First passage fluctuation relations rules by cycle affinities

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Abstract

For a non-equilibrium stationary state described by a Markovian process it is well known that the entropy production rate can be expressed in terms of the affinity associated with every transition in the graph representation of the master equation. We exhibit the invariance of cycle affinities in finite state Markov processes under various natural probabilistic constructions : for instance under conditioning and under a new combinatorial construction that we call "drag and drop". For semi-markovian processes whose corresponding graph is made of a single cycle, we establish that the cycle current obeys a fluctuation relation for first passage times at integer winding numbers, which is dual to the fluctuation relation for the cycle current at fixed time : contrarily to seminal fluctuation relations about the probabilities for measuring a random cumulative exchange quantity or its opposite value during a given time, the latter fluctuation relations deal with the probabilities for the random time needed for one cycle to be performed in one sense or in the opposite one with a given winding number. Reference : M. Bauer and F. Cornu, J. Stat. Phys. 155 (2014) 703-736.

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