PMLS: External Media

Here is a list of movies and other media mentioned in *Physical Models of Living Systems*. Some of these are available directly via links below; in other cases, the link below takes you to the original journal article's media section (you may need an institutional subscription to view those ones). If your browser balks when you click a link, you may succeed by instead copying it, then pasting it into the browser's address space.

#1: See
http://www.pdb.org/pdb/static.do?p=education_discussion/educational_resources/hiv-animation.html

#2: http://www.youtube.com/watch?v=cDcprgWiQEY: Free Brownian motion of micrometer-scale particles.
TPM.avi, TPM.mov, TPM.m4v, TPM.wmv: Brownian motion of particles tethered to a microscope slide by single strands of DNA (not visible) (courtesy Prof. Laura Finzi, Emory University). One particle breaks loose from its tether and escapes.
BeadJump.avi, BeadJump.mov, BeadJump.m4v: Brownian motion of a single particle in a double potential energy well, showing thermally activated hopping between two local equilibria (courtesy Dr. Adam J. Simon).

#3: Molecular visualization data and tools are available at the RCSB Protein Database:
Overview: http://www.rcsb.org/pdb/home/home.do .
Visualization:
http://www.rcsb.org/pdb/101/static101.do?p=education_discussion/Looking-at-Structures/intro.html and
http://www.rcsb.org/pdb/101/static101.do?p=education_discussion/Looking-at-Structures/graphics.html
Links to software packages:
http://www.rcsb.org/pdb/101/static101.do?p=software/software_links/molecular_graphics.html

#4: http://www.biochemweb.org/neutrophil.shtml shows a neutrophil chasing *Staphylococcus aureus* (David Rogers, Vanderbilt University). This video shows this process at about twice actual speed.

#5: Files shotNoise.aiff and shotNoise.mp3 contain clicks representing the actual arrival times of photon detection events. (Data courtesy Dr. John F. Beausang and Prof. Yale E. Goldman.)

#6: Files 60Hz.aiff and 60Hz.mp3 contain uniformly spaced clicks.

#7: Files myoV.mov and myoV.avi show motion of the molecular motor myosin-V. Myosin-V was labeled by the fluorescent dye rhodamine (green) and is seen walking along actin filaments labeled with Alexa 647 (blue). The actin filaments in turn are attached to a quartz microscope slide, in the presence of 5 μM ATP. The motion consists of about four steps per second, giving an overall speed of about 140 nm/s. (Courtesy Dr. John F Beausang and Yale E Goldman.)

#8: See Supplementary Movie S1 at
http://www.sciencemag.org/content/suppl/2003/06/25/1084398.DC1/1084398S1.mov: "Movement of a single fluorescent dye attached to myosin V for the lower right trace shown in Fig. 3. Each pixel is 86 nm. Discrete 74-nm steps are clearly visible." [Supplement to A Yildiz et al. Myosin V walks hand-over-hand: Single fluorophore imaging with 1.5-nm localization. Science (2003) vol. 300 (5628) pp. 2061–2065.]

#9: http://www.sciencemag.org/content/suppl/2006/08/08/1127344.DC1/1127344s1.mov: "Partial summed molecule TIRF image (center) and PALM image (right) constructed during the acquisition of 300 single molecule frames (left) out of the 20 000 frames used to construct the images in Fig. 2. Scale bar is 0.5 μm." [Supplement to E Betzig et al. Imaging intracellular fluorescent proteins at nanometer resolution. Science (2006) vol. 313 (5793) pp. 1642–1645.]
The same processing applied to the lights on the Eiffel Tower: https://www.youtube.com/watch?v=RE70GuMCzww .
How to construct your own superresolution apparatus: https://www.youtube.com/watch?v=5_4aVx6v72A and
https://www.youtube.com/watch?v=kwQ609_BgNo .

#10: Courtesy Prof. Vladimir I. Gelfand, Northwestern University Feinberg School of Medicine:
GelfandAggregation.mov: Aggregation of melanosomes in zebrafish.
GelfandDispersion.mov: Dispersion of melanosomes in zebrafish.
GelfandMelanosomeMT.avi: Traffic of melanosomes along microtubules during dispersion of pigment in *Xenopus* melanophores. (Courtesy Professor Vladimir I Gelfand, Northwestern University Feinberg School of Medicine; see also: Park M, Serpinskaya AS, Papalopulu N, Gelfand VI. Rab32 regulates melanosome transport in Xenopus melanophores by protein kinase a recruitment. Curr Biol. 2007 Dec 4;17(23):2030–4.)

