Computer Vision in an Hour

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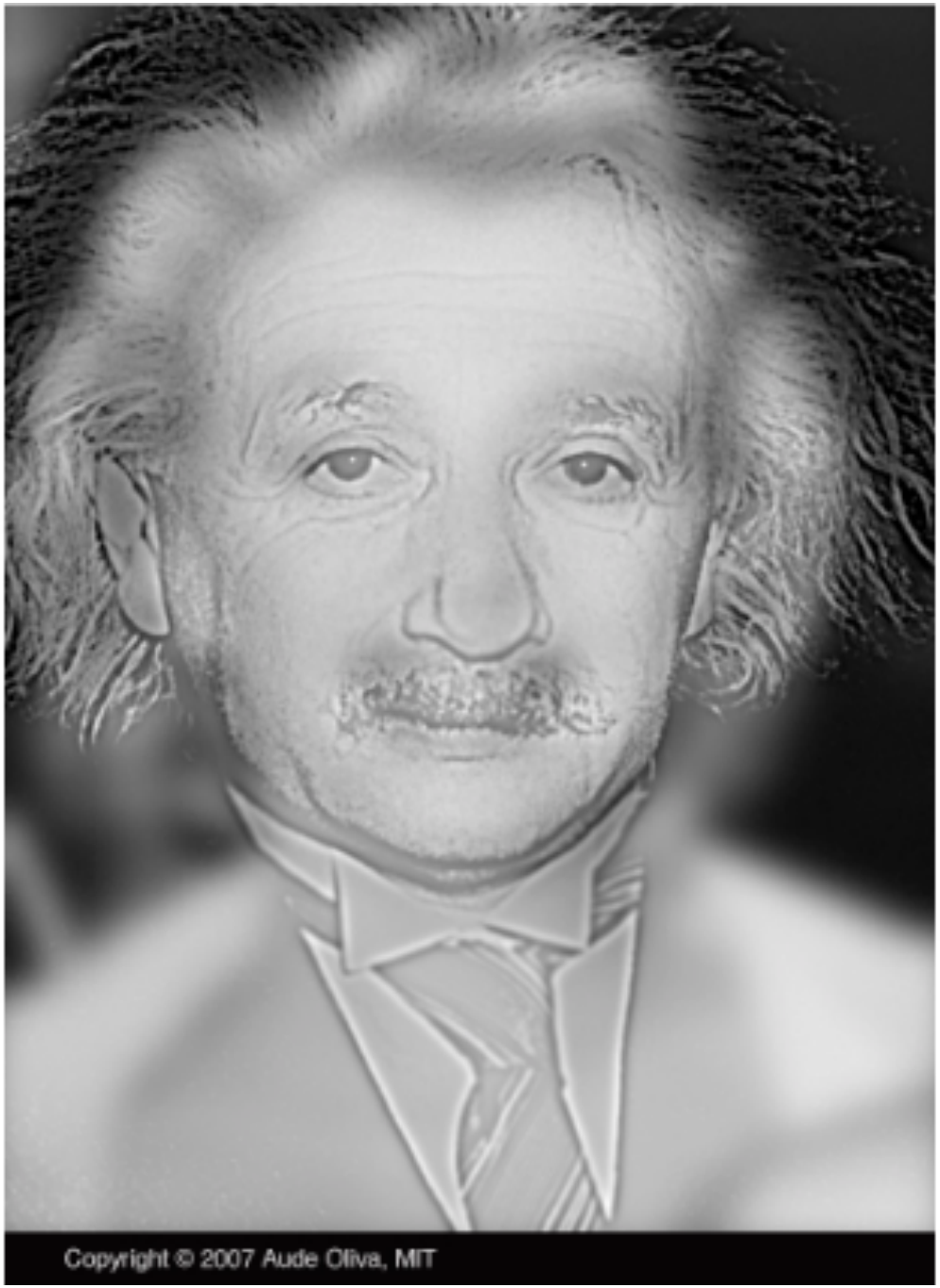
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What is computer vision?

