

CARATTERIZZAZIONE FUNZIONALE DEL SISTEMA VISIVO

- II parte -

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SCENARIO

Strategie di rappresentazione:

- organizzazione
- relazione tra le informazioni estratte dalle singole cellule

Come viene mappato il campo visivo?

- rappresentazione retinotopica
- sovrapposizione dei campi recettivi
- fattore di ingrandimento/eccentricità

Come variano le proprietà di risposta delle singole cellule con la posizione sulla corteccia?

- le esperienze di Hubel and Wiesel
- colonne di dominanza oculare
- distribuzione periodica della selettività all'orientamento
- curve di selettività e mappe parametriche
- significato computazionale delle mappe

In che modo vengono raggruppate e messe in relazione le risposte di cellule diverse rispetto alle proprietà globali del segnale visivo? (*binding problem*)

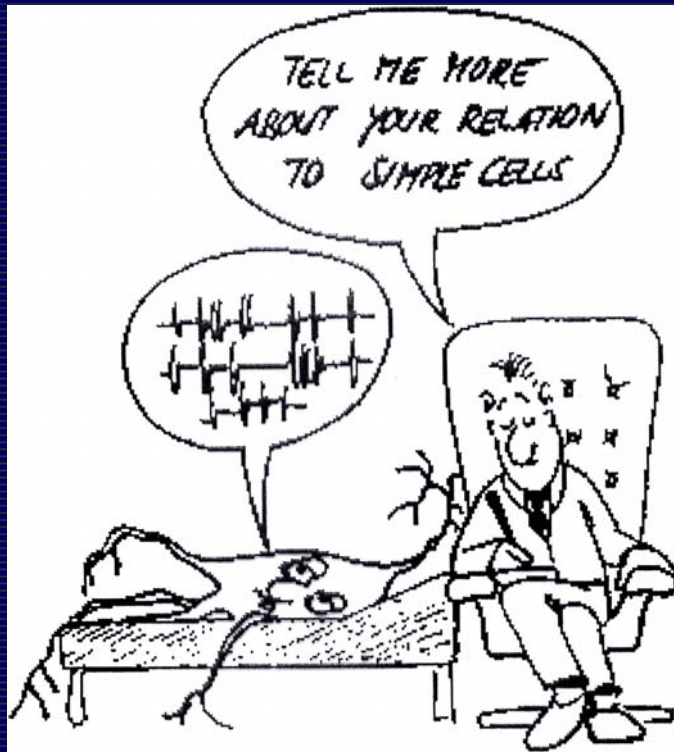
- campi "relazionali" (*linking fields*)
- *perceptual grouping*
- codice temporale (oscillazioni coerenti)



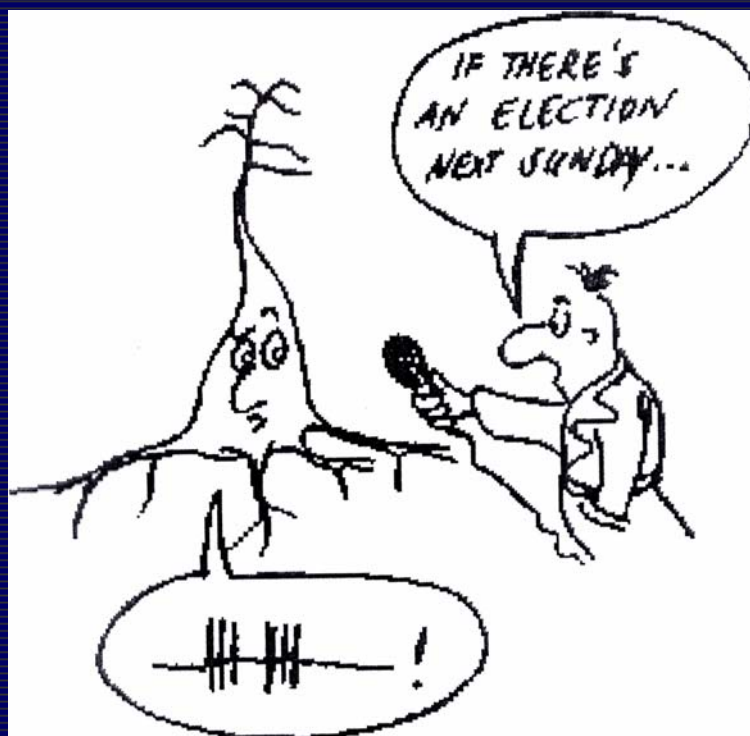
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“PSYCHOANALYTICAL” APPROACH



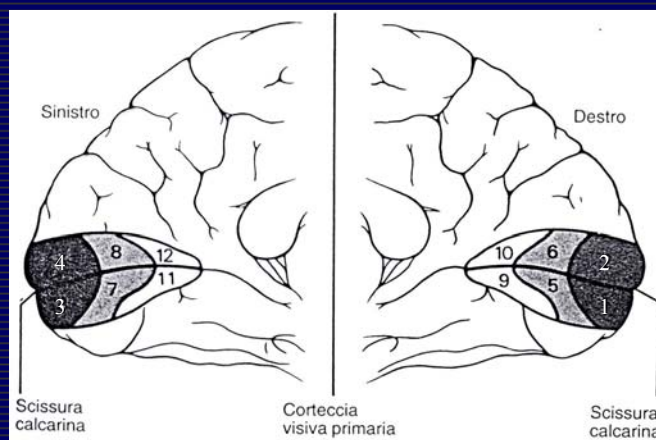
“SOCIOLOGICAL” APPROACH



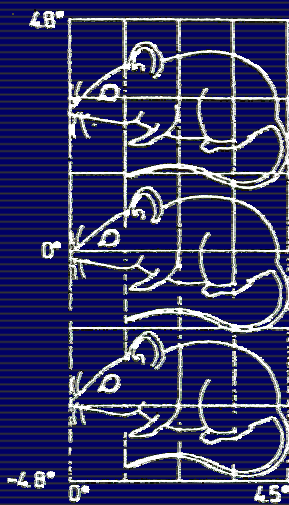
ORGANIZING PRINCIPLES

- Topographic (retinotopic) mapping
Near points in the visual field excite near locations on the visual cortices
- Binocular convergence
Cortical mapping of the inputs from the left and the right eyes and the **ocular dominance columns**
- Feature maps
Ordered mapping of feature selectivity (e.g., **orientation** and **direction maps**)

RETINOTOPIC MAPPING



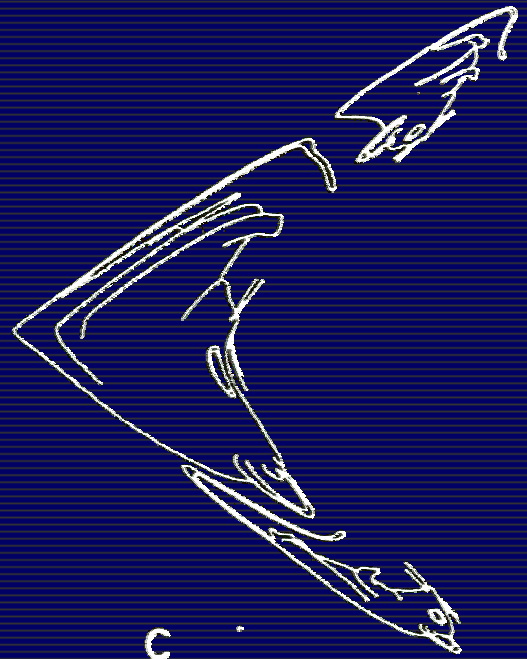
RETINOTOPIC MAPPING



a



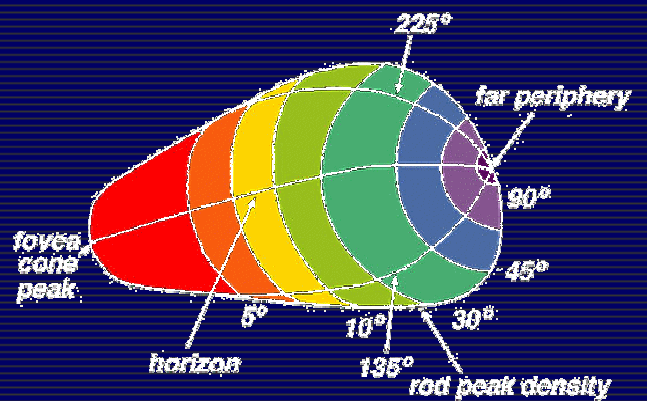
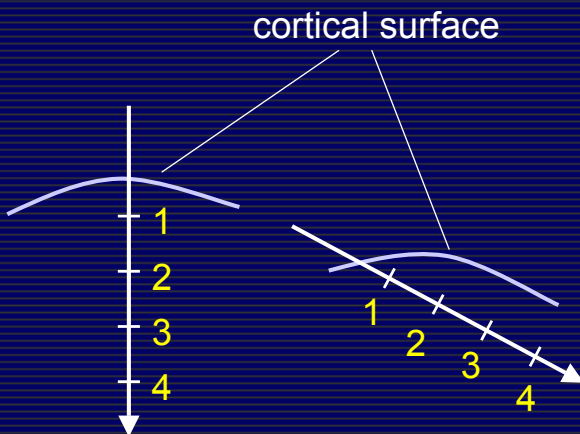
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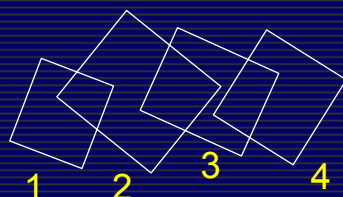
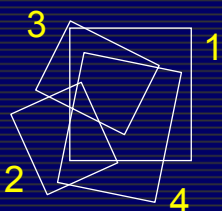
c

