

## Le immagini ibride



### Speaker:

Alessandro Farini  
CNR-Istituto Nazionale di Ottica  
UNIFI-cds in Ottica e Optometria  
IRSOO-Vinci

Caffè Scienza Firenze



# Chi sono



<https://linktr.ee/alessandrofarini>





Illusioni visuali in cui due differenti interpretazioni di un'immagine possono essere percepite **cambiando la distanza da cui sono viste o il tempo a cui sono presentate**

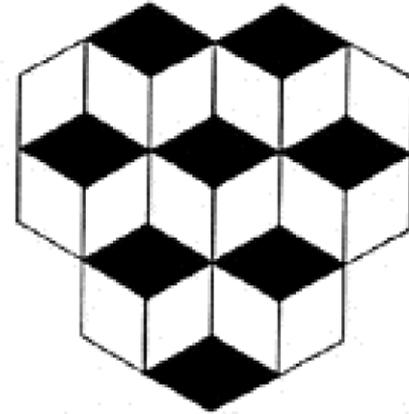
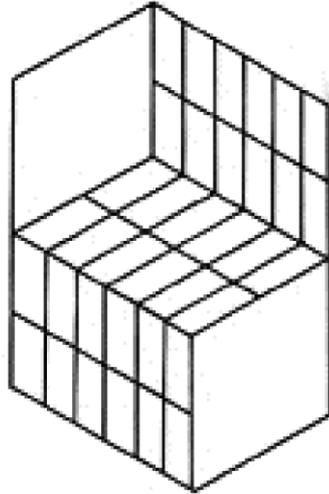
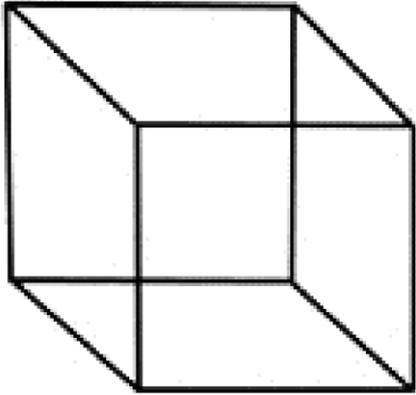


Illusioni visuali in cui due differenti interpretazioni di un'immagine possono essere percepite.



# Immagini bistabili

# Immagini bistabili



Arecchi, F.T., Farini, A. & Megna, N. A test of multiple correlation temporal window characteristic of non-Markov processes. *Eur. Phys. J. Plus* 131, 50 (2016). <https://doi.org/10.1140/epjp/i2016-16050-6>

<https://arxiv.org/abs/1504.07089>



# Immagini bimodali

#thedress  
March 2015





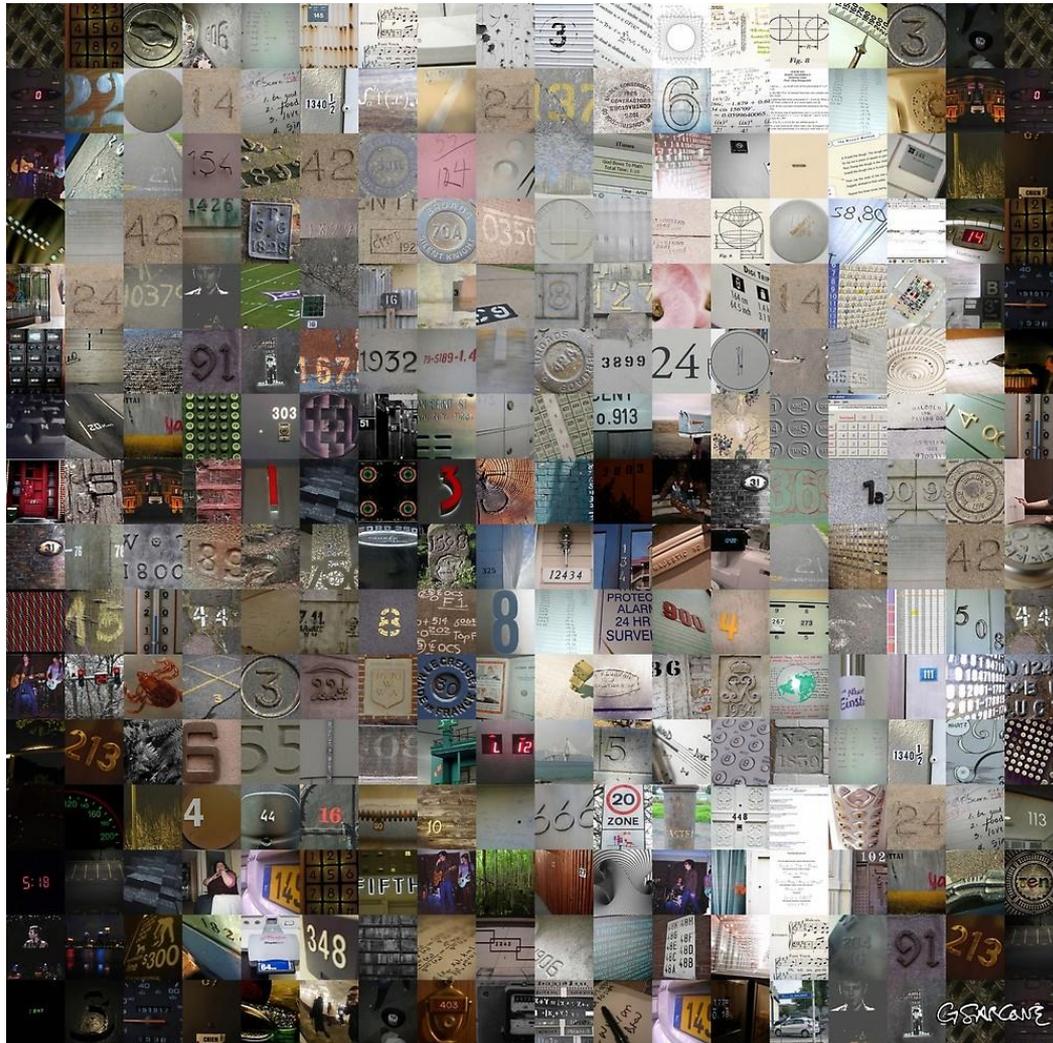


# Immagini mosaico

# Immagine mosaico



# Gianni Sarcone

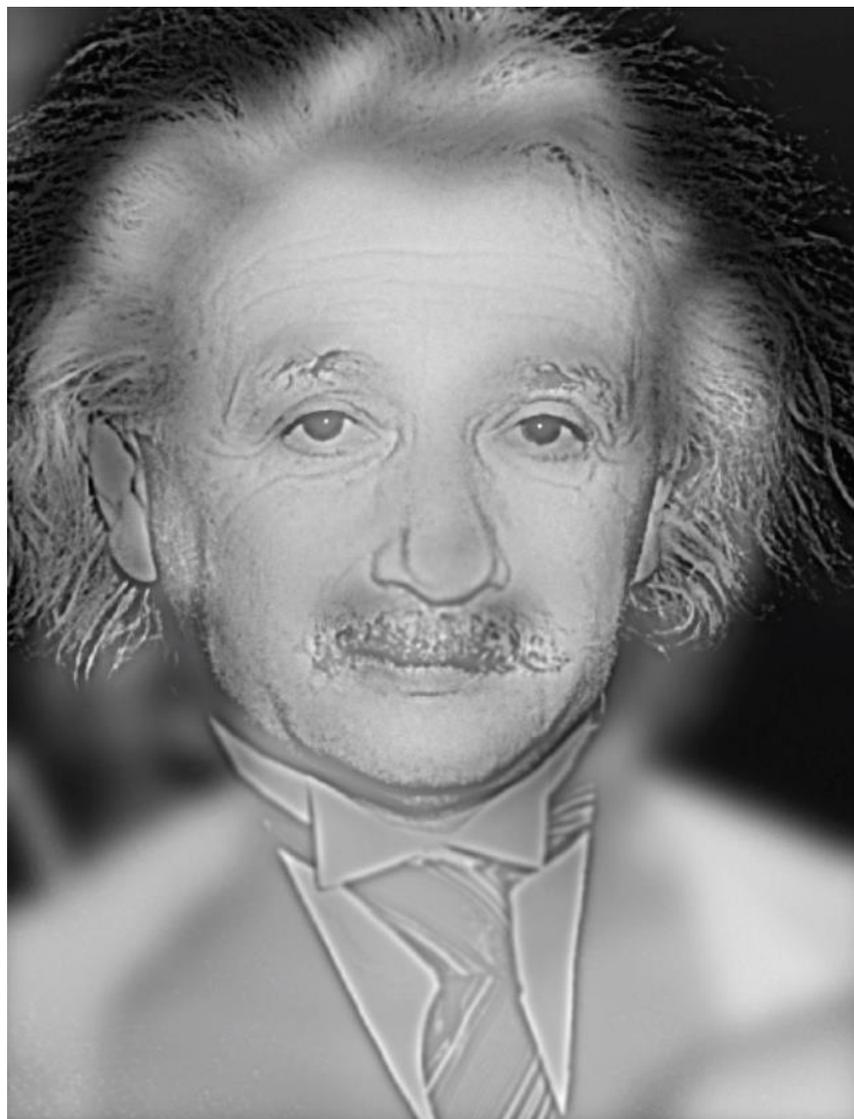


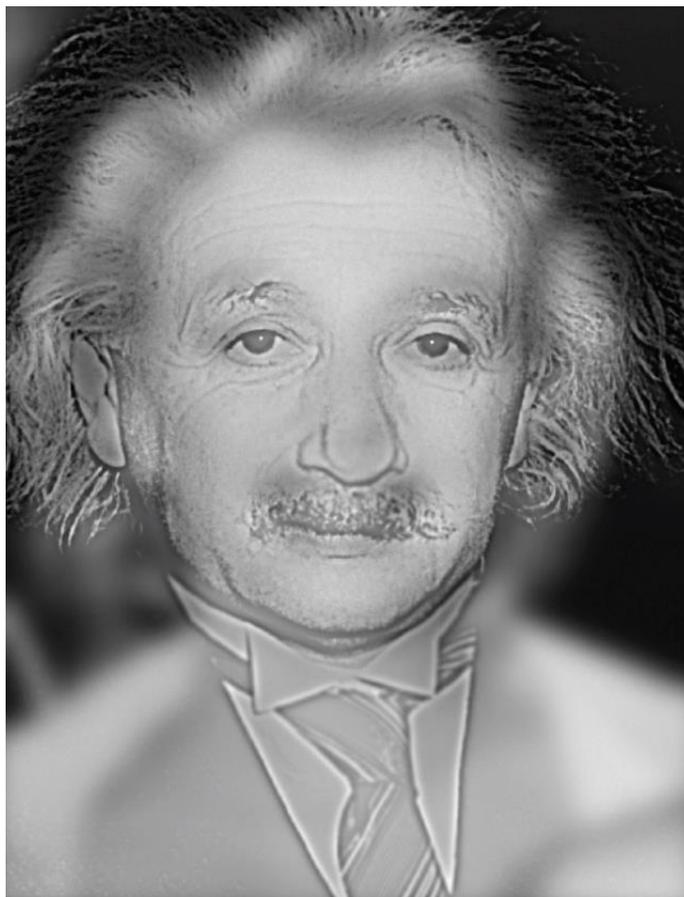


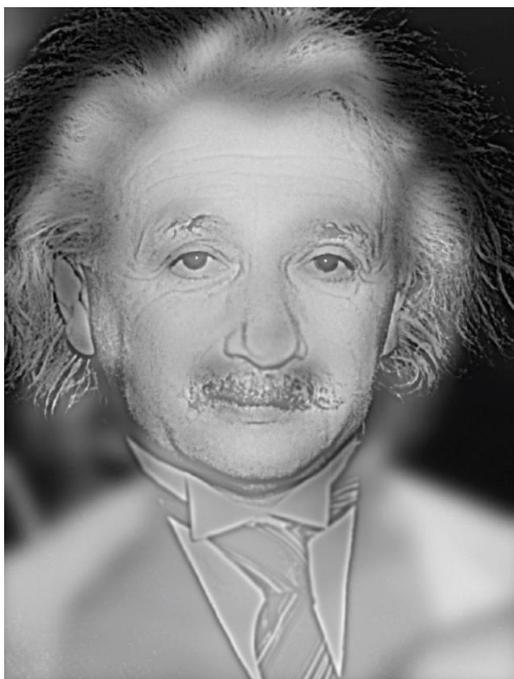
<https://www.giannisarcone.com/wp/blog/tag/albert-einstein/>

