# Diverse Functional Repertoire in Neural Circuit Motifs with Mutual Inhibition

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Biological mechanisms are often found to operate in an optimized fashion. One realization of optimization is flexibility, which is indeed observed across various biological systems. That is, neural networks alter between different functionalities when given neuromodulation or top-down signals. However, how such flexibility is achieved remains an open question. Here we are interested in studying a class of small neural circuits we named CRIREL (coupled recurrent inhibition and recurrent excitation loop), which is capable of switching between multiple functions, such as various types of decision-making-like behaviors, bistability, toggle, different forms of central pattern generators, working memory, chaos, etc. The crux of the circuit being capable of exhibiting such a wide functional repertoire lies in its recurrent structure, which gives rise to a double-cusp bifurcation. In particular, we show that while the role of recurrent (mutual) inhibition is often not systematically studied, it is actually very crucial in increasing complexity of computation in a neural network.

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