

Homeostasis Mode Interactions

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Homeostasis is a regulatory mechanism that keeps a specific variable close to a set value as other variables fluctuate. The notion of homeostasis can be rigorously formulated when the model of interest is represented as an input-output network, with distinguished input and output nodes, and the dynamics of the network determines the corresponding input-output function of the system. In this context, homeostasis can be defined as an ‘infinitesimal’ notion, namely, the derivative of the input-output function is zero at an isolated point. Combining this approach with graph-theoretic ideas from combinatorial matrix theory provides a systematic framework for calculating homeostasis points in models and classifying the different homeostasis types in input-output networks. In this work, we develop this theory by introducing the notion of a homeostasis mode interaction, defined as two homeostasis types are triggered simultaneously. Specifically, our work provides a direct method to determine whether an input-output network exhibits a bifurcation or homeostasis at a mode interaction, depending on the pattern relationship between the two triggered homeostasis types.

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