Recent reading

Theory

[1]

Brown and Sivak conclude that minimizing the depth (and number, I think) of intermediate metastable states maximizes the flux.

Their model defines forward and reverse rate constants similar to our model, although they deal with the input energy in a somewhat different manner. In our case, nonequilibrium populations drive the system. Here, the energy difference between the initial and final state of the system drive the population (see figure 1).

The forward rate constants from state i to j are k_{ij}^{+} and these are reversible transitions. The is $k_{ij}^{+}P_i$, where P_i is the probability in bin (or state) i. There is a total free energy budget σ^{tot} that describes the free energy difference across the cycle. This seems a little strange to me, but perhaps this is the same as saying the free energy from ATP hydrolysis is what drives each cycle.

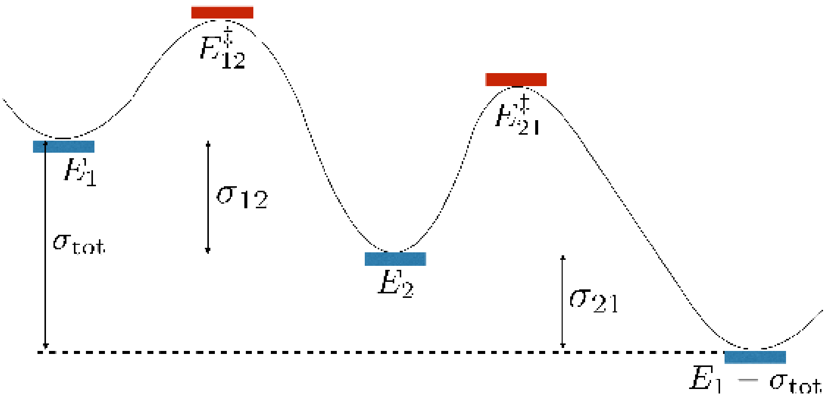

FIG. 2. **Free energy landscape** representing a two-state molecular machine. The left-most state (at free energy E_1) and the right-most state ($E_1 - \sigma_{\rm tot}$) represent the same stage of molecular machine operation, separated by one complete cycle. The middle state (E_2) represents an intermediate state, while $E_{12}^{\ddagger}$ and $E_{21}^{\ddagger}$ are the free energies of barriers between the states. σ_{12} and σ_{21} are the dissipations for each transition, which sum to $\sigma_{\rm tot}$, the dissipation budget for one cycle.

Figure 1:

A corollary of their central claim is that when barriers are lower, transitions are faster, and flux increases. The authors also claim that flux is maximized by reducing the number of metastable states, i.e., turning a three state system into a two state system.

[2]

A new synchronous rotary molecular motor from Feringa's group.

References

1. Brown AI, Sivak DA. 2017 Allocating dissipation across a molecular machine cycle to maximize flux. See https://arxiv.org/abs/1703.05283v3.

2. Štacko P, Kistemaker JCM, van Leeuwen T, Chang M-C, Otten E, Feringa BL. 2017 Locked synchronous rotor motion in a molecular motor. *Science*. See http://science.sciencemag.org/content/sci/356/6341/964.