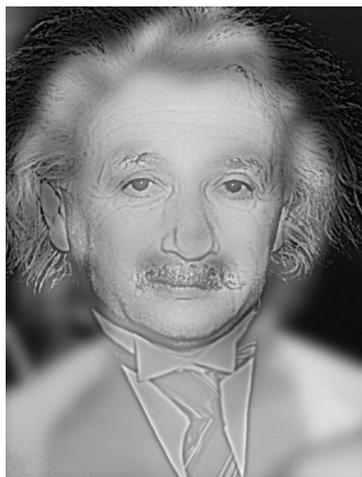


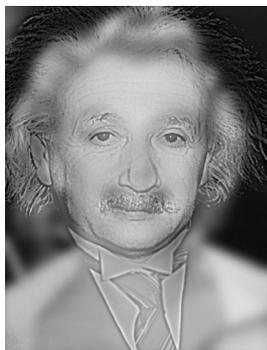
**Ma allora cosa sono le  
immagini ibride?**

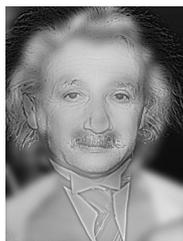














# Vuoi vederne di più e dal vivo?



Vieni a vedere la mostra stabile che si trova  
al Dipartimento di Fisica «Enlighting mind»

 ENLIGHTING MIND

Forme impossibili, anamorfosi, effetti 3D, sfondi e illusioni di contrasto, oggetti in movimento, figure bistabili:  
*uno straordinario viaggio di **disorientamento percettivo della realtà**, nel mondo delle illusioni ottiche.*



Di cosa è fatta un'immagine?

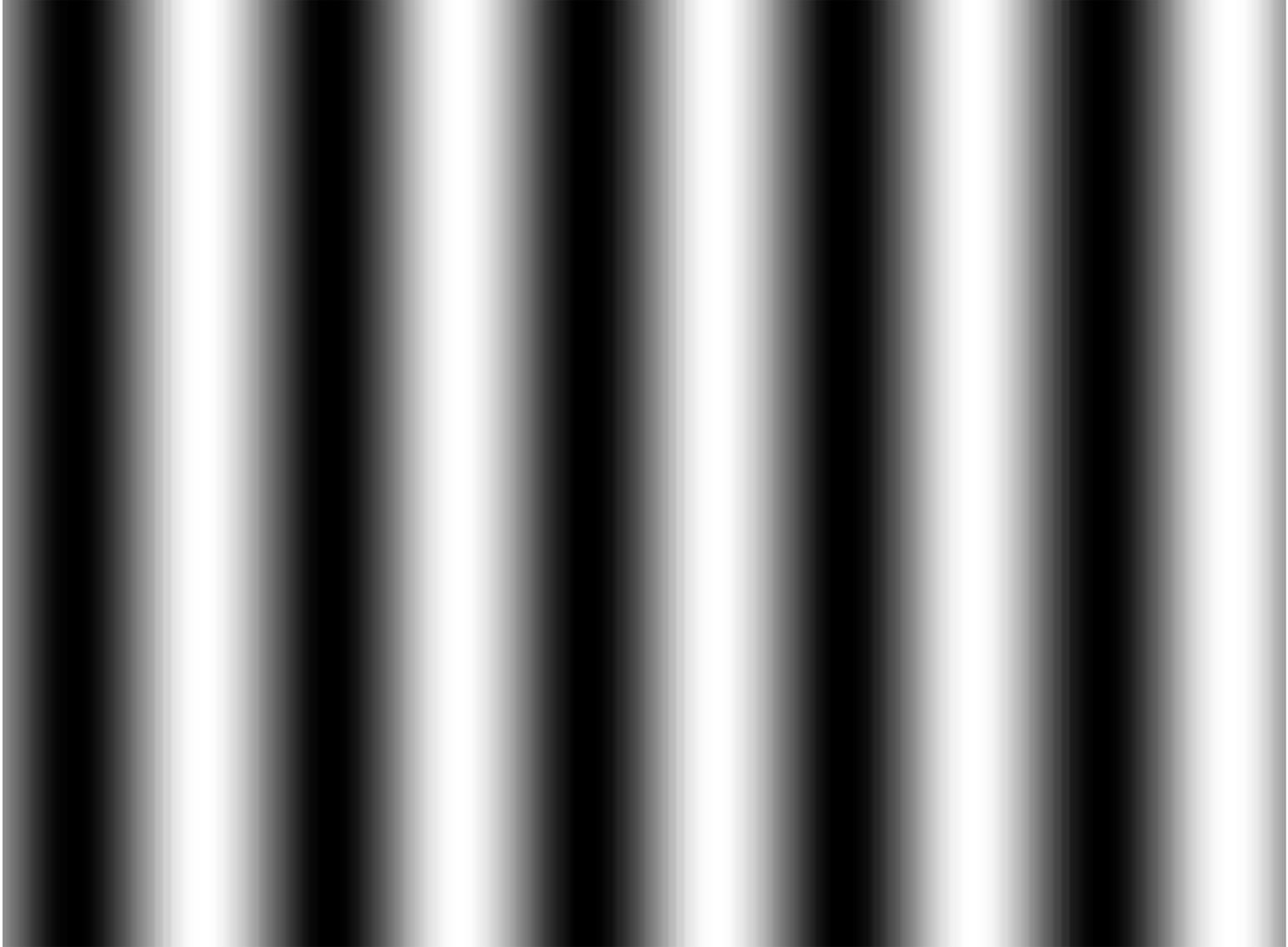
# Tipico comportamento da fisico



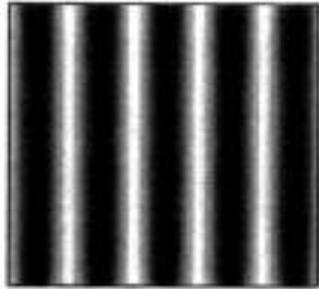
<https://www.youtube.com/watch?v=Xk2eVX5FTnE>



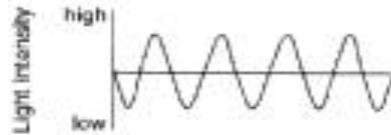
# Tipico comportamento da fisico



# I parametri di un reticolo



A. Sinusoidal Grating

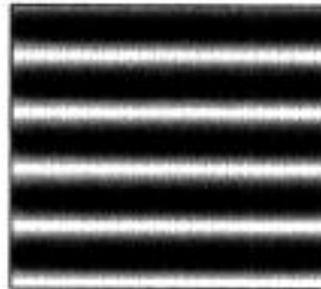


Un reticolo sinusoidale può essere definito da quattro parametri

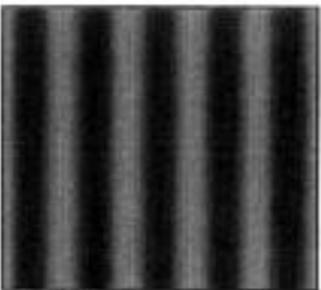
1. Frequenza spaziale
2. Orientamento
3. Modulazione (Contrasto)
4. Fase