Mallot *et al.*, 1990

RETINOTOPIC MAPPING

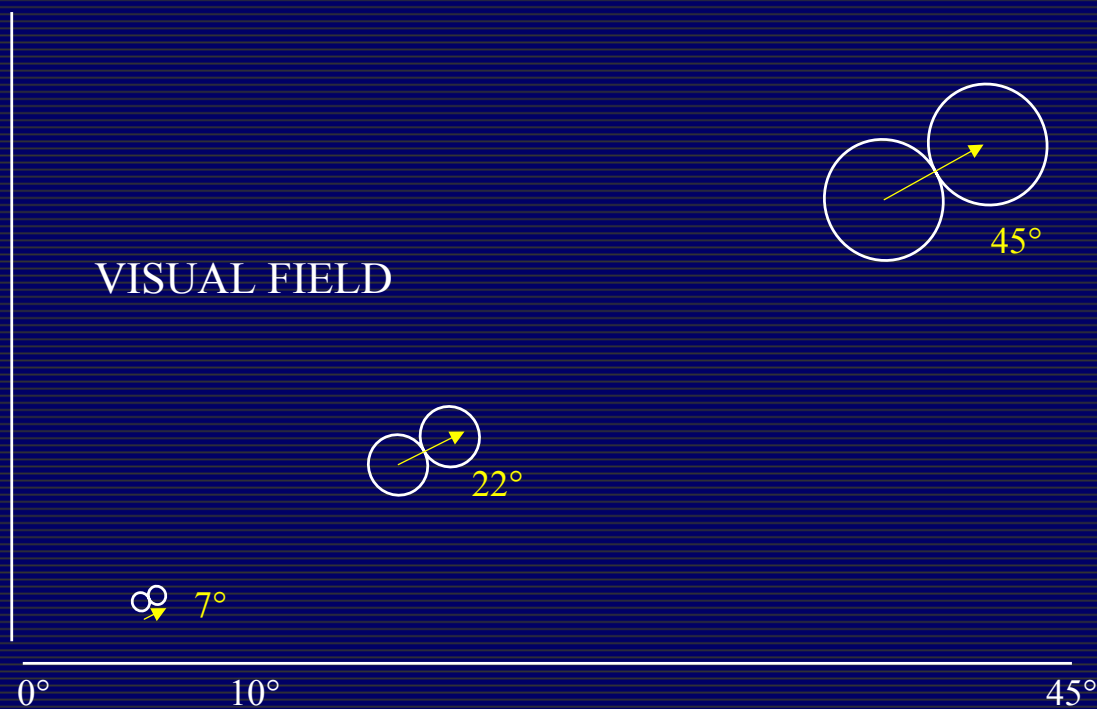


[Hubel, 1988]



