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## **A subnetwork-based approach for studying concentration robustness**

Disturbances in the cellular environment can lead to variations in the chemical profile of the cytoplasm and result in deviations from homeostasis that are detrimental to the organism. In response, cellular networks have evolved to be robust to such perturbations but network complexity and the elusiveness of parameter values makes analysis difficult. Studying the network topology provides a way around this by delineating families of networks capable of exhibiting robustness based solely on their structure. Nevertheless, conditions for robustness have been studied mostly in the global context of the network and it is presumed that many of these conditions remain unknown. We propose that examination of a subset of reactions within the network suffices to show the presence of robustness. In particular, if a subnetwork inherits every possible steady state from its parent network, robustness in the subnetwork will extend to the entire network. We derive conditions that result in “steady state inheritance” for networks composed of at most two subnetworks. Additionally, we show that the steady state inheritance of one subnetwork extends to the other subnetwork as well. Lastly, we note an alternative submodule-based approach that extends robustness to the whole network based on species at the intersection of both subnetworks.

**Primary authors:** Mr FLETCHER, Alvaro; Dr ENCISO, German

**Presenter:** Mr FLETCHER, Alvaro

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