Gain-Based Computing Using Light and Matter

N Berloff[1]

[1] *University of Cambridge, Wilberforce Road, Cambridge, UK. Contact Phone: ++447578649944*
Contact Email: ngb23@damtp.cam.ac.uk

In my talk I will discuss a unified, gain-based framework for analogue optimization that maps a broad class of NP-hard combinatorial problems onto spin Hamiltonians and exploits physical platforms supporting multi-body interactions. I begin by presenting Stuart–Landau (Andronov–Hopf) networks as a universal dynamical model whose fixed points implement XY Hamiltonian minimization. I will demonstrate how controlled bifurcation and symmetry-breaking in a gain-based optimizer allow the same core network to emulate: the Ising Hamiltonian, including the coherent Ising machine with chaotic-amplitude control or oscillator Ising machine, the q-state Potts (clock) model, and generic k-local Hamiltonians relevant to polynomial unconstrained binary optimization (PUBO). I will consider several applied problems that go beyond spin Hamiltonians and exploit the amplitude degree of freedom including the phase retrieval and dense-subnetwork detection.