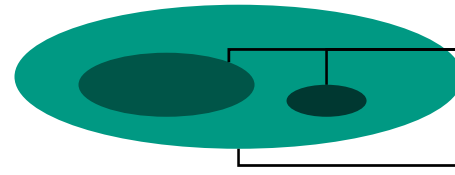
NEAR-MAXIMUM ENTROPY MODELS FOR BINARY NEURAL REPRESENTATIONS OF NATURAL IMAGES

MATTHIAS BETHGE AND PHILIPP BERENS (W46)

What is the influence of pairwise correlations on large networks of neurons?

Low dimensional observations: often well described with pairwise statistics

Full system: ?

Near-MaxEnt Model

Dichotomized Gaussian distribution:

$$\mathbf{z} \sim \mathcal{N}(\gamma, \Lambda)$$

$$s_i = \mathrm{sgn}(z_i)$$

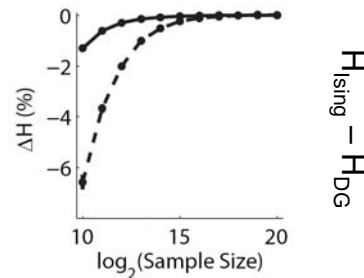
Parameter estimation and sampling are easy.

$$\gamma_i = \Phi^{-1}\left(\frac{\mu_i + 1}{2}\right)$$

$$\Sigma_{ij} - 4\Psi(\gamma_i, \gamma_j, \Lambda_{ij}) = 0$$

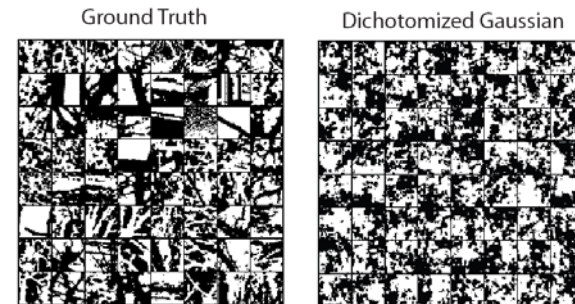
Model has entropy close to the maximum.

$H_{Ising} - H_{DG}$

ΔH (%) vs $\log_2$(Sample Size)

Binarized Natural Images

Ground Truth | Dichotomized Gaussian | Independent Model

Ground Truth | Dichotomized Gaussian

Small network: Pairwise correlations sufficient

Large network: Pairwise correlations fail

COMPUTATIONAL VISION & NEUROSCIENCE GROUP   MAX PLANCK INSTITUTE FOR BIOLOGICAL CYBERNETICS