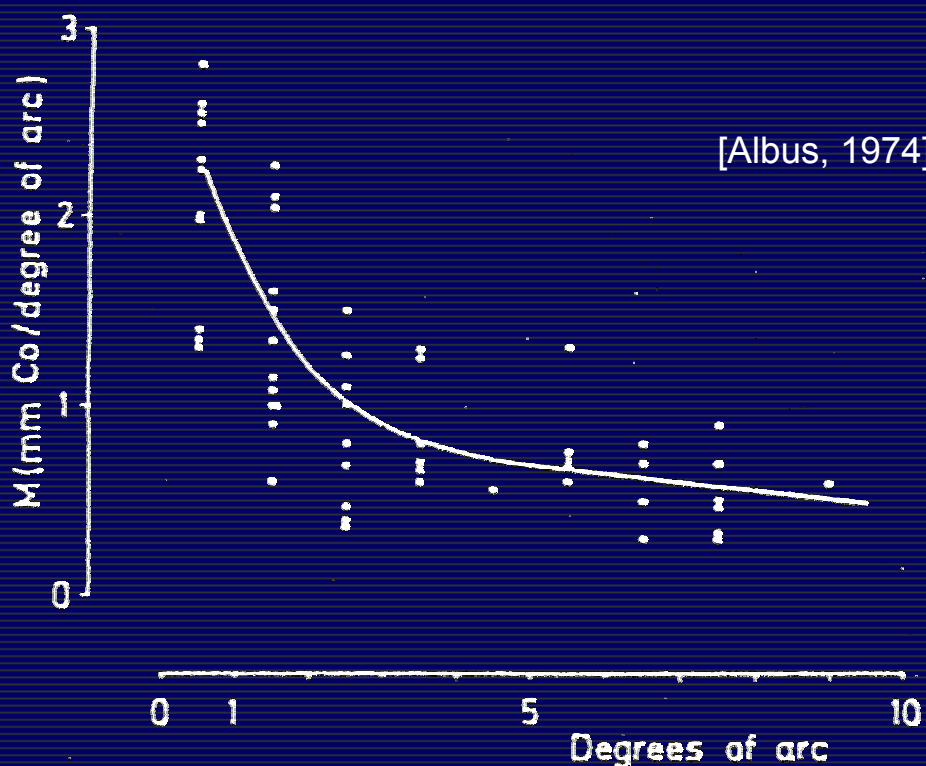
Receptive field locations on retina

VARIATION OF RECEPTIVE FIELD DRIFT



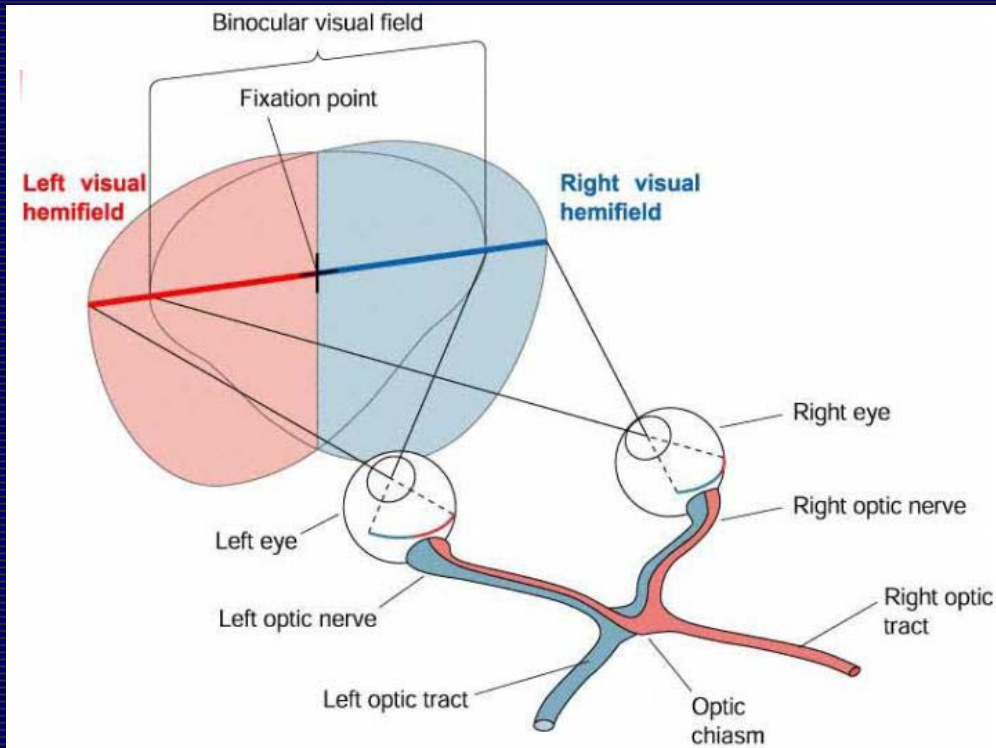
Hubel & Wiesel, 1974, 1977

CORTICAL MAGNIFICATION FACTOR



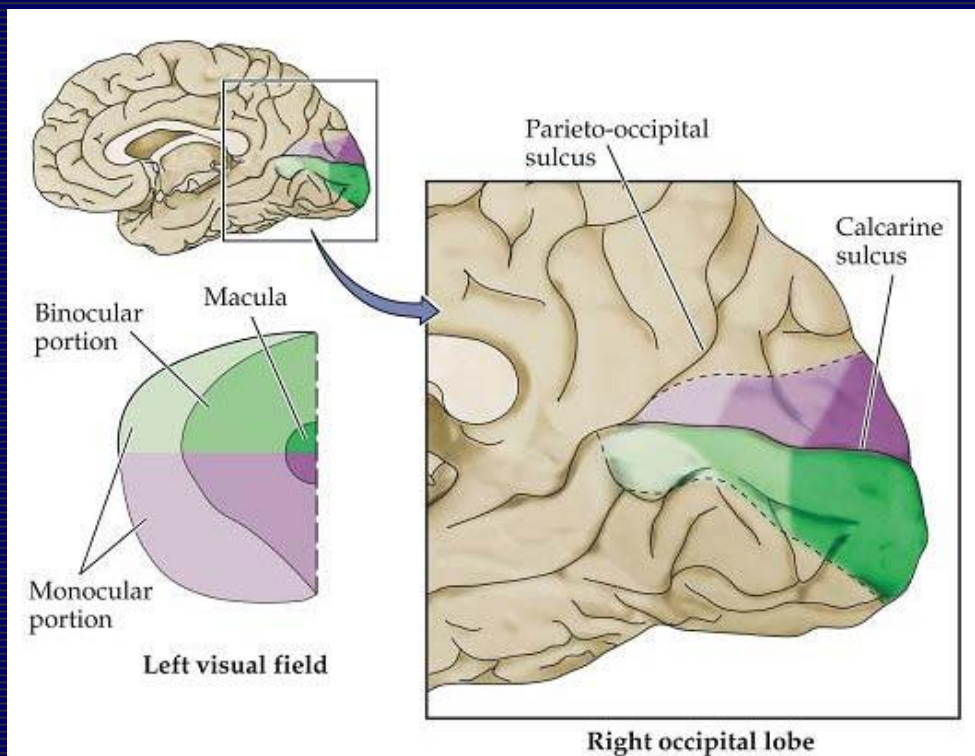
BINOCULAR CONVERGENCE

[Van Essen et al., 1995]

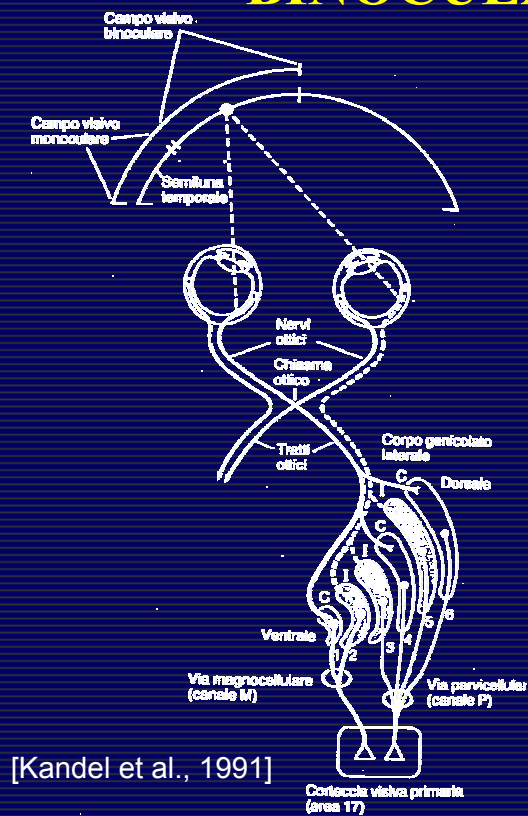


BINOCULAR CONVERGENCE

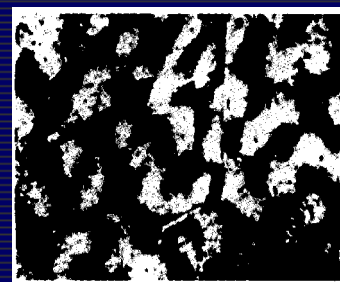
[Van Essen et al., 1995]



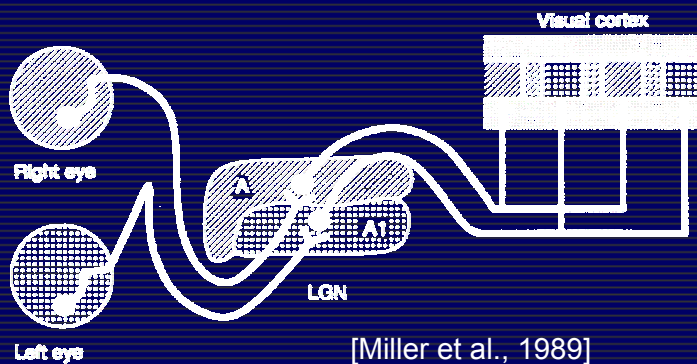
BINOCULAR CONVERGENCE



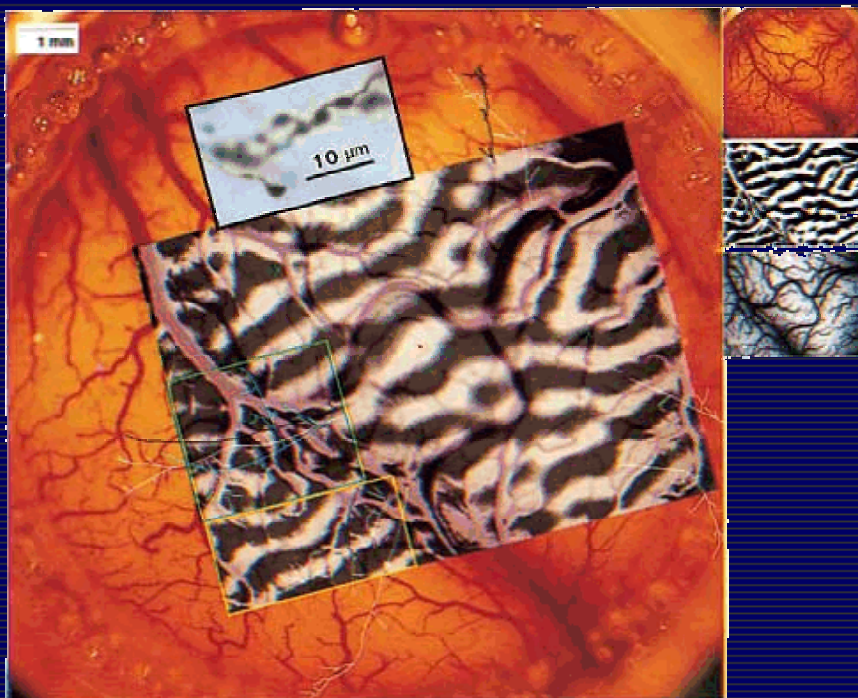
[LeVay et al., 1975]



[Miller et al., 1989]

