

2 Cortical Maps and Enabling factor

In the class *The Early Visual System*, we learned that the visual world, projected onto the retina, is transformed at the primary visual cortex in a peculiar manner. In this homework, we learn the kind of mathematical description appropriate for this *retinotopic* mapping or transformation.

First, download and read *hw2-1.pdf*. On page 57, you see four blanked-out equations with a “Q” mark.

2.1 [1.2%]

You should derive these equations (Q1-Q4). They involve simple mathematics.

2.2 [1.2%]

Plot the *linear cortical magnification factor* as a function of eccentricity. From this plot, what can you say about the representation of the visual world at the level of primary visual cortex (compare the factor at the fovea and periphery)? What might be the computational advantage of such a representation of visual space? Quantify your argument by estimating how big the brain would be if it wanted to achieve the same grain of resolution it has at the fovea everywhere else?

This is not a difficult question but do read the paper by Horton and Hoyt 91 ([horton.pdf](#)) we provide.

2.3 [0.6%]

For this simple problem, you should be familiar with matlab. Download *hw2.m* and *amadamug2.jpg*. Run *hw2.m* in matlab command line, as “hw2” (without any argument). Observe the transformation of image “amadamug2.jpg” onto the cortical surface. What kind of transformation occurred? Can you describe it? Pay special attention to the various left/right, up/down transformations.

[0.2 Extra %] If you have your own favorite picture, you can supply the filename into *hw2*, such as *hw2 ('myface.jpg')* to see how it is transformed at the level of V1. We recommend you use a small image unless you have access to a high-speed machine. Printing in color is unnecessary.

2.4 [1%]

Download *hockneyphoto.jpg* and *hockneypbwhy.jpg*, and you will find the well known collage painting “Pearblossom Highway” (Route 130) by the British painter David Hockney (who now lives in LA). You will also find a photograph of this highway taken with a camera. The photograph corresponds to the objective view of the visual scene, while the collage painting represents the artist’s

subjective view of the same scene. Comment on the similarities and differences from the perspective of a scientist who has thought about the nature of our perceptions (what we think we see), what our retina sees, and how these relate to what is out there (for instance, comment on *object constancy* etc).

2.5 Enabling factor and consciousness [2%]

Elaborate or criticize briefly (50 words) any four of the statements indicated by arrows on the pages included on the bloom.pdf text (Bloom et al, 2001 and p484,6,7 from Kolb and Wishaw, 2000).