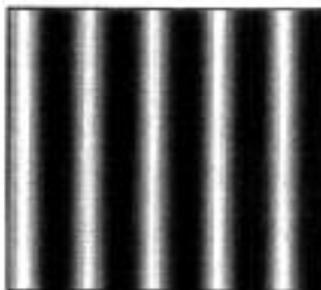
B. Different Frequency



C. Different Orientation

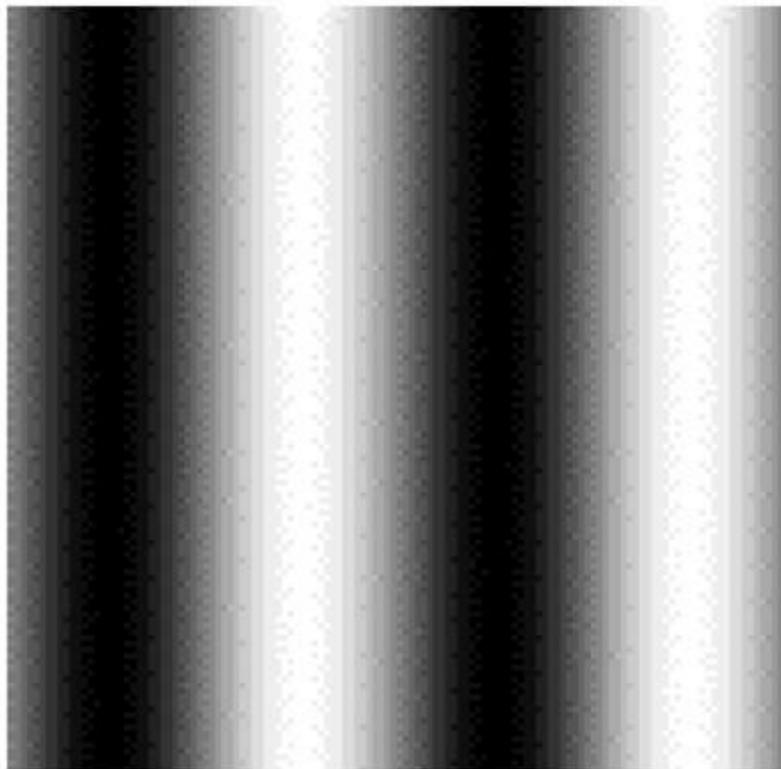


D. Different Amplitude

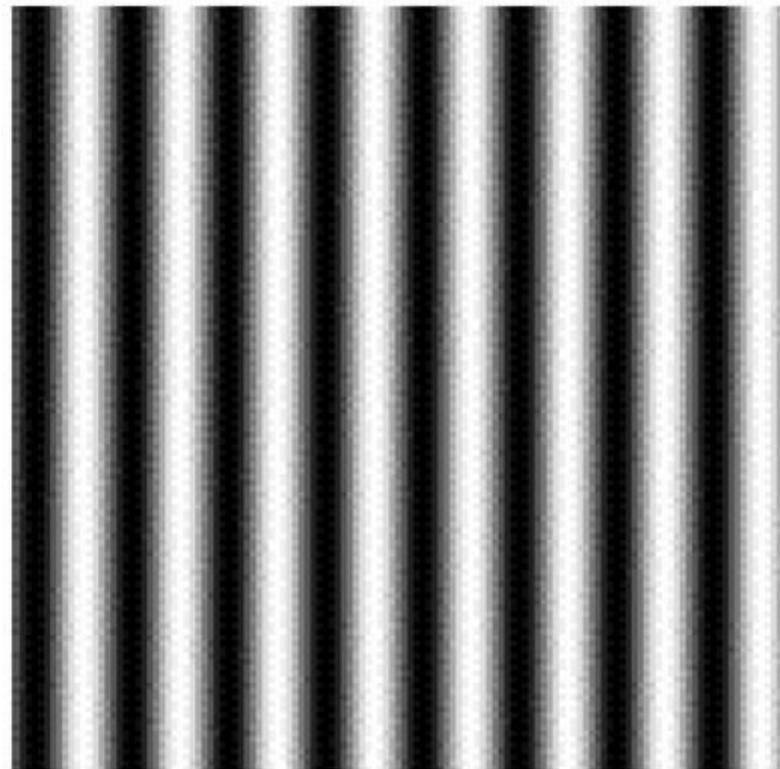


E. Different Phase

# La frequenza spaziale

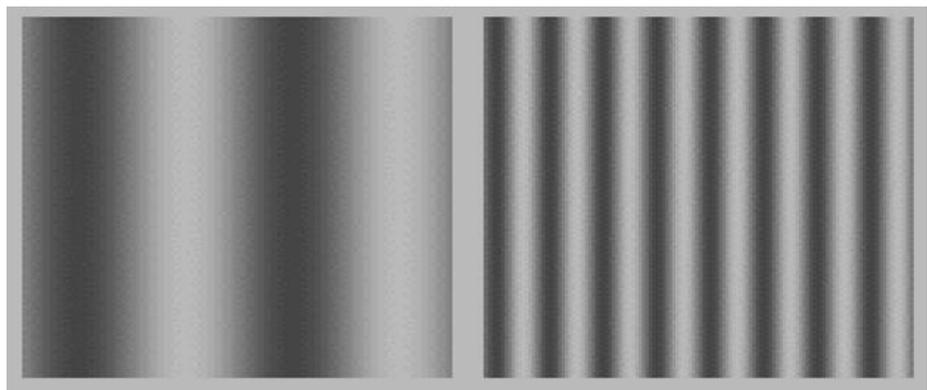
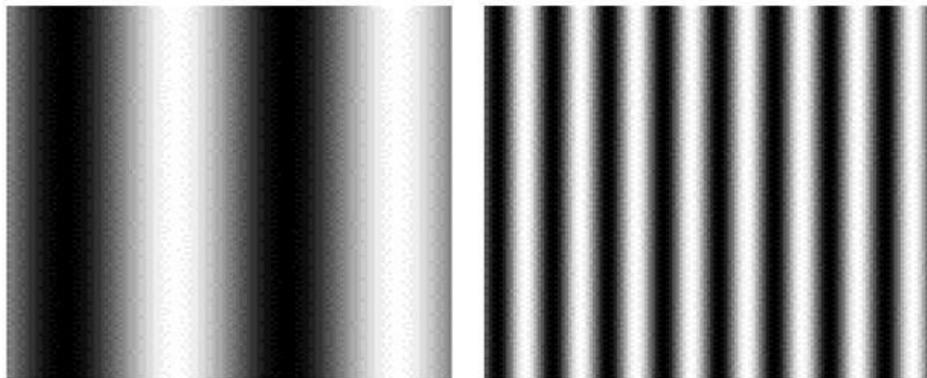


Low SF



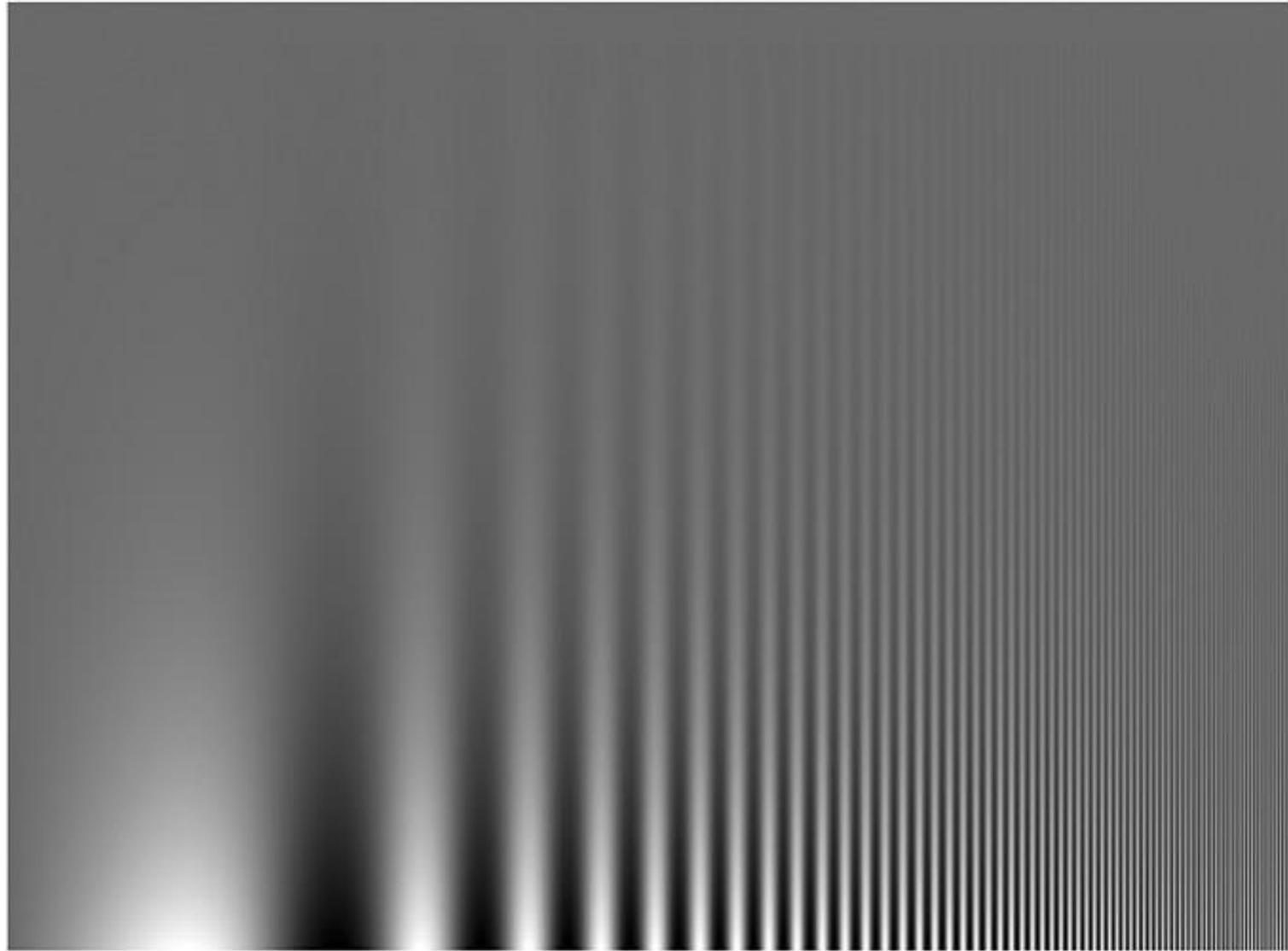
High SF

# Modulazione



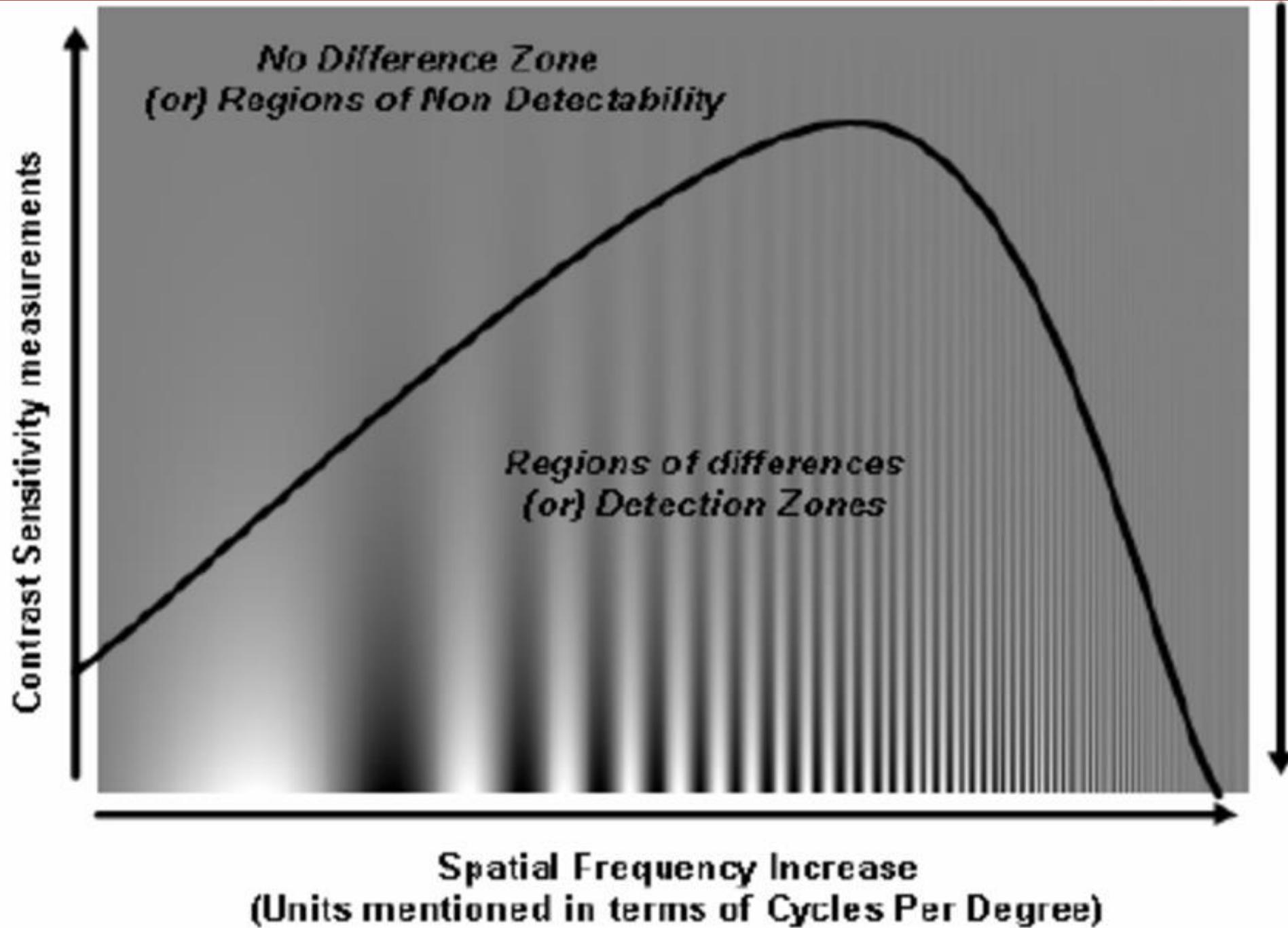


Contrasto



frequenza





# Acuità visiva



Quale è la frequenza spaziale più elevata che riesco a risolvere? (cioè quanto possono essere vicine due righe che io continuo a vedere separate)