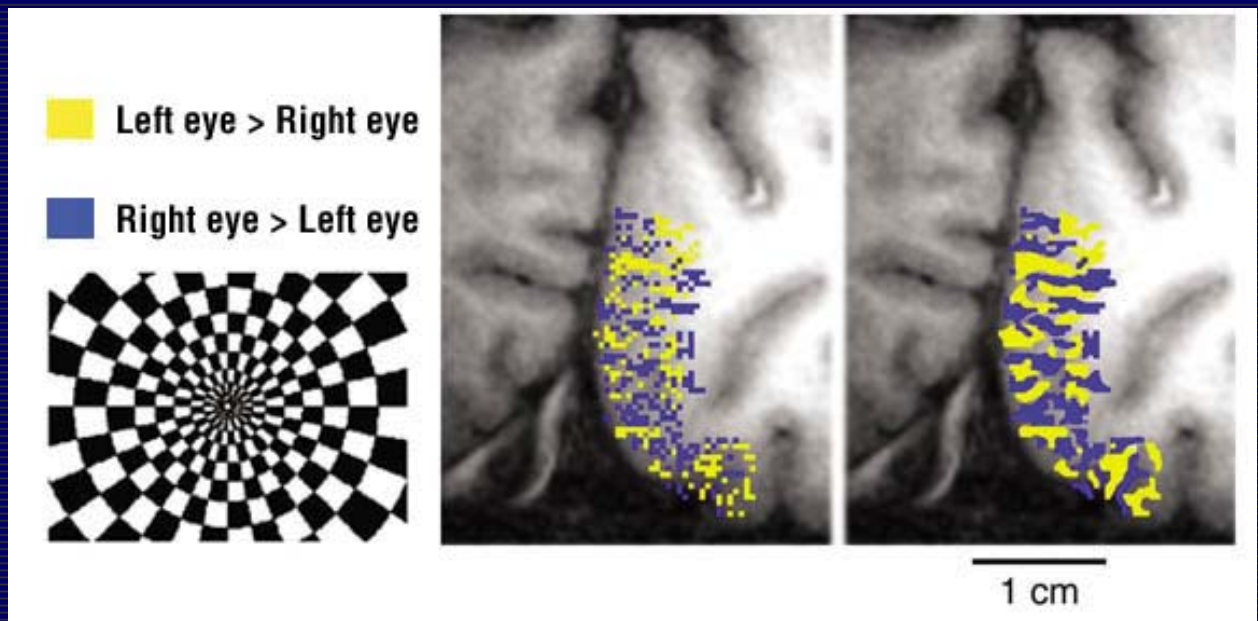


OCULAR DOMINANCE COLUMNS



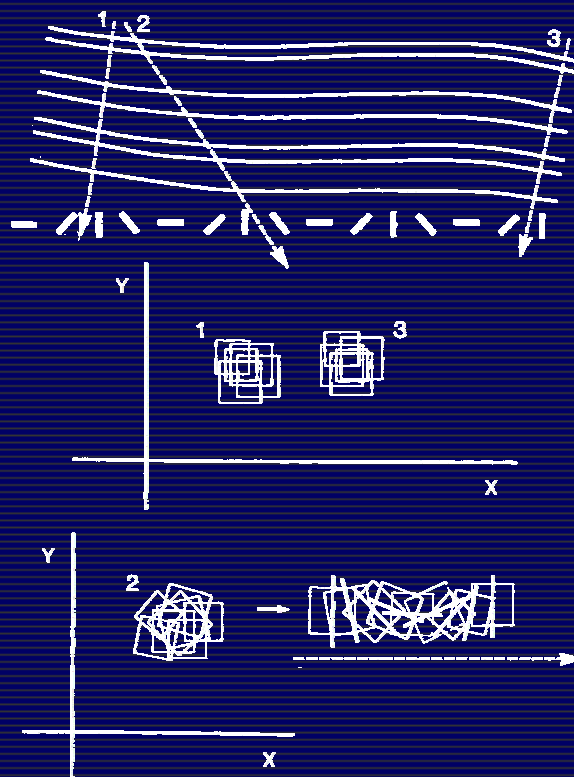
Li H, Fukuda M, Tanifuji M, Rockland KS.
Intrinsic collaterals of layer 6 Meynert cells and functional columns in primate V1. Neuroscience.
2003;120(4):1061-9

OCULAR DOMINANCE COLUMNS

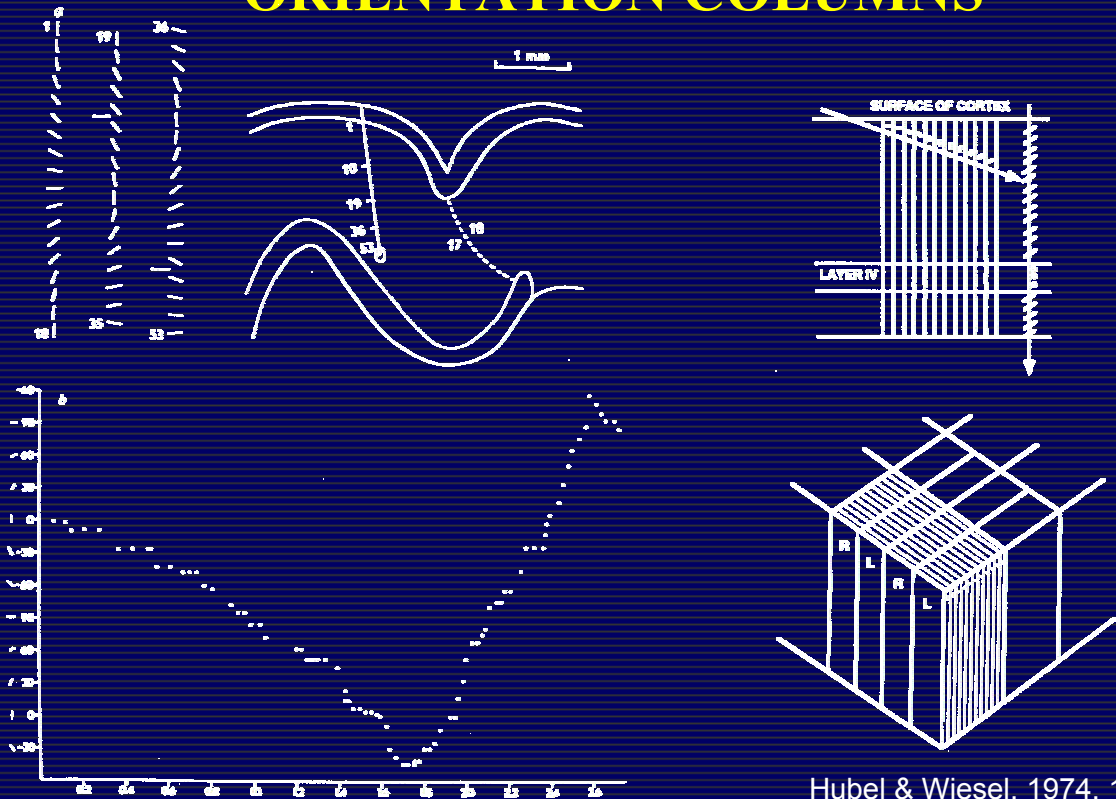


Cheng K., Waggoner R. A., and Tanaka K.: "Human ocular dominance columns as revealed by high-field functional magnetic resonance imaging" *Neuron* 32, 359-374 (2001).

