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Partial Synchronization in Pulse-Coupled Oscillator Networks I: Theory[1] JAN ENGELBRECHT, BOLUN CHEN, RENATO MIROLLO, Boston College — We study N identical integrate and fire model neurons coupled in an all to all network through α-function pulses, weighted by a parameter K. Studies of the dynamics of this system often focus on the stability of the fully synchronous and the fully asynchronous splay states, that naturally depend on the sign of K, i.e. excitation vs inhibition. We find that for finite N there is a rich set of other partially synchronized attractors, such as $(N-1,1)$ fixed states and partially synchronized splay states. Our framework exploits the neutrality of the dynamics for $K=0$ which allows us to implement a dimensional reduction strategy that replaces the discrete pulses with a continuous flow, with the sign of K determining the flow direction. This framework naturally incorporates a hierarchy of partially synchronized subspaces in which the new states lie. For $N=2,\ 3,\ 4$, we completely describe the sequence of bifurcations and the stability of all fixed points and limit cycles.

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