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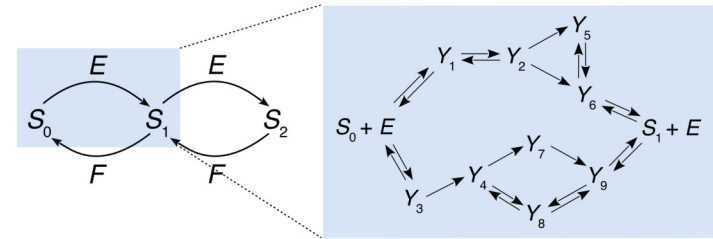
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Mathematics

Robustness and parameter geography in post-translational modification systems

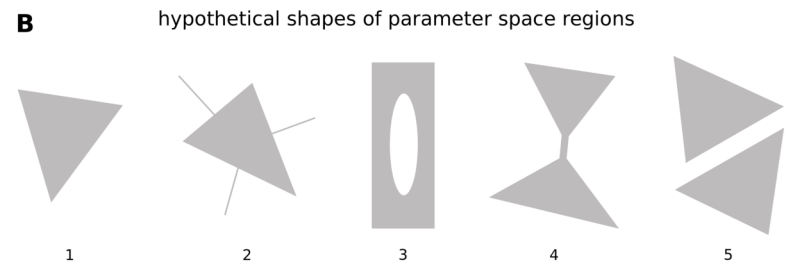
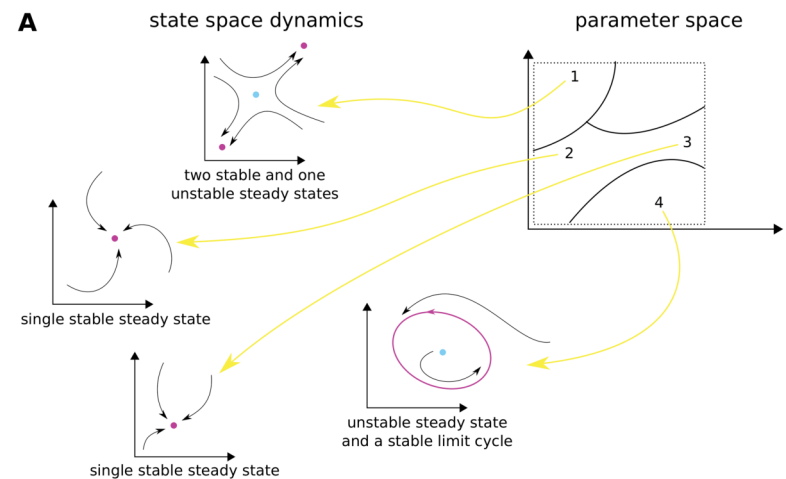
PloS Computational Biology

Biological systems are acknowledged to be robust to perturbations but a rigorous understanding of this has been elusive. We explore “parameter geography” for bistability in post-translational modification (PTM) systems. We use the numerical algebraic geometry tools Bertini, Paramotopy, and alphaCertified to statistically assess the solutions to these equations at 10^9 parameter points in total. Subject to sampling limitations, we find no bistability when substrate amount is below a threshold relative to enzyme amounts. As substrate increases, the bistable region acquires 8-dimensional volume which increases in apparently monotonic and sigmoidal manner towards saturation.

Reaction network and example enzyme mechanism for a two-site PTM system



Models and their parameter geography



images by Kee-Myoung Nam