ORIENTATION COLUMNS

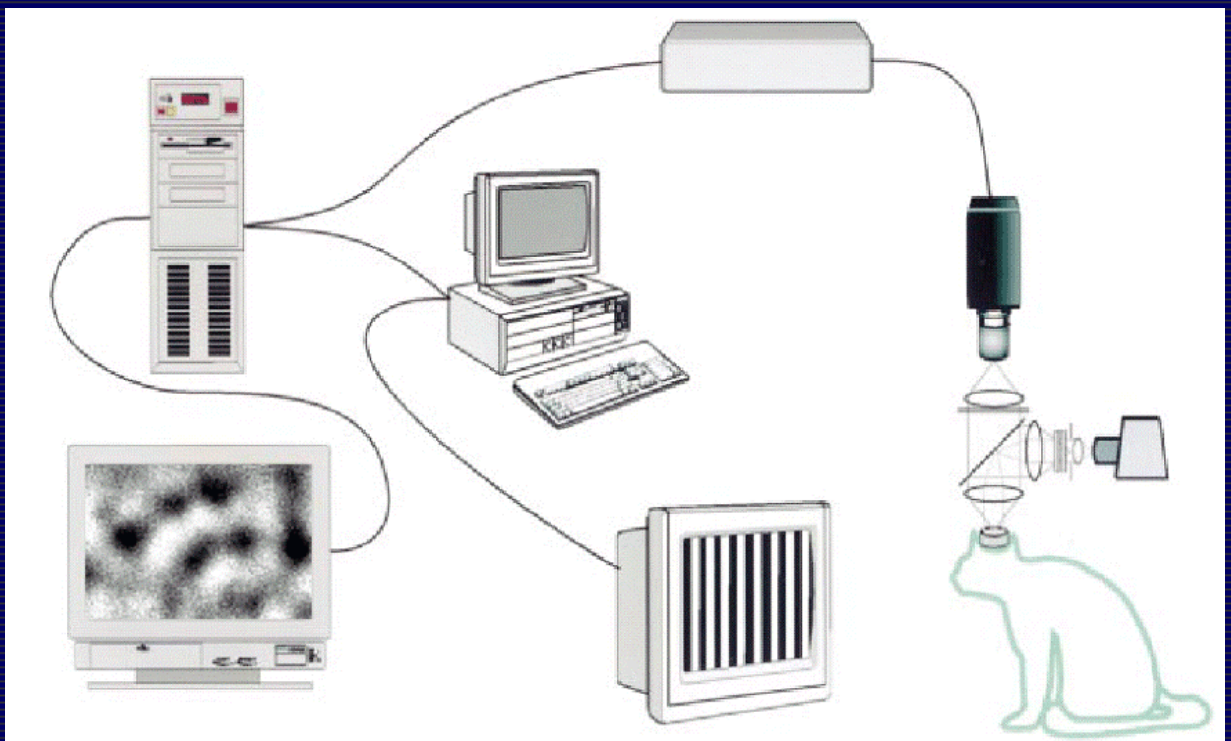


ORIENTATION COLUMNS

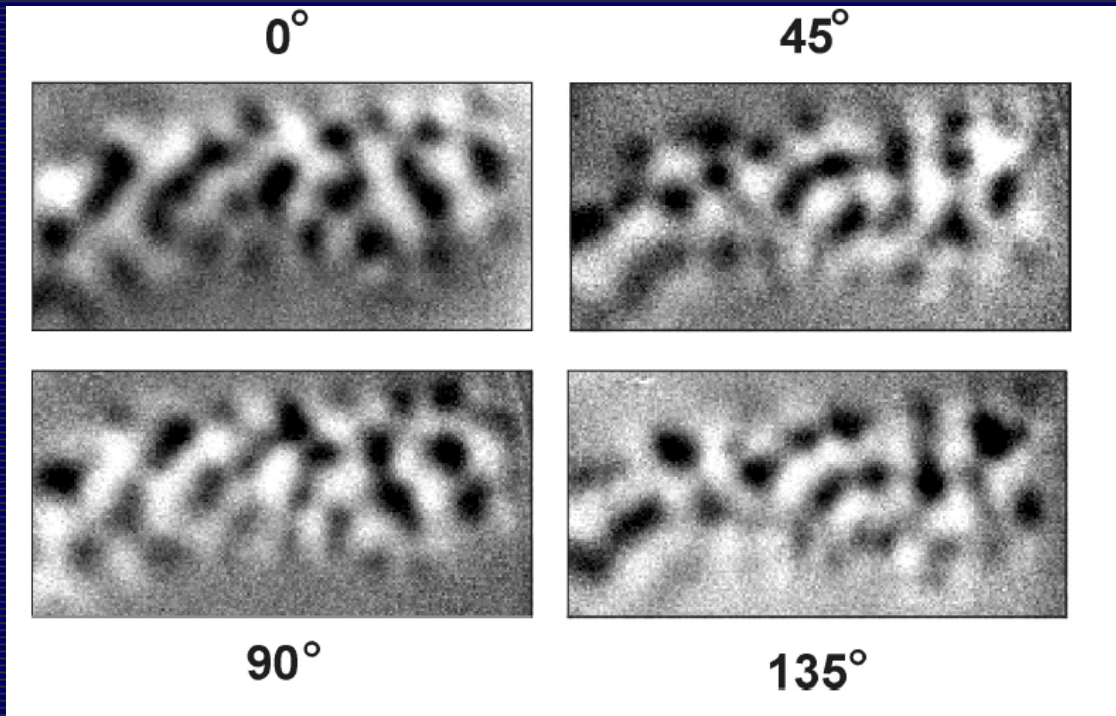


Hubel & Wiesel, 1974, 1977

OPTICAL IMAGING TECHNIQUES

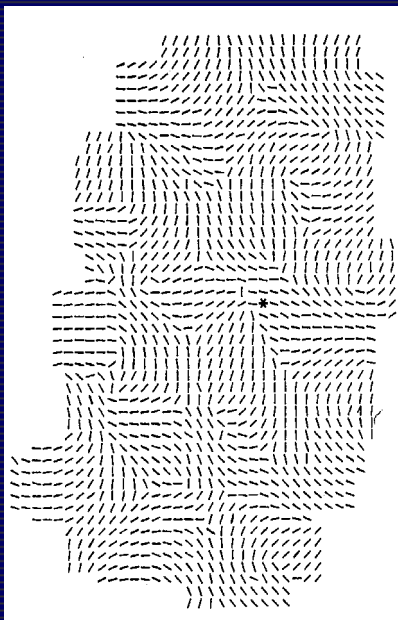


SINGLE CONDITION MAPS

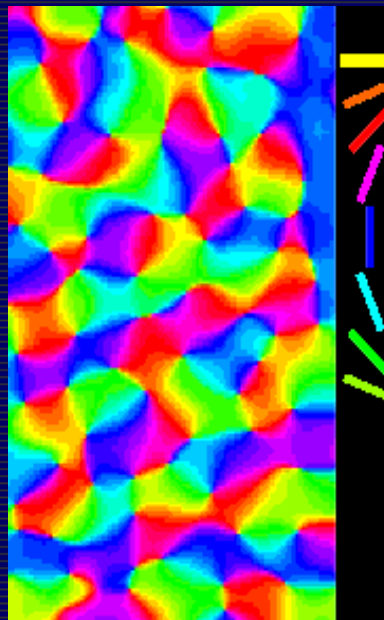


ORIENTATION MAPS

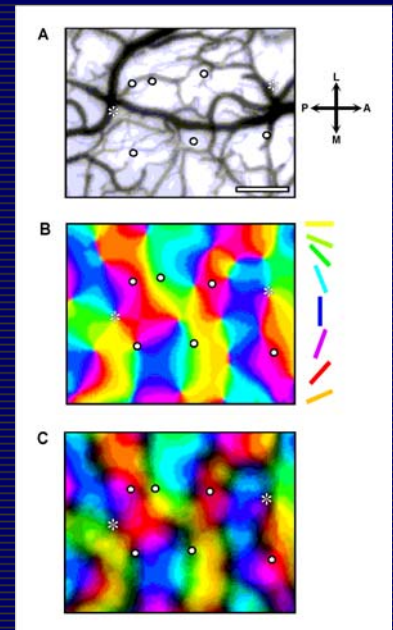
(The legacy of Hubel & Wiesel)