	Log	VAR
V D R S N	1.0	50
R V K D C	0.9	55
Z O N C R	0.8	60
N V D K S	0.7	65
V S O Z H	0.6	70
D N R H C	0.5	75
Z O C V K	0.4	80
O D R V K	0.3	85
K S N C H	0.2	90
C D O S N	0.1	95
V D D C R	0	100
H L D R S	-0.1	105
K L D R S	-0.2	110
K L D R S	-0.3	115

# Teorema di Fourier per le immagini



Ogni immagine bidimensionale può essere considerata come la composizione di reticoli sinusoidali che differiscono in **frequenza spaziale**, orientamento, **modulazione** e fase





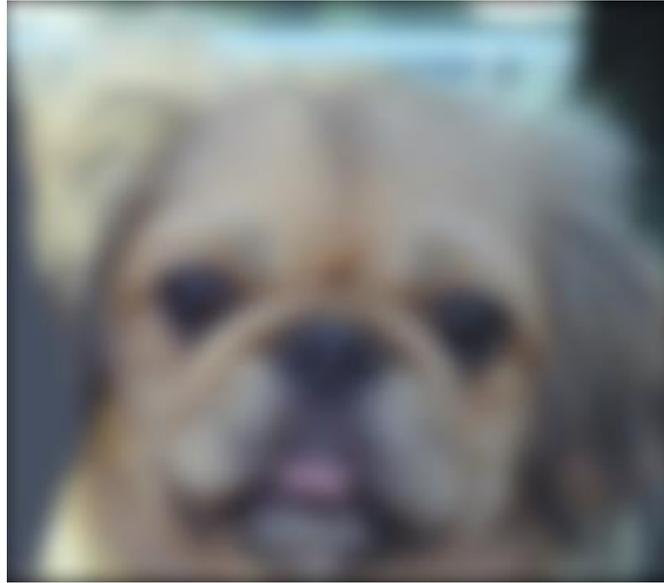
Immagine completa



Solo frequenze spaziali basse

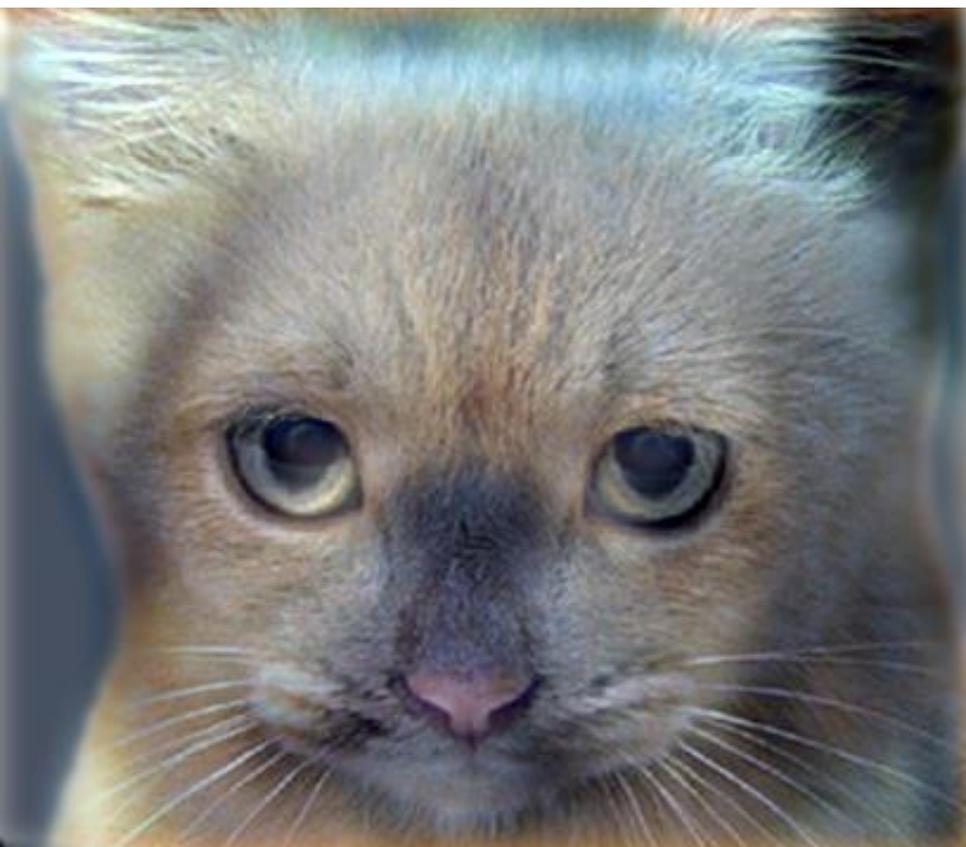


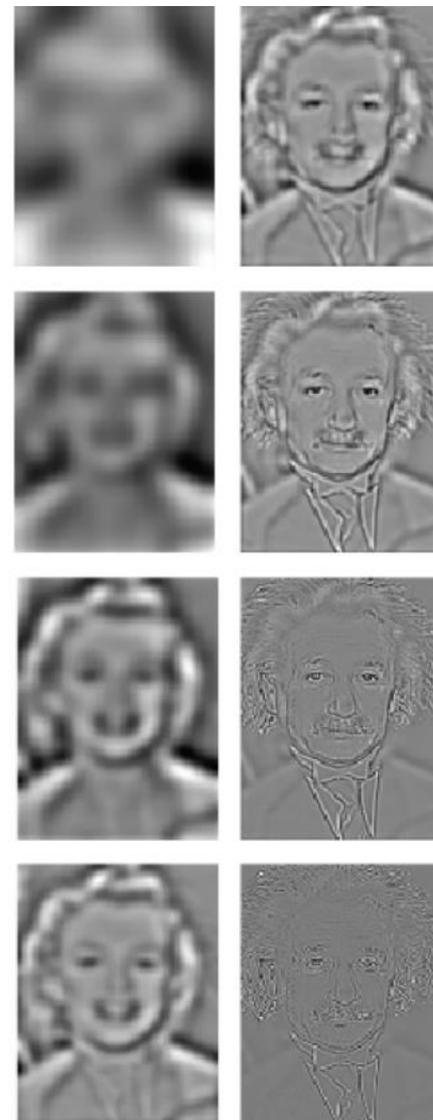
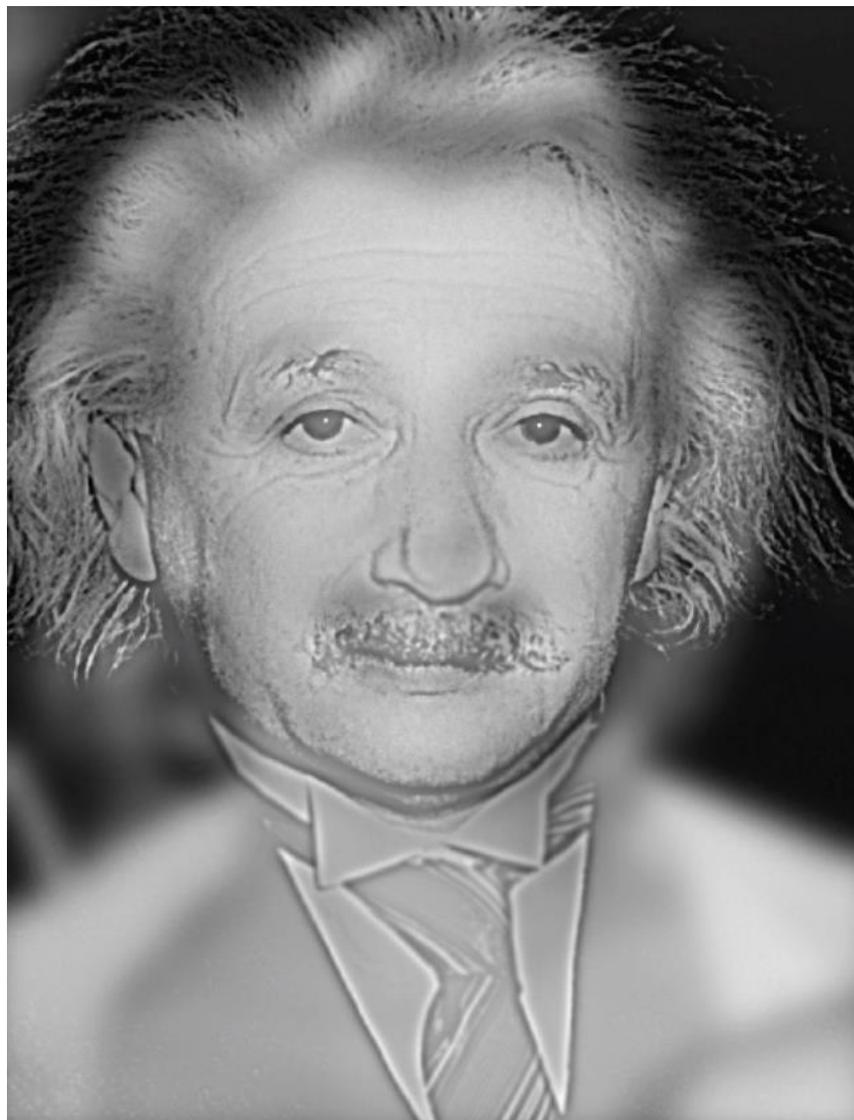
Solo frequenze spaziali alte



[https://sites.c.c.gatech.edu/classes/AY2016/cs4476\\_fall/results/proj1/html/smanivasagam3/index.html](https://sites.c.c.gatech.edu/classes/AY2016/cs4476_fall/results/proj1/html/smanivasagam3/index.html)