#11: See
http://www.nature.com/nature/journal/v468/n7320/full/nature09450.html#supplementary-information . [Supplement to N Kodera et al. Video imaging of walking myosin V by high-speed atomic force microscopy. Nature (2010) vol. 468 (7320) pp. 72–6.]

#12:
http://www.jleukbio.org/content/suppl/2006/09/18/jlb.0506346.DC1/SupMovie1.mov: "Wild-type leukocyte response

to fin wound. A wild-type zebrafish embryo was wounded in the ventral fin and observed by time-lapse DIC microscopy; the region imaged is the ventral fin in the midsection of the embryo, just below the vasculature and ICM. Note the migration of apparent leukocytes from the vasculature/ICM to the wound site." [Supplement to J R Mathias et al. Resolution of inflammation by retrograde chemotaxis of neutrophils in transgenic zebrafish. J Leukoc Biol (2006) vol. 80 (6) pp. 1281–8.]
http://dictybase.org/Multimedia/development/ax320x.mov: Aggregation of *Dictyostelium discoideum* amebæ towards a pipette emitting the chemoattractant cAMP. [R. Firtel, University of California, San Diego.] (More at http://dictybase.org/Multimedia/.)
http://www.rsc.org/suppdata/ib/c0/c0ib00033g/c0ib00033g_1.mov: A Dictyostelium cell expressing the F-actin reporter ΔlimE - GFP chemotaxing in a gradient chamber. Confocal fluorescence images were taken at both the cell-glass (red) and cell-PDMS (green) contact planes and superimposed at each frame. [Supplement to M Skoge et al. Gradient sensing in defined chemotactic fields. Integr Biol (Camb) (2010) vol. 2 (11-12) pp. 659–68.]

#13: Howard Berg's *E. coli* movies:
http://www.rowland.harvard.edu/labs/bacteria/index_movies.html.

#14: http://www.sciencemag.org/content/suppl/2008/10/16/322.5900.442.DC1. See Movie S1 and its caption.

#15: See
http://www.sciencemag.org/content/suppl/2008/10/16/322.5900.442.DC1/1161427s1.mov. [Supplement to P Choi et al. A stochastic single-molecule event triggers phenotype switching of a bacterial cell. Science (2008) vol. 322 (5900) pp. 442–446.]

#16:
http://www.nature.com/nature/journal/v456/n7221/suppinfo/nature07389.html: "Timelapse microscopy of JS013 cells (negative feedback only), continuously induced with 0.6 mM IPTG at 37°C. The phase-contrast image is shown in gray, and fluorescence is shown in green. Total time of movie is 210 min with a sampling rate of one image every 3 min." [Supplementary Movie 11 to J Stricker et al. A fast, robust and tunable synthetic gene oscillator. Nature (2008) vol. 456 (7221) pp. 516–519.]

#17: relaxationOsc.mov: Operation of a mechanical relaxation oscillator similar to the one in Fig. 11.4. There are differences between this realization and the idealized one in the text: (*i*) Switching between the two buckets is done manually: The feedback loop consists of a human continuously observing the bucket positions and supplying beads always to the higher bucket. The human does not, however, impose any particular periodicity. (*ii*) The system has friction, but is not in a high-friction regime where inertia may be neglected. Indeed the system displays bounces, also visible in the traces shown in the figures below. (*iii*) There are "hard stops" at the extreme values of θ, instead of gradually increasing restoring torques as in the main text. (*iv*) The toggle element is implemented by magnets in each bucket, similar to Figure 10.6a, so it only comes into effect at the extreme values of θ. Despite all these differences, the system displays the basic behavior expected for a relaxation oscillator. relaxationOscResults.pdf: Time series showing the operation of the oscillator with (a) no toggle, and with (b) weak and (c) strong toggle elements. (Realization courtesy William Berner.)

#18: http://www.nature.com/nature/journal/v456/n7221/suppinfo/nature07389.html: Supplementary Movie 1 shows a timelapse microscopy of JS011 cells continuously induced with 0.7% arabinose and 2 mM IPTG at 37 C. The brightfield image is shown in gray, and fluorescence is shown in green. Total time of movie is 228 min with a sampling rate of one image every 3 min.

#19: T-TsaiXenopus.mov: Timelapse microscopy of cell division in a *Xenopus* embryo. The overall size of the embryo is about 1 mm diameter throughout the video; the real-time duration of each division cycle is about 25 min. Video micrograph courtesy Tony Yu-Chen Tsai [see also T Tsai et al. Changes in oscillatory dynamics in the cell cycle of early Xenopus laevis embryos. PLoS Biol. (2014) vol. 12 (2) e1001788].