Swindale *et al.*, 1987

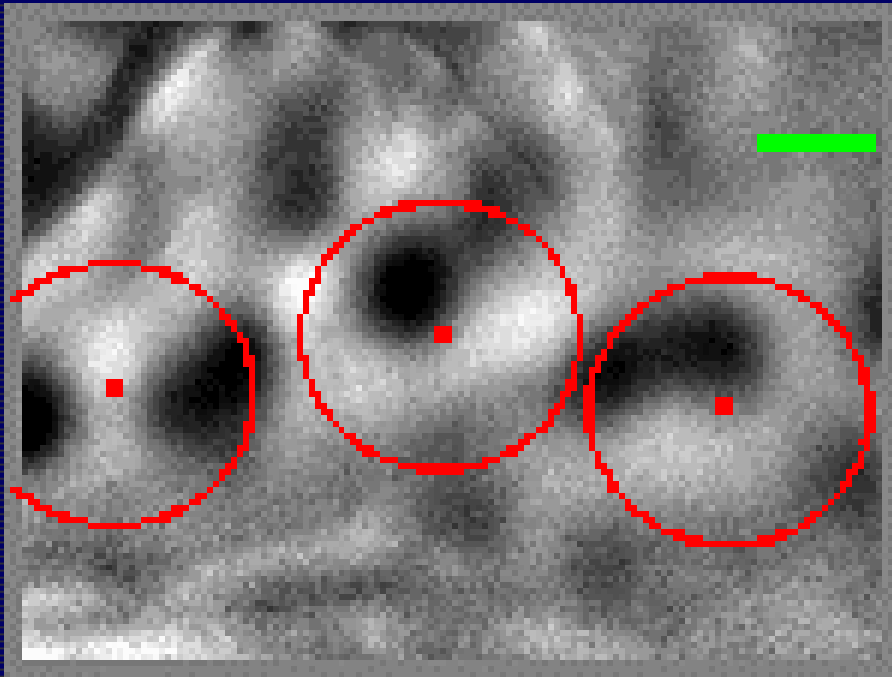


Bonhoeffer *et al.*, 1993

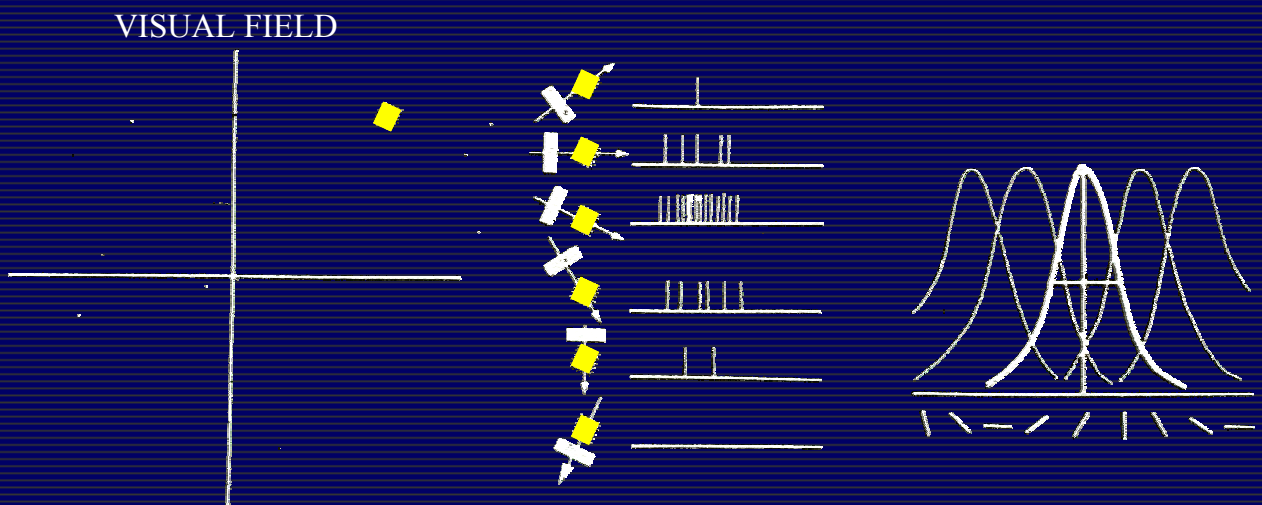


Maldonado *et al.*, 1997

ORIENTATION PINWHEELS

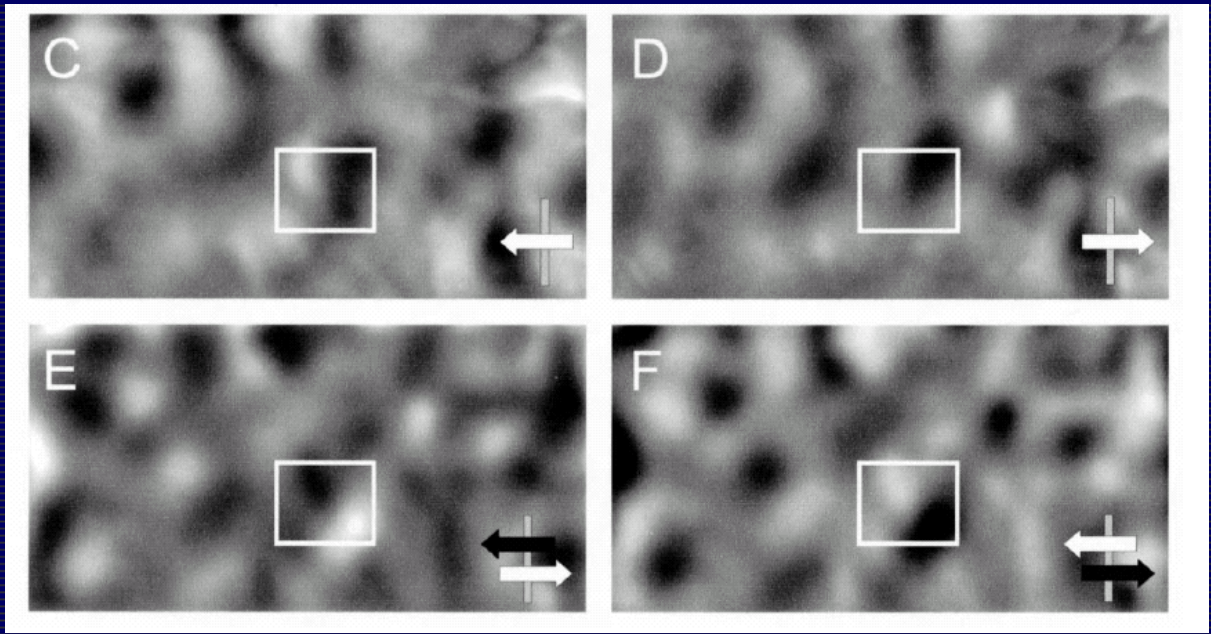


ORIENTATION TUNING CURVE



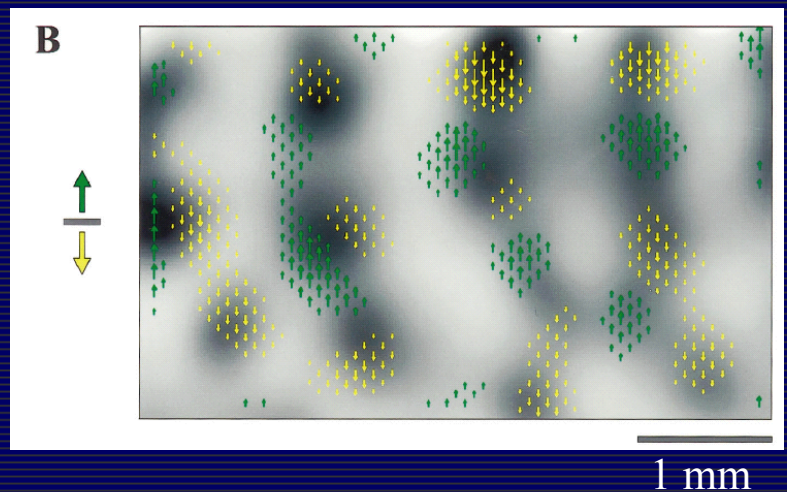
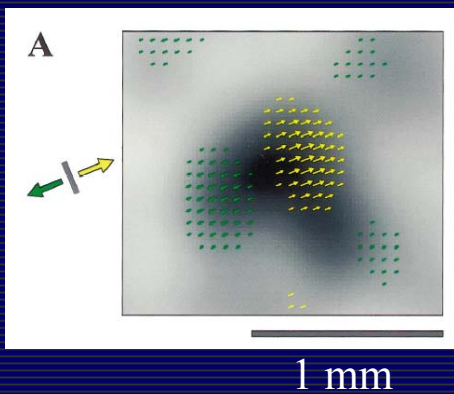
[Gilbert, 1989]

SINGLE CONDITION MAPS



[Kisvarday et al., 2001]

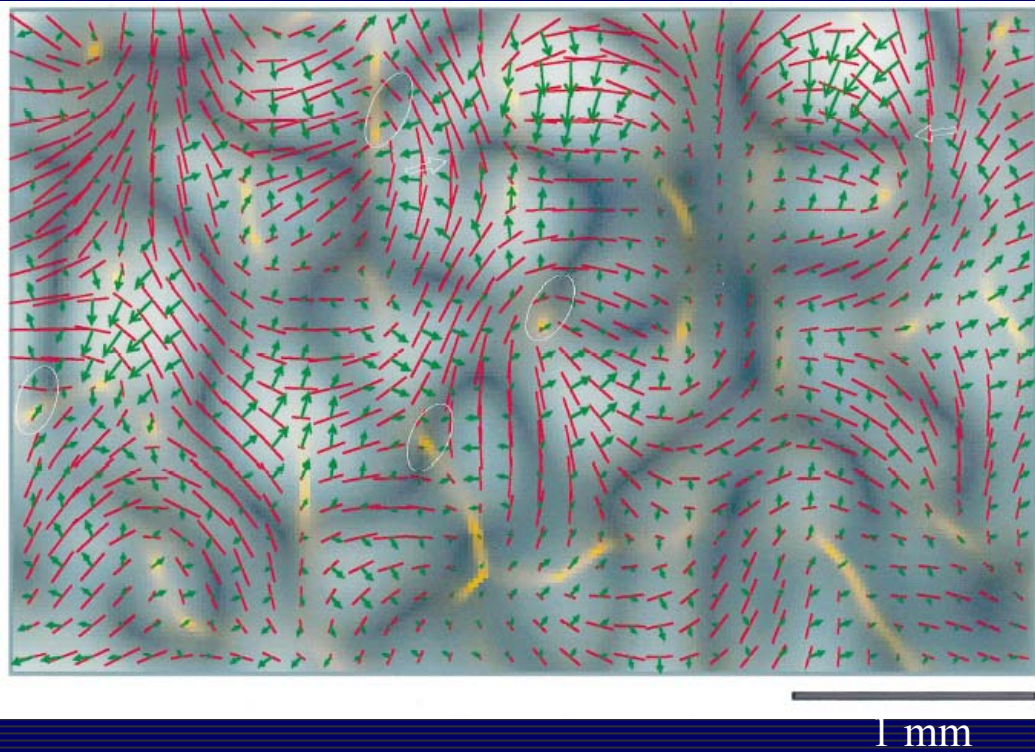
ORIENTATION *vs* DIRECTION SELECTIVITY



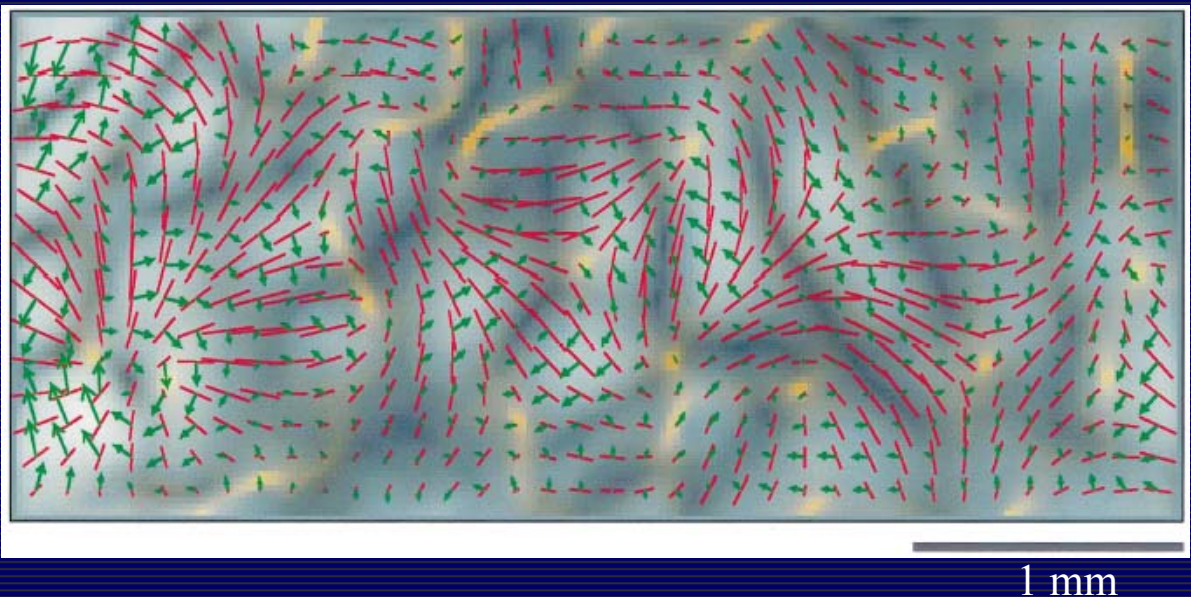
[Grinvald et al., 1999]

ORIENTATION vs DIRECTION SELECTIVITY

[Grinvald et al., 1999]