## Hybrid images

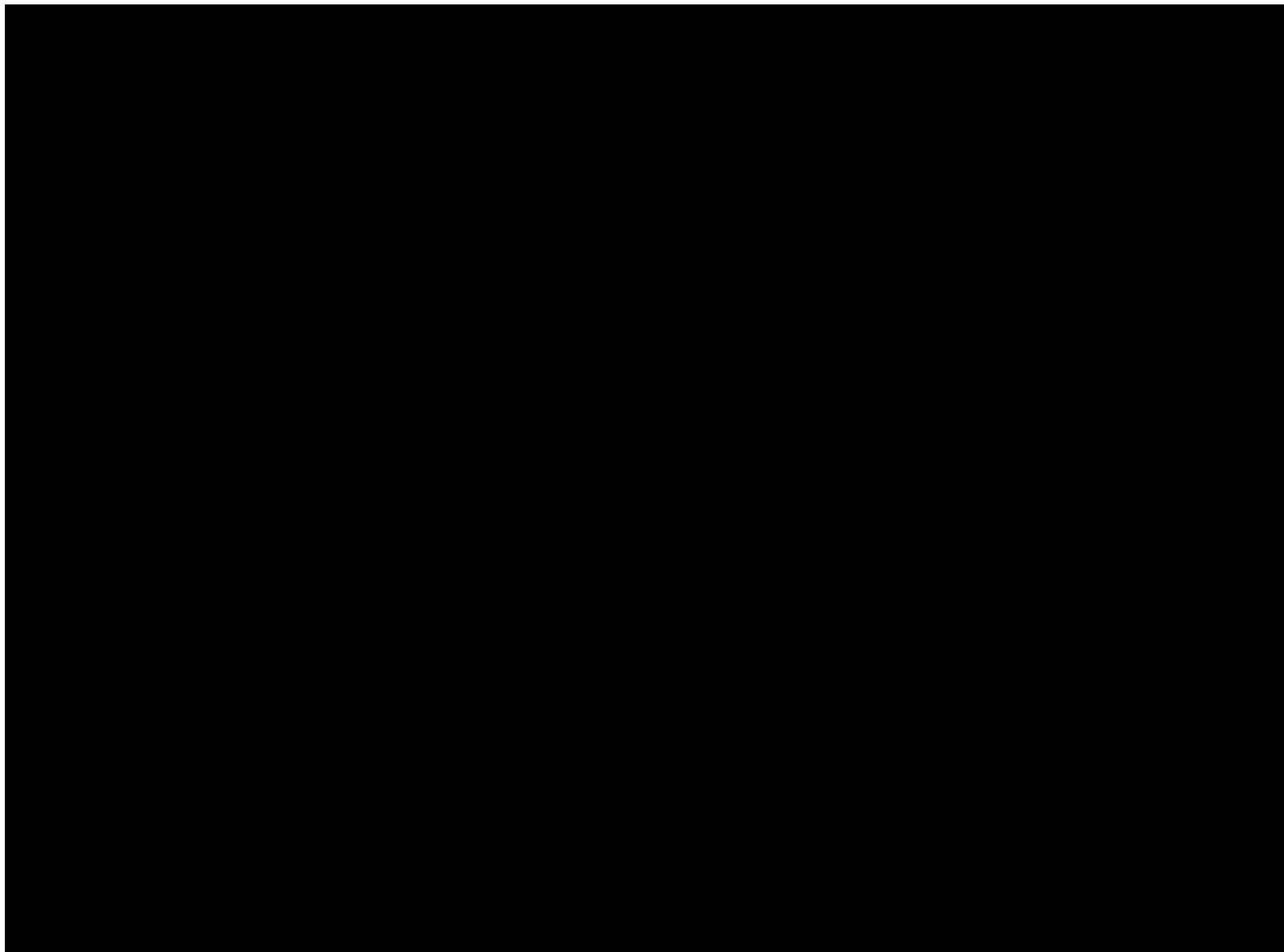
Video di:

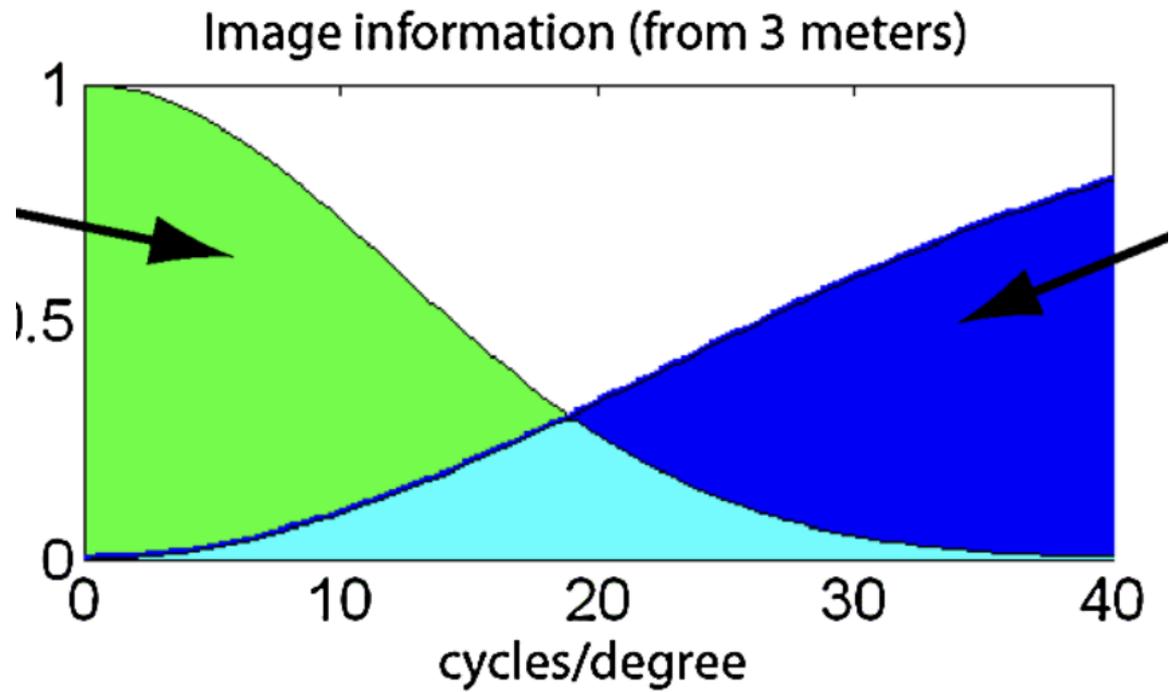
Aude Oliva

Antonio Torralba

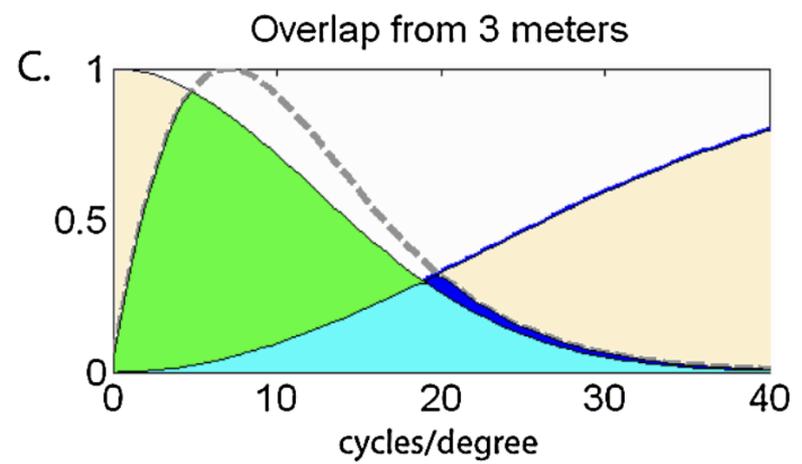
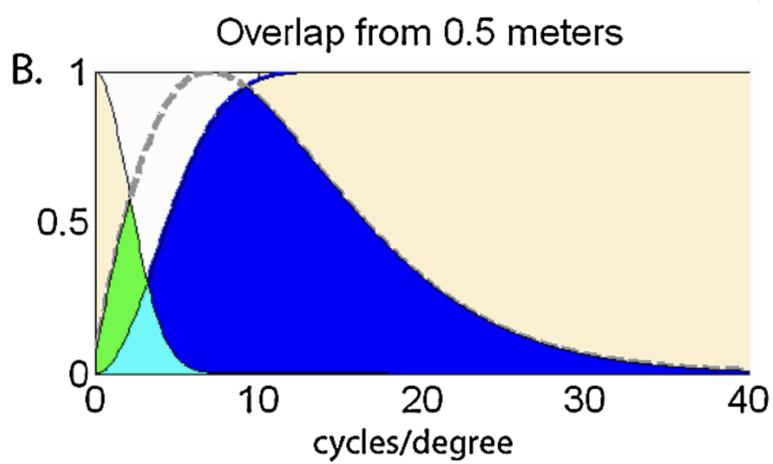
Philippe G. Schyns

