of these repeats along each of the 9 microtubules was ranked from 0 to 9 as they varied over time when the axoneme moved in the simulation (center). The circle indicates the 9 microtubules; the length of the line indicates the rank of the repeat at the same position along each of the microtubules. As the sperm tail underwent sinusoidal motions, individual repeats changed their length rank differentially along the length of the axoneme, indicating local changes in tension and compression (right). **(B)** Diagrams of changing rank along the axoneme edge (left) and plots showing the length ranks of all 24 nm repeating units along the length of each of the 9 microtubules from proximal to distal locations along the axoneme (right). Black line in plot is the trend line indicating the curvature of each microtubule and how the different microtubules along the width of the axoneme within the same bent region differentially experience tension and compression in a complementary manner (when one is stretched, other parallel microtubules must be compressed).

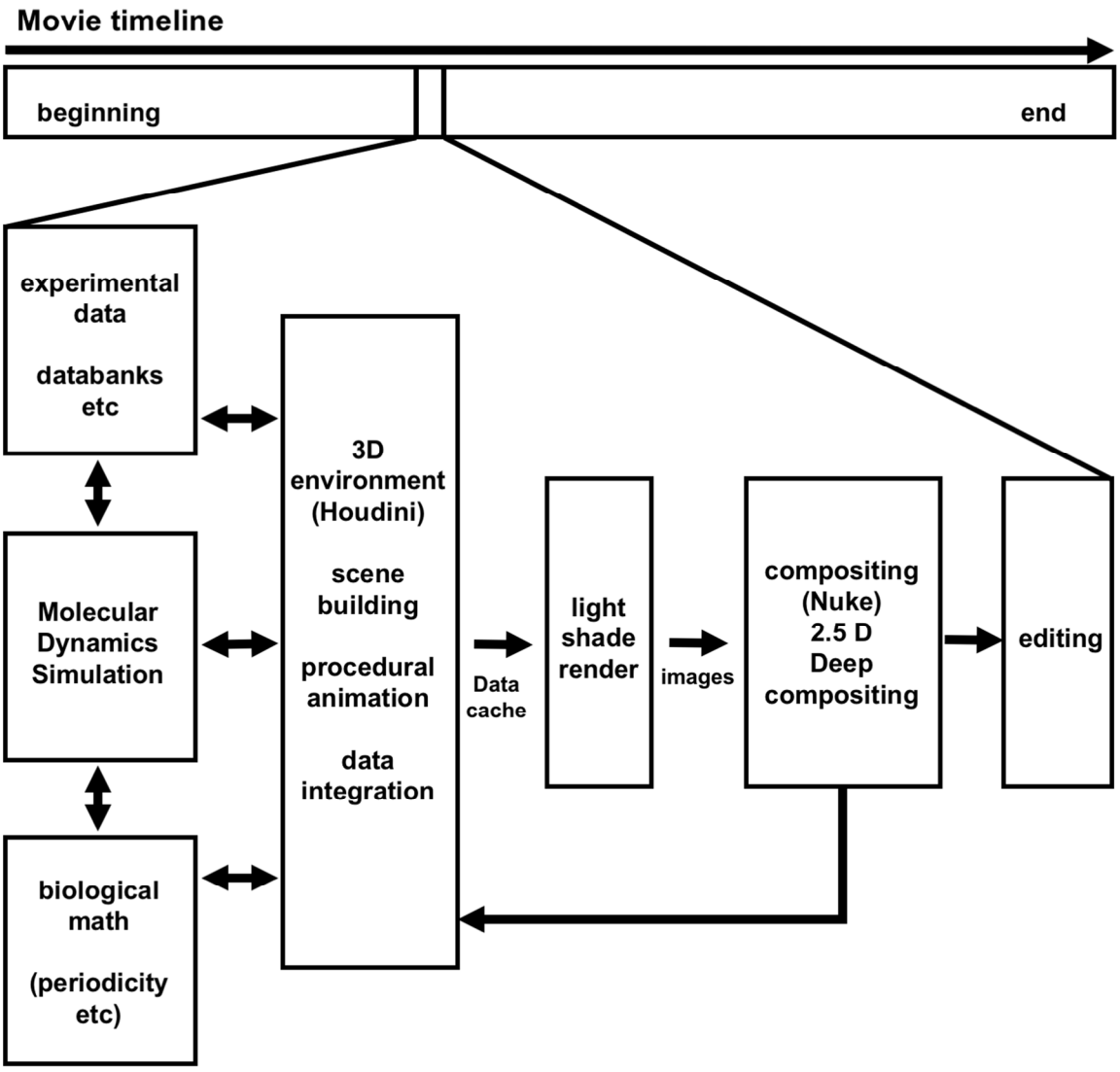

Figure S2. An overview of the filmmaking pipeline.

Movie S1. A cell scale depiction of sperm movement generated with inverse kinematic-coupled Finite Element Method (FEM) simulation, with a head representation passively connected.

Movie S2. Analysis of 24 nm repeating subunits of FEM model reveals changing lengths of subunits in a complementary balance of tension and compression**.**

Movie S3. Compression and tension seen in analysis of axoneme FEM simulation.

Movie S4. Molecular dynamic simulation (MDS) of dynein's microtubule binding domain bound to microtubule subunits. Conformational shifts during the course of the MDS reveal changes in length and width of the subunits.

Movie S5. MDS trajectory of dynein with hinge constraint and energy introduced through ligand prestressing.

Movie S6. MDS trajectory of dynein without hinge constraint and energy introduced through ligand prestressing.

Movie S7. An overview of how our MDS trajectory provides transition states between dynein conformations observed in cryoEM data.

Movie S8. MDS of trajectories generated with incremental increases in temperature through Langevin temperature scaling. The effect is applied to either the whole system or just the ADP ligands.

Movie S9. A clip from the short film *The Beginning*, that depicts the coordinated motion of multiple dyneins within the axoneme.