# Oscillatory Dynamics in an Attractor Network with Spike Frequency Adaptation

Shailendra Rathore[a], Daniel Bush[b,c], Peter Latham[d] and Neil Burgess[b,c]

[a]*CoMPLEX, UCL, Physics Building, Gower Street, London, WC1E 6BT*
[b]*UCL Institute of Cognitive Neuroscience, Queen Square, London WC1N 3AR*
[c]*UCL Institute of Neurology, Queen Square, London, WC1N 3BG*
[d] *Gatsby Computational Neuroscience Unit, London WC1N 3AR*

**Abstract.** We present a novel method for generating controlled, periodic oscillations in continuous attractor networks. In simulations using both rate-coded and spiking neurons, we demonstrate that spike frequency adaptation and symmetric weights can be used to generate a stable activity bump which subsequently moves around the ring attractor network at a constant rate. Furthermore, varying net excitatory input to the network allows the speed of rotation, which is analogous to the oscillation frequency of each neuron within the ring, to be manipulated. This mechanism of generating variable frequency oscillations is more parsimonious and biologically plausible than modification of an asymmetric weight component proposed previously[1]. Finally, we show that several such networks can be combined to replicate the spatially periodic firing pattern of grid cells in the medial entorhinal cortex, which have been implicated in mammalian path integration. This work therefore represents an architecture for a combined attractor network[2,3,4] – oscillatory interference[5] model of grid cell firing, as posited by Blair et al[6]. More generally, this neural network model provides a generalised framework for generating controlled, phase offset oscillations which could be instrumental in various forms of phase coding.

**Keywords:** Neural Oscillations, Attractor Networks, Oscillatory Interference, Grid Cells

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