1

STRUCTURAL ASPECTS

Stepping away, we

Maybe simplicity of the model makes stuff wrong. Tune to Perin distance profile.

Let

In their study, Perin et al. (2011) heavily rely on a distance-dependent

Here we introduce anisotropic networks tuned to reflect a given distance-dependent connection profile. We face the following: Given $C(x)$: $[0, \sqrt{2}) \to [0, 1]$, choose $w(x)$ such that the probability to have a vertex is $C(x)$ G_n, w.

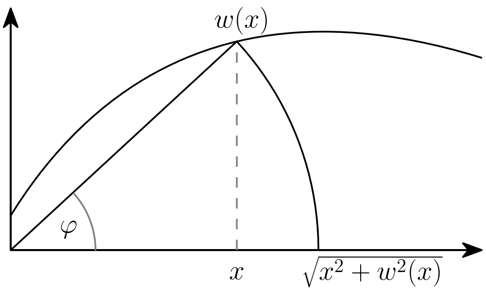

Figure 1.1: Computing connection probability $C(x)$ from non-constant $w(x)$

From this we have the relation

$$C\left(\sqrt{x^2 + w^2(x)}\right) = \frac{1}{\pi} \arctan \frac{w(x)}{x}.$$

In order to solve for $w(x)$ we first consider a linear approximation, expanding

$$C\left(\sqrt{x^2 + w^2(x)}\right) \approx C(x) + \left(\sqrt{x^2 + w^2(x)} - x\right) C'(x).$$

The resulting equation

$$C(x) + \left(\sqrt{x^2 + w^2(x)} - x\right) C'(x) = \frac{1}{\pi} \arctan \frac{w(x)}{x}$$

is however to complicated to solve.

Instead we propose the approximation $\sqrt{x^2 + w^2(x)} \approx x$, yielding

$$C(x) \approx \frac{1}{\pi} \arctan \frac{w(x)}{x}.$$

This approximation holds well as long as $x \gg w(x)$. Taking the distance-dependent connection profile $C(x)$ in the anisotropic network model (cf. Theorem **??**), we find that x is strictly (**??**)

With $w(x) = x \tan(C(x)\pi)$ we build anisotropic sample

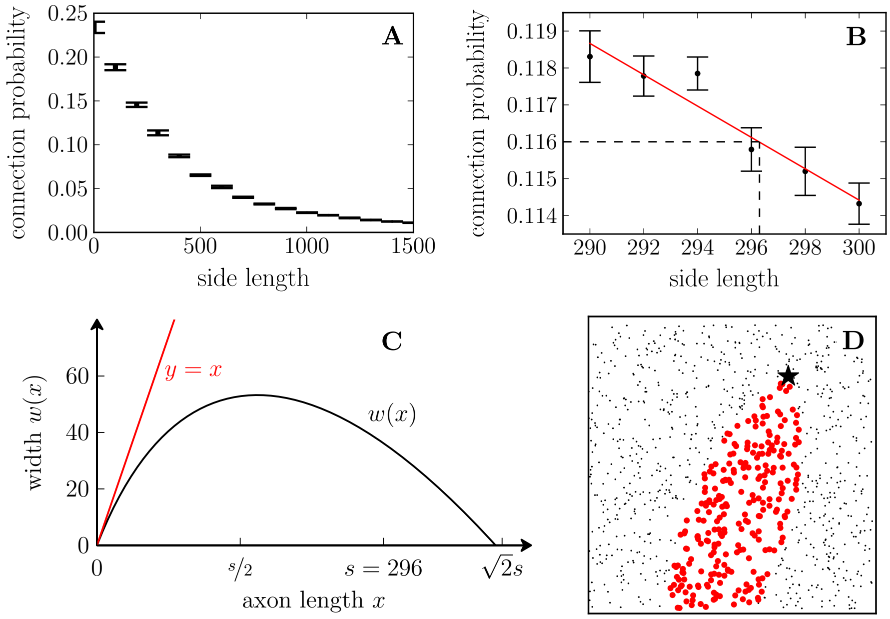

Figure 1.2: Anisotropic network model with tuned axon width w(x) **A-B)** Side length of the network's surface determines the connection probability, in B) length s is matched to $p = 0.116$, as reported by Song et al. (2005). **C)** Resulting axon width function $w(x)$ from tuning to distance-dependent connection profile as reported by Perin et al. (2011), see also Figure 1.3. Note that $x \gg w(x)$ for most x, justifying the approximation 1.1. **D)** Showing for a single neuron (star) connected (red) and unconnected (gray) neurons in the tuned anisotropic network, revealing characteristic new axon shape.

With side length 296:

from `f11dca65`.

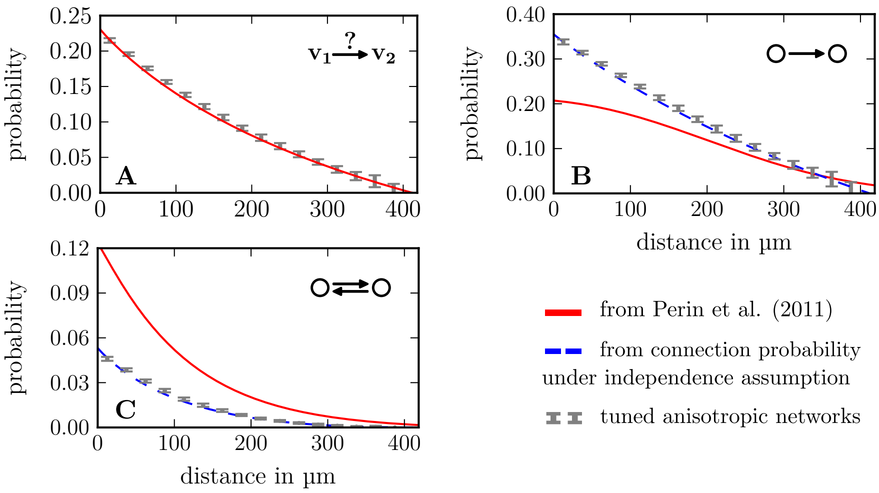

Figure 1.3: Overrepresentation of reciprocal connections independent of Comparison of occurrences of one- and bidirectionally connected neuron pairs in (gray) with profiles found by Perin et al. (2011) (red), shows that overrepresentation of bidirectional pairs is distance-independent and not connected to anisotropy. **A)** Overall connection probability in the adapted anisotropic networks was successfully tuned to reflect connection probability found by Perin et al. **B)-C)** Probabilities for a random neuron pair to display , (875505b0)