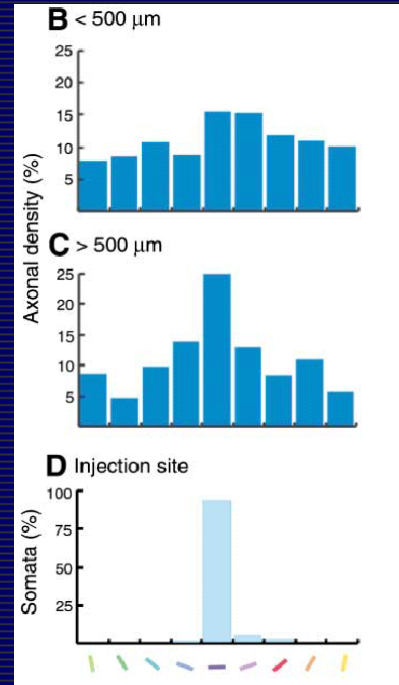
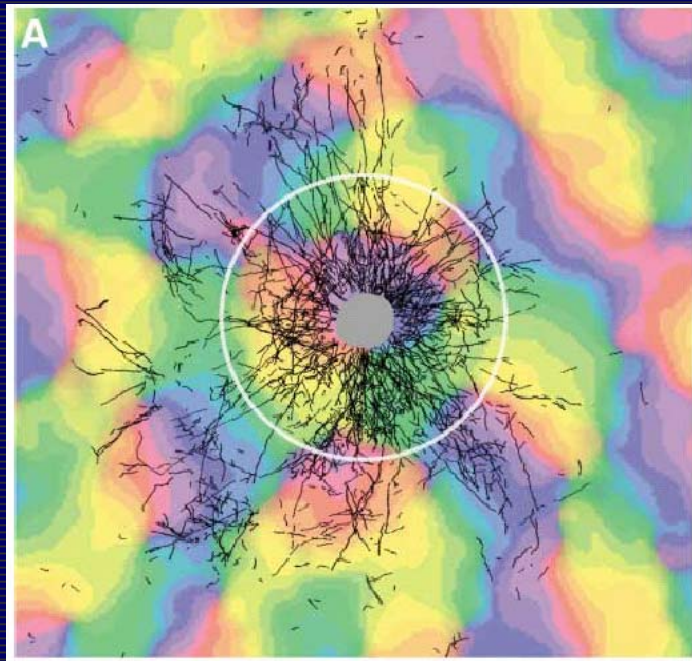


ORIENTATION vs DIRECTION SELECTIVITY



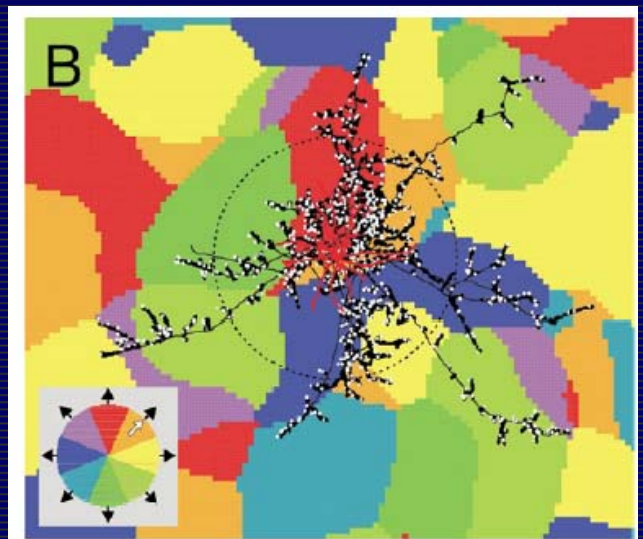
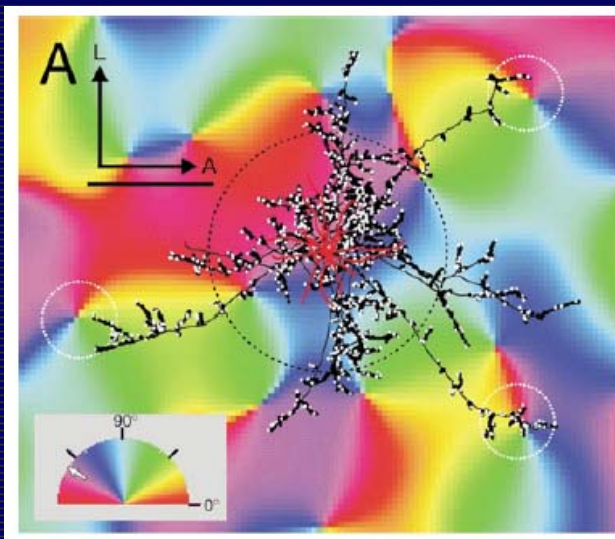
[Grinvald et al., 1999]

INTRACORTICAL CONNECTIONS



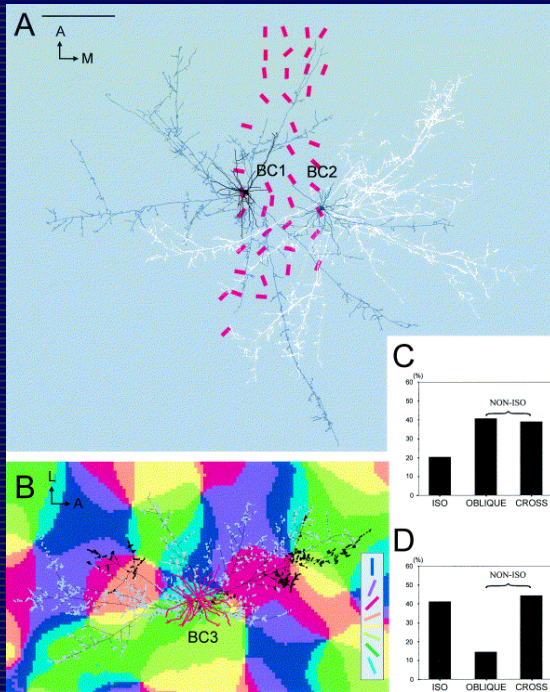
[Stettler *et al.*, 2002]

INTRACORTICAL CONNECTIONS

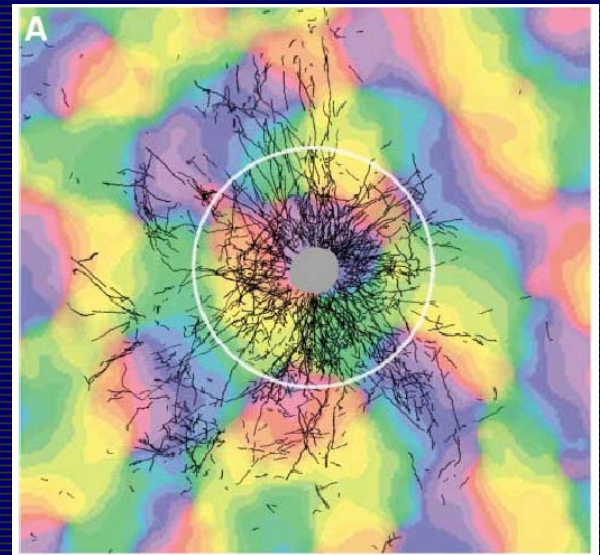


[Kisvarday *et al.* 2000]

INTRACORTICAL CONNECTIONS



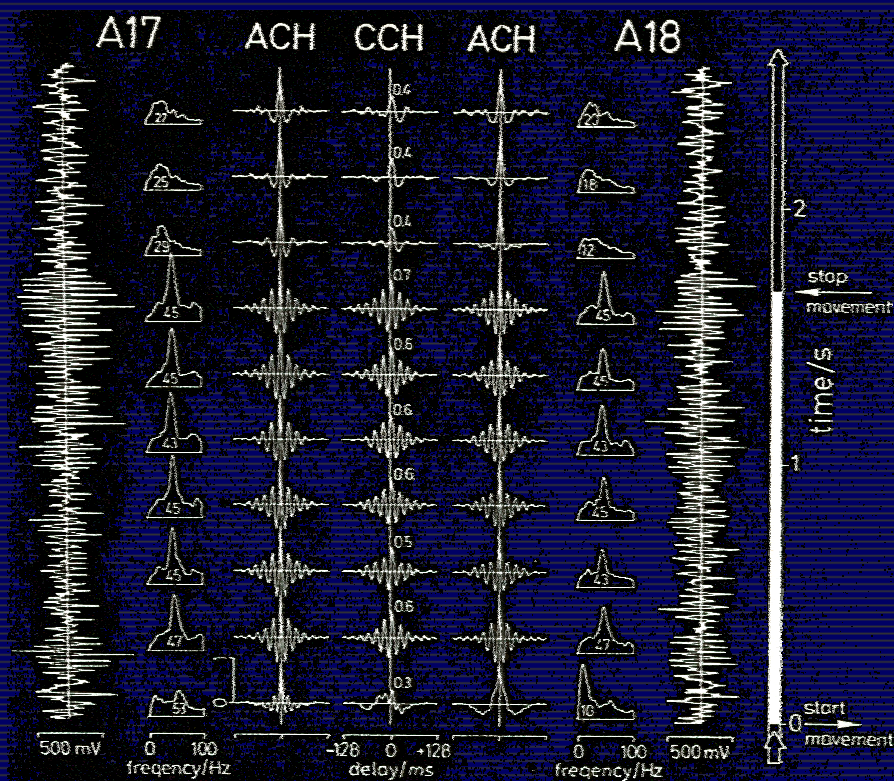
[Kisvarday *et al.* 2000]