<http://olivalab.mit.edu/publications/Hybrid.mp4>

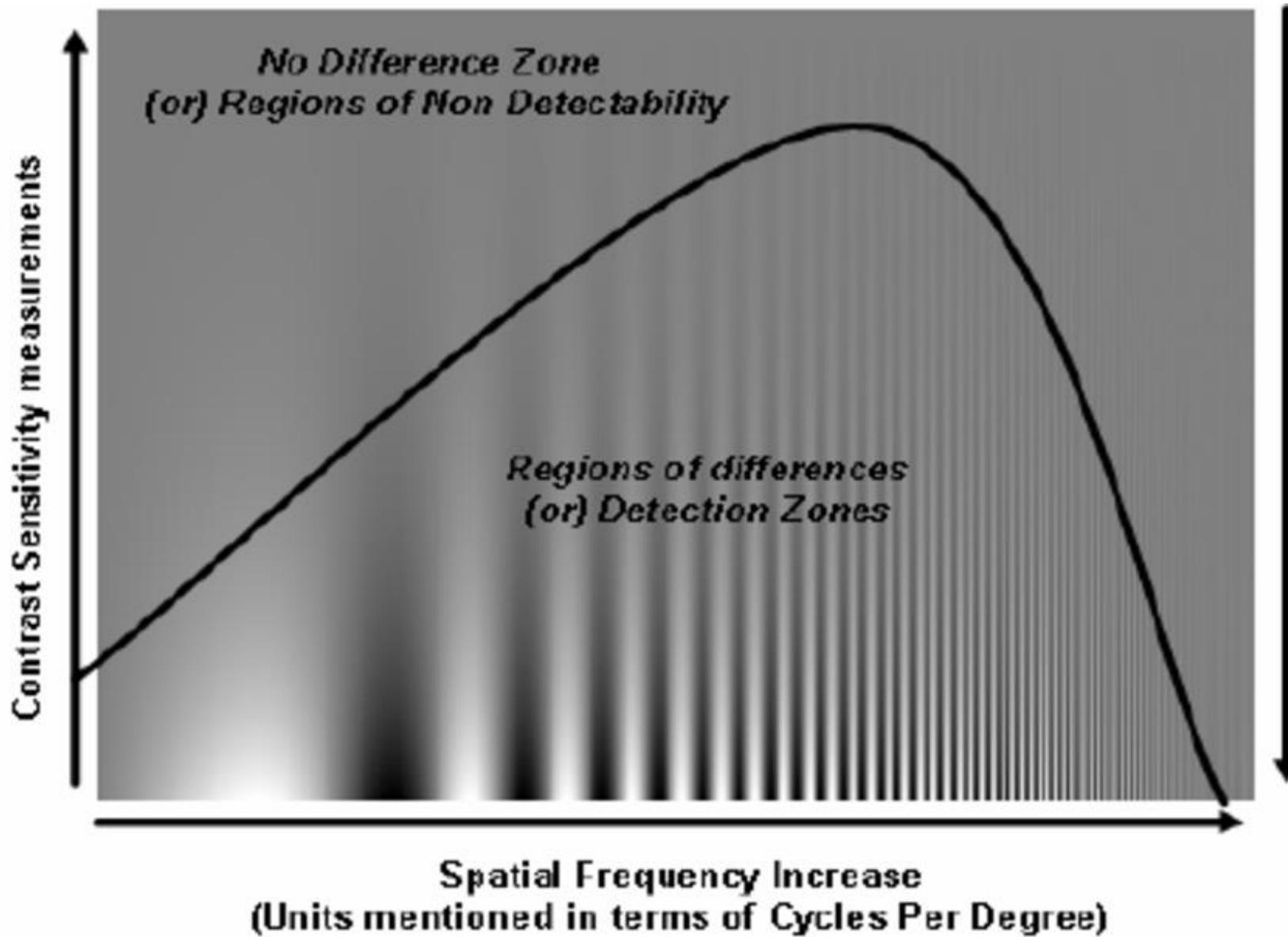


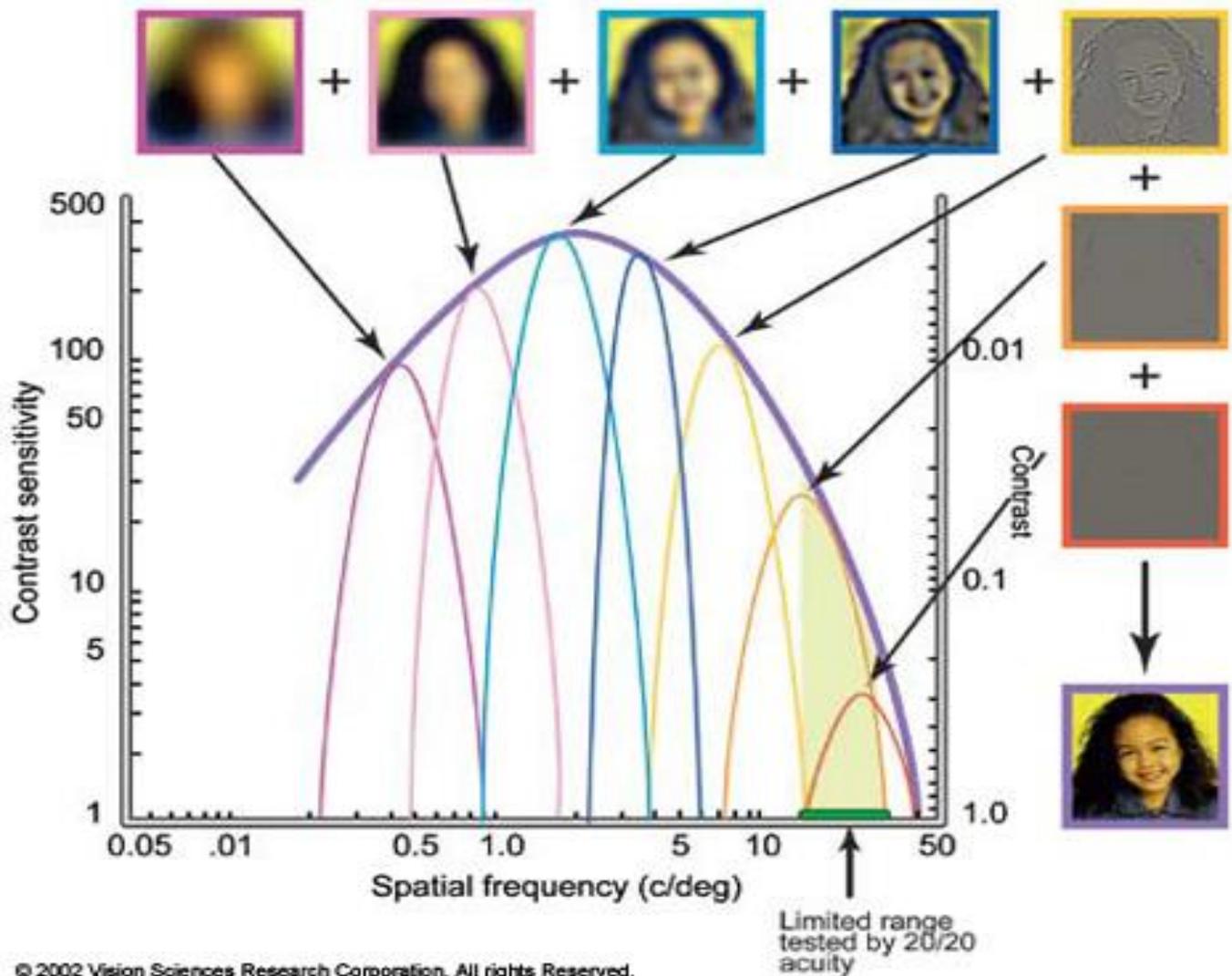


Oliva, A. (2013). The art of hybrid images: Two for the view of one. *Art & Perception*, 1(1-2), 65-74.

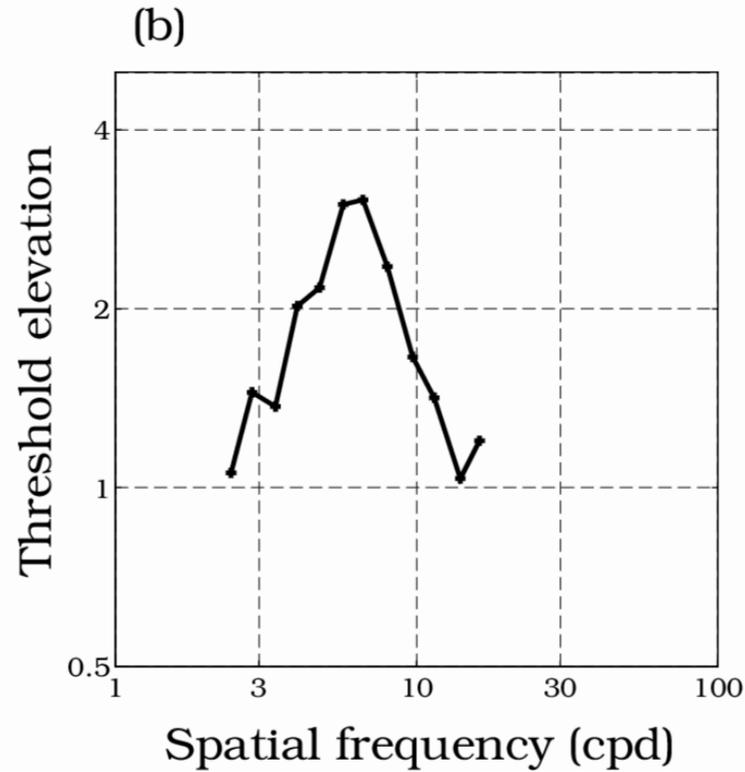
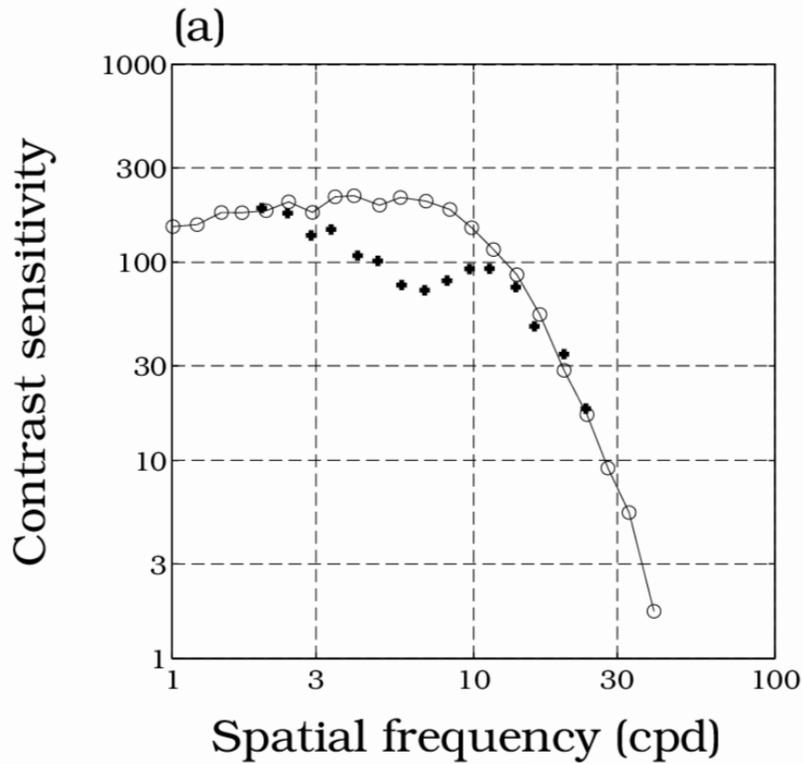


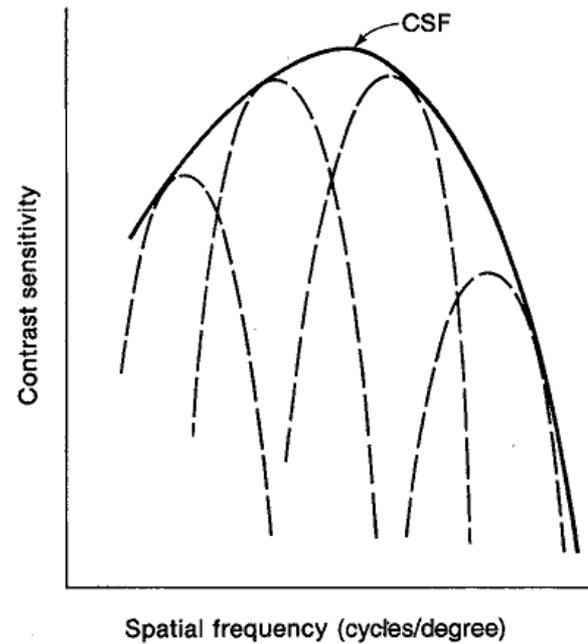
# Un filtro passa banda





# Blakemore e Campbell





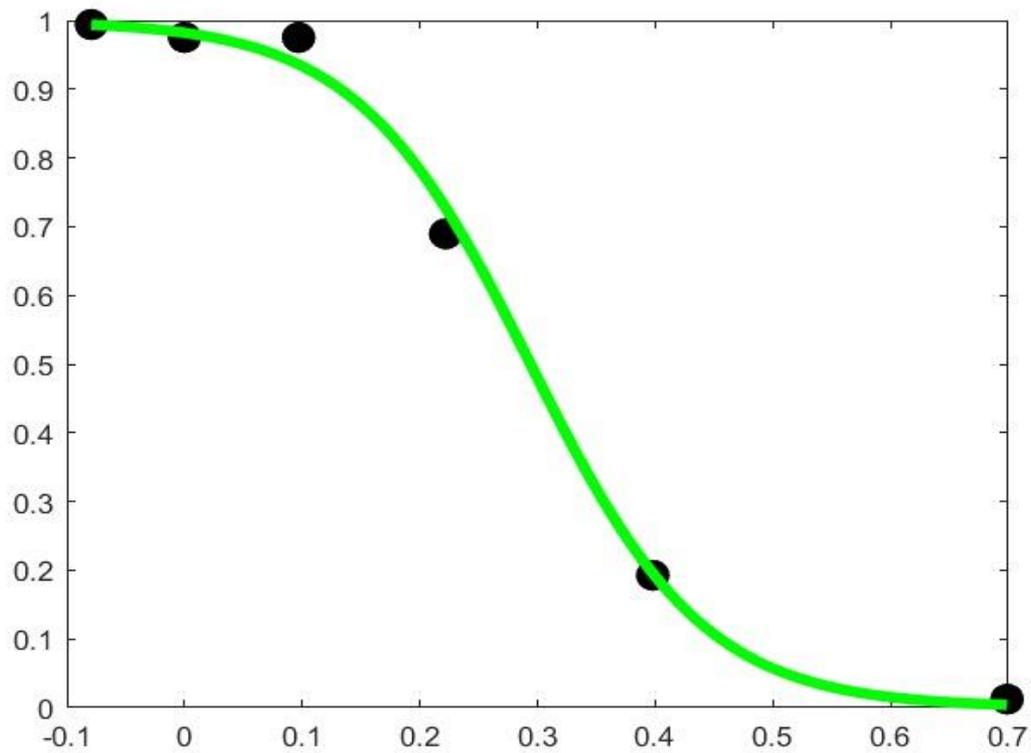
**Figure 3.23**

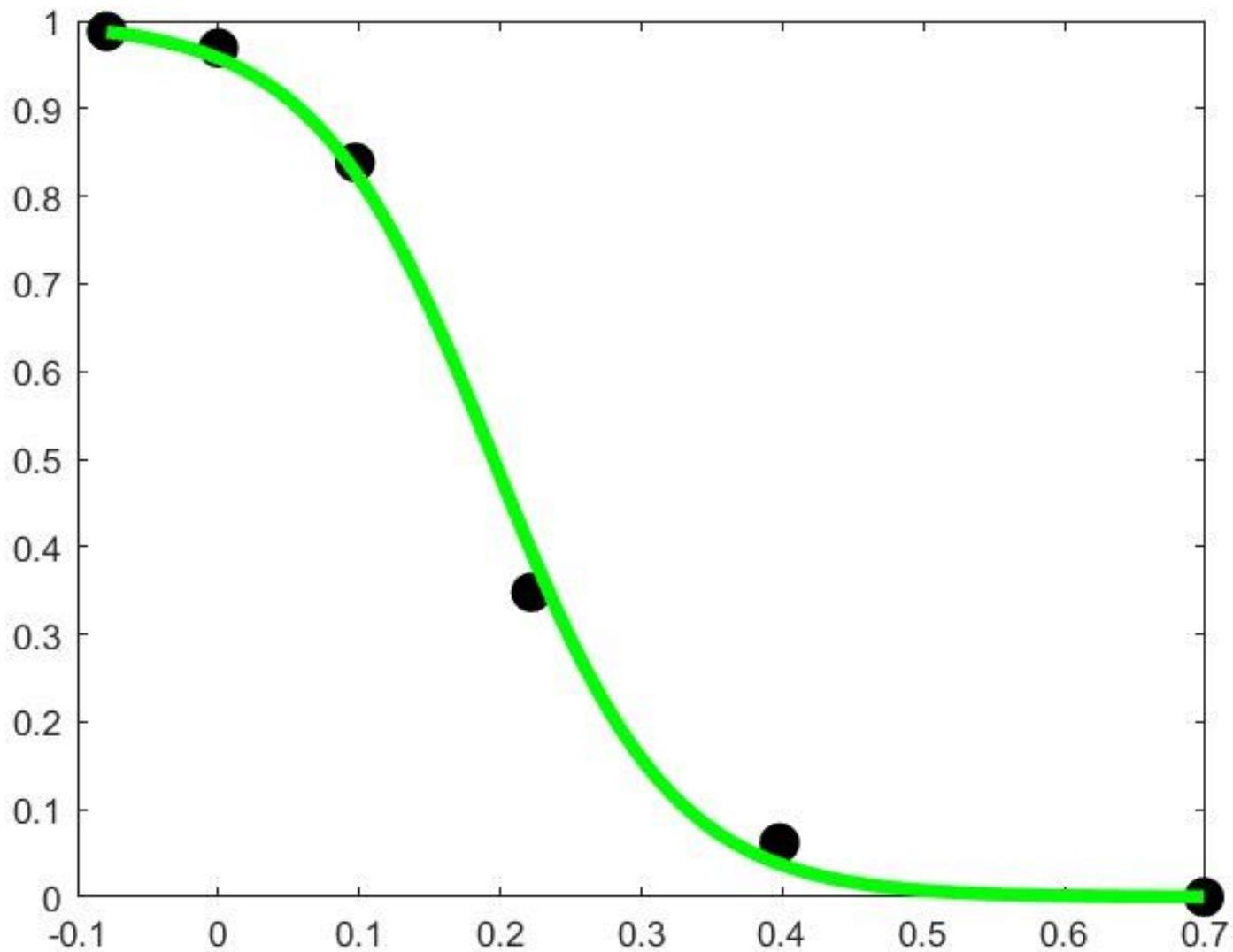
*The contrast sensitivity function (solid line) and some of its underlying channels (dashed lines). These channels, each of which is sensitive to a narrow range of frequencies, add together to create the CSF.*



Chi è miope, ipermetrope o astigmatico vede sfuocata un'immagine a una distanza a cui una persona emmetrope («che ci vede bene») riesce invece a percepire i dettagli.

Quindi un'immagine ibrida può essere utilizzata per capire se una persona è emmetrope o no.







Illusioni visuali in cui due differenti interpretazioni di un'immagine possono essere percepite cambiando la distanza da cui sono viste o il tempo a cui sono presentate

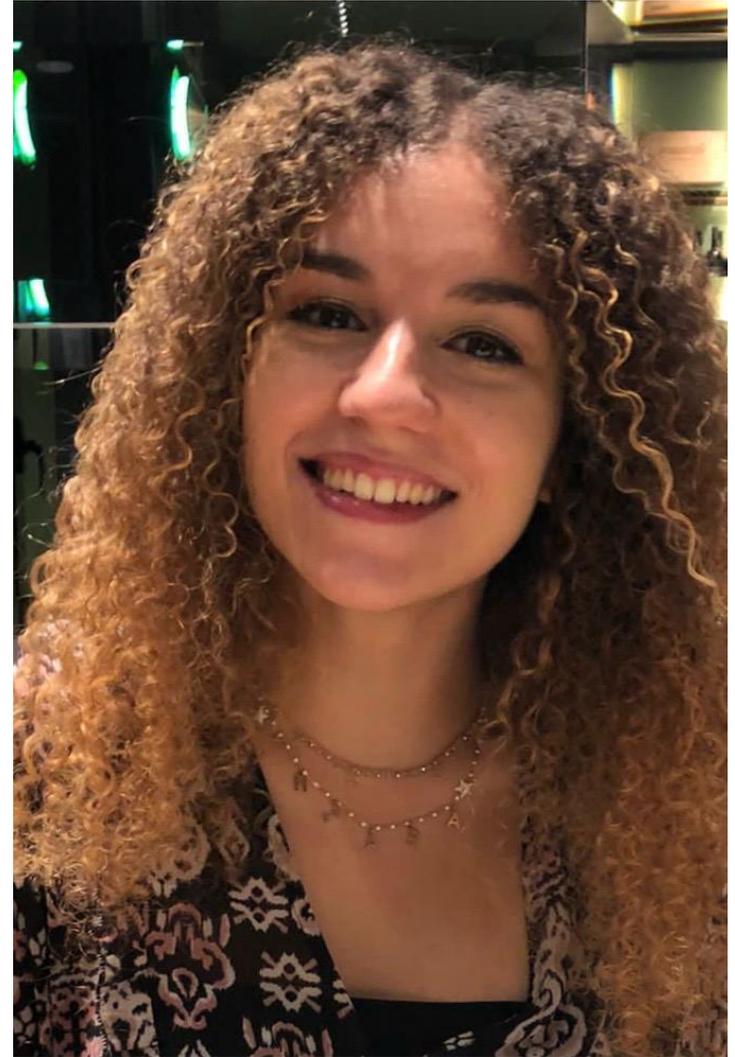
# Quanto tempo ci vuole?



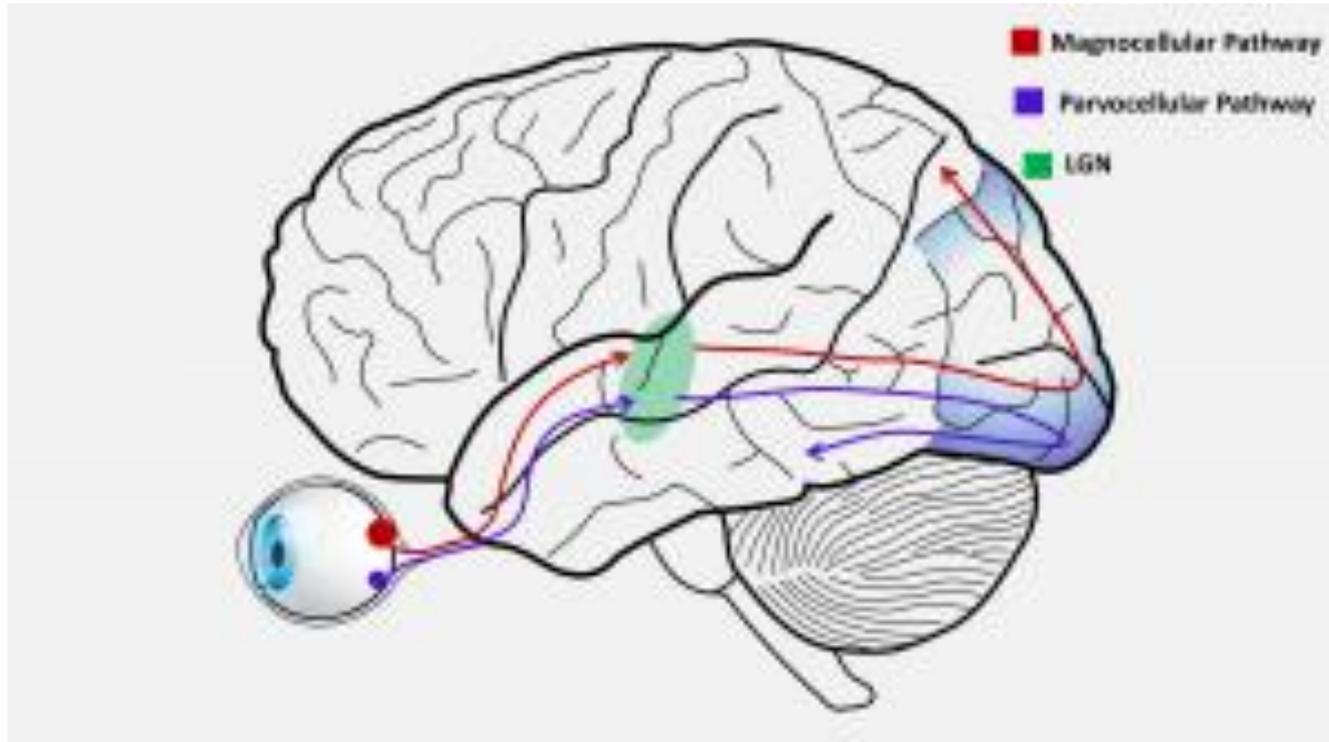
In un decimo di secondo il cervello comprende il significato di un'immagine sconosciuta. (Potter M.C. (1975). Meaning in visual search. Science 187, 965-966.)