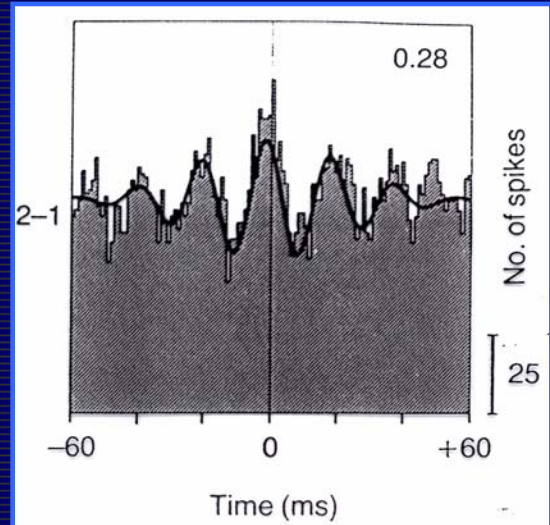
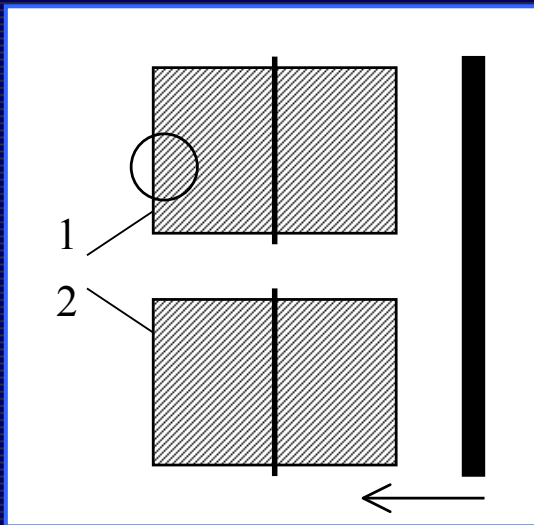
[Stettler *et al.*, 2002]

LINKING FIELDS

[Eckhorn *et al.*, 1988]

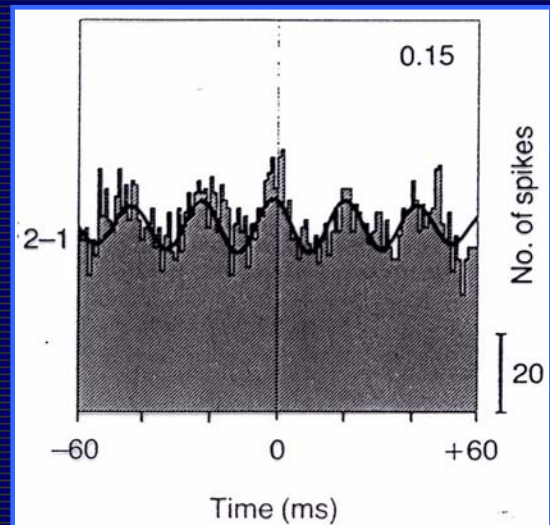
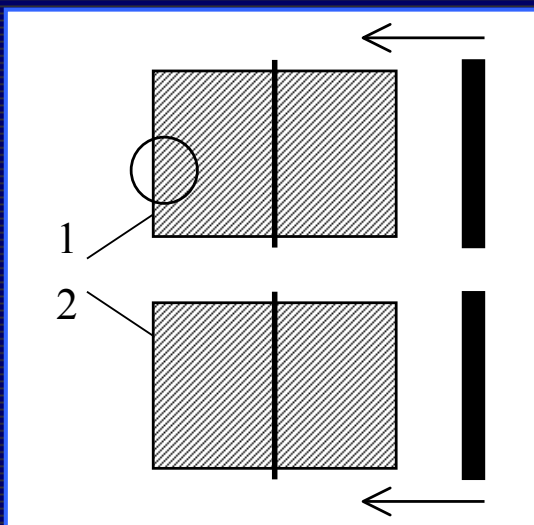


TEMPORAL CODING IN THE VISUAL CORTEX



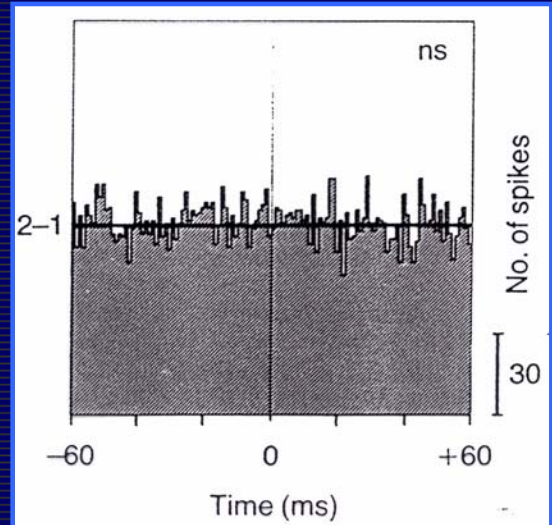
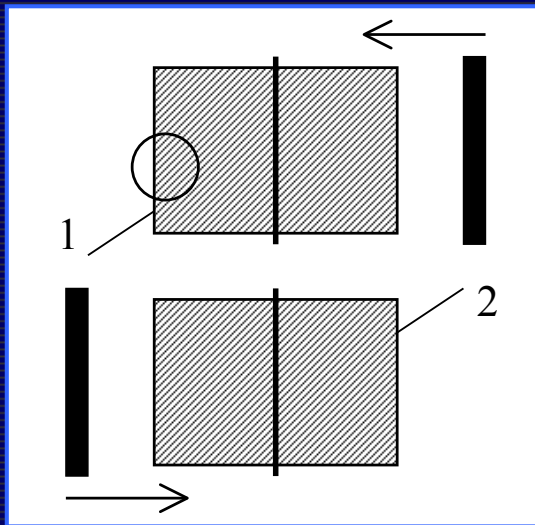
[Engel *et al.*, 1992]

TEMPORAL CODING IN THE VISUAL CORTEX



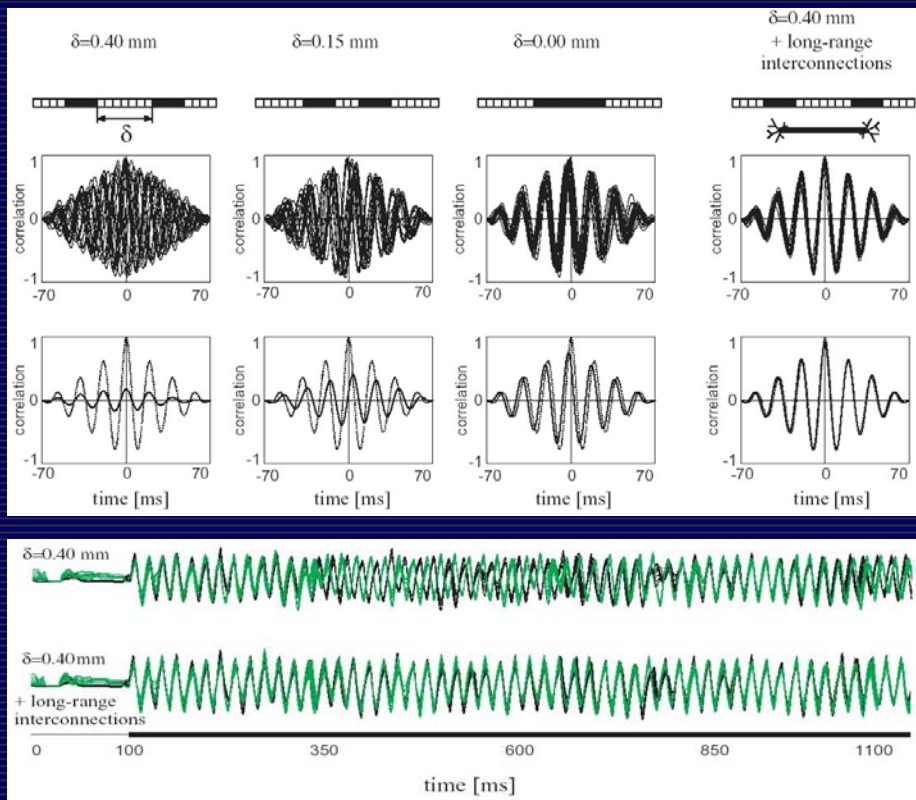
[Engel *et al.*, 1992]

TEMPORAL CODING IN THE VISUAL CORTEX



[Engel *et al.*, 1992]

TEMPORAL CODING



[Sabatini *et al.*, 2004]