Si parte da una comprensione globale che poi guida a guardare gli aspetti locali «si vede la foresta prima degli alberi» (Navon, D. (1977). Forest before trees: The precedence of global features in visual perception. Cognitive Psychology, 9(3), 353-383)

Negli esperimenti di Oliva et al., con 30 ms si vede l'immagine a basse frequenze, con 150 ms si vede quella ad alte frequenze.



# I differenti canali



Type	Size*	Source / Type of Information	Location	Response	Number
M: Magnocellular cells	Large	Rods; necessary for the perception of <b>movement</b> , depth, and small differences in brightness	Layers 1 and 2	rapid and transient	?
P: Parvocellular cells (or "parvicellular")	Small	Cones; long- and medium-wavelength ("red" and "green" cones); necessary for the perception of <b>color</b> and form (fine details).	Layers 3, 4, 5 and 6	slow and sustained	?
K: Koniocellular cells (or "interlaminar")	Very small cell bodies	Short-wavelength "blue" cones.	Between each of the M and P layers		

# Acuità visiva in periferia



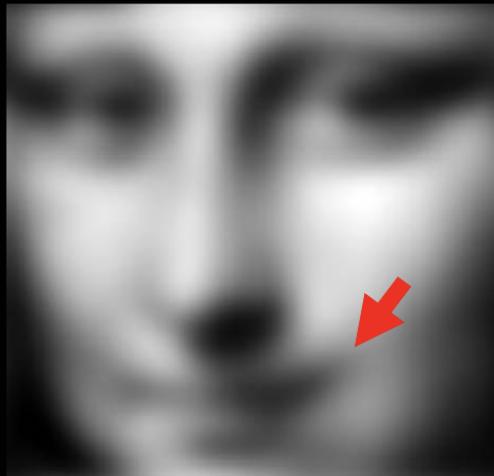
Con l'eccentricità l'acuità visiva decresce notevolmente: a 7° di distanza l'acuità visiva è diventata un decimo di quello che si guardando direttamente.

In questa figura se le lettere al centro sono appena riconoscibili, lo stesso accade a quelle via via che si allontanano dal centro

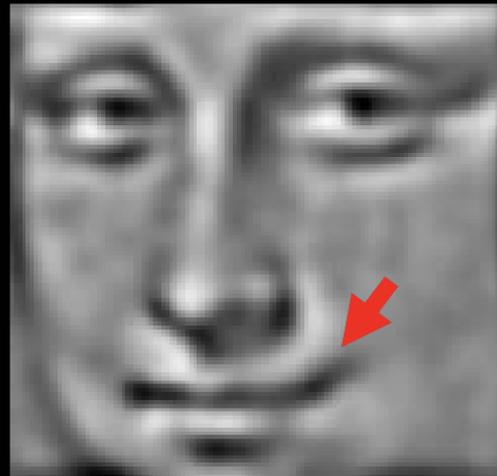




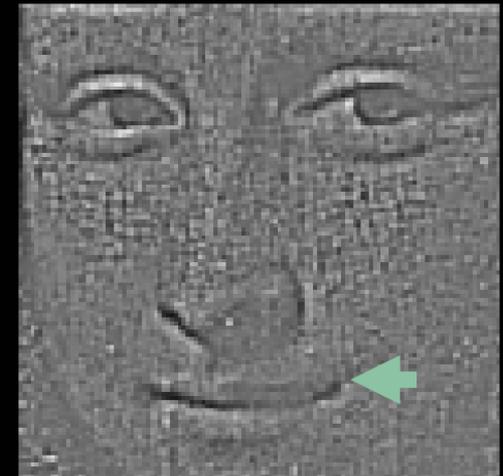
Smile



Smile



No smile



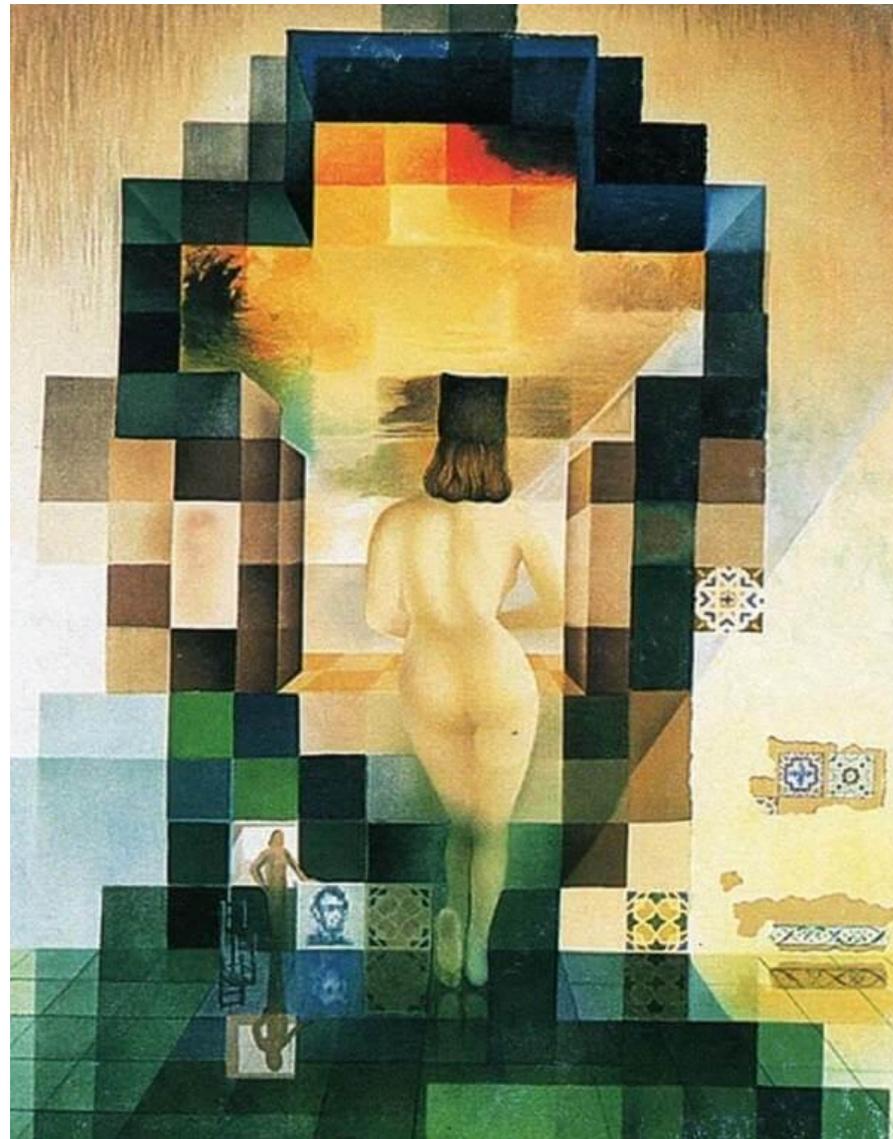
Low

Spatial frequency

High

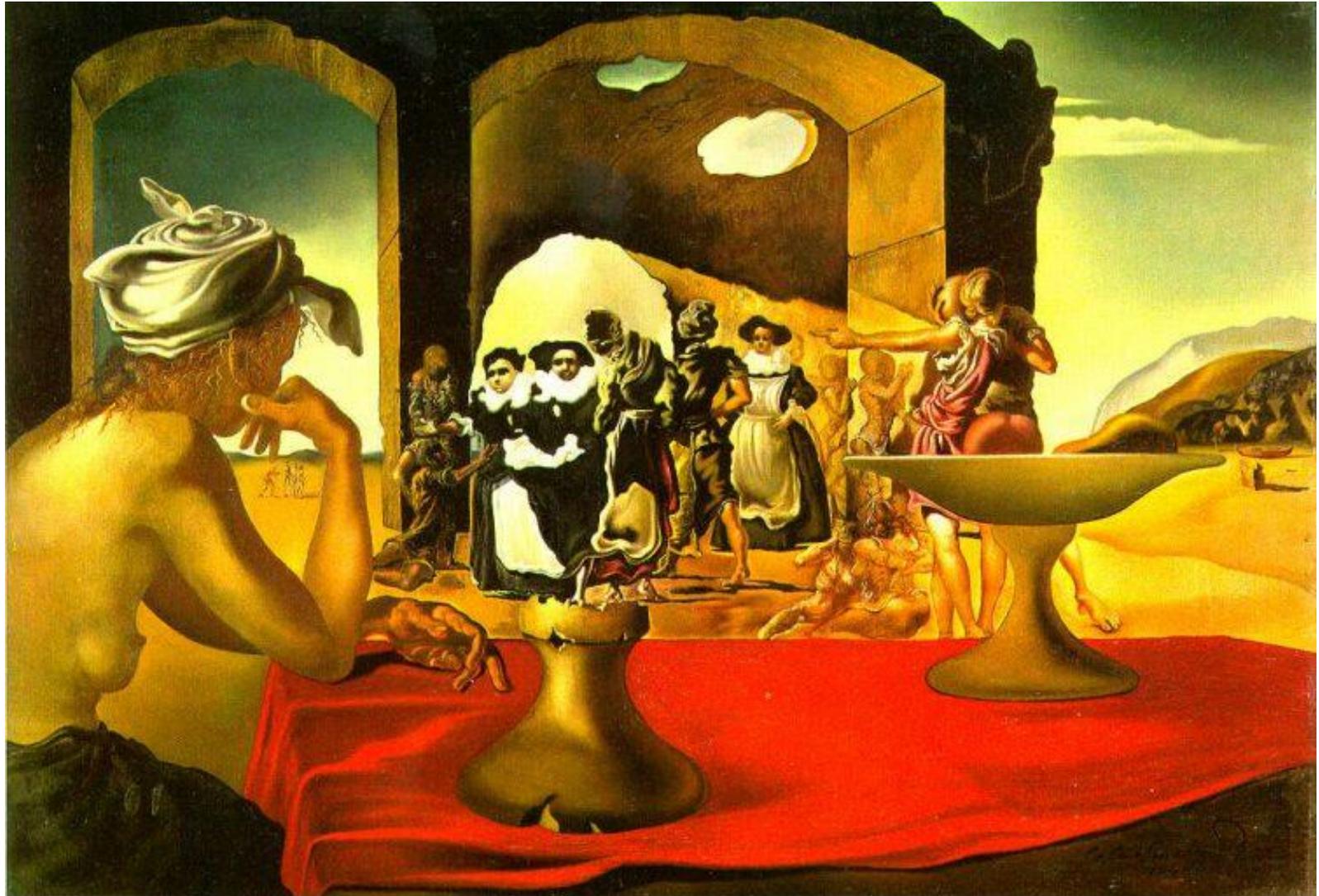
Livingstone, M. (2000). *Science*

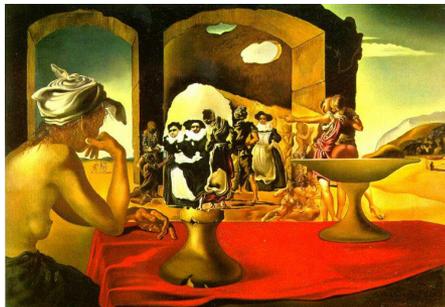
Setlur & Gooch (2004), *NPAR*













FEIMC 20



$$E=mc^2$$

# Chi siamo?



# Chi sono



<https://linktr.ee/alessandrofarini>