- build a system to see intelligently
- best model we know is our own brain (that's how we understand images)

Vision vs. graphics

Vision = image -> information

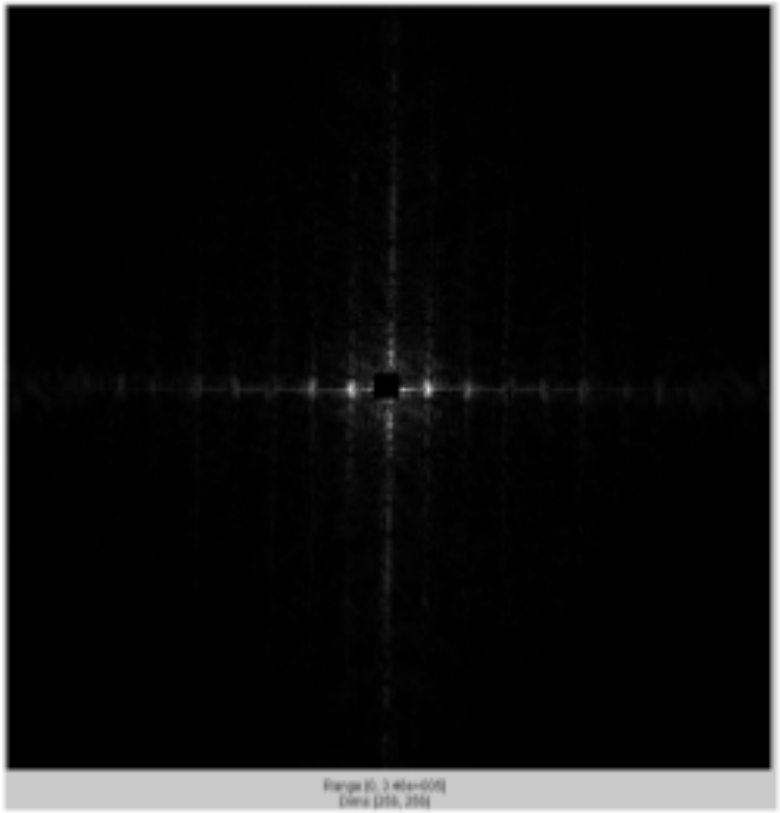
Graphics = information -> image

Why the Fourier domain is cool for images

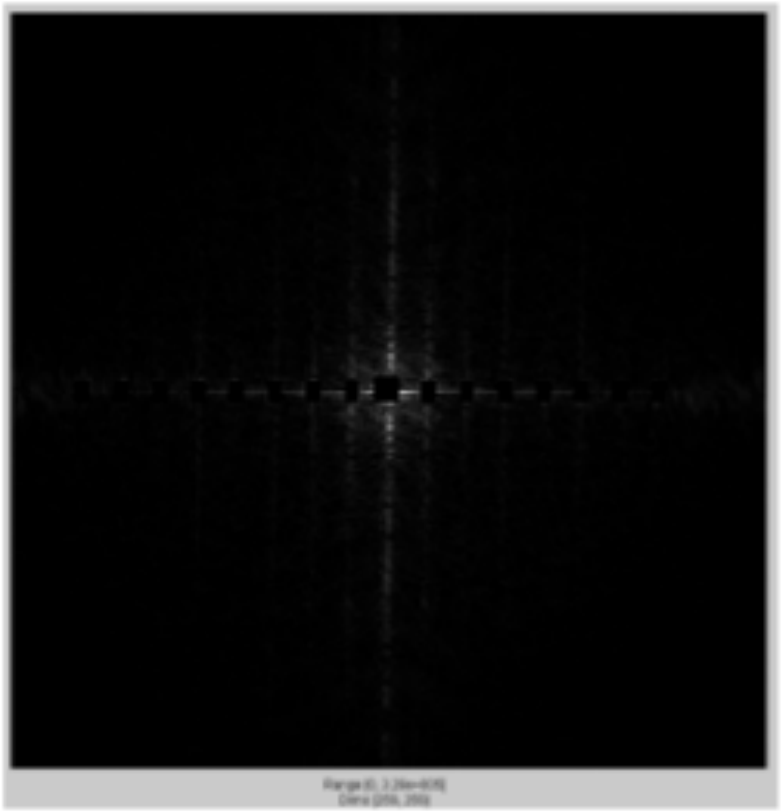
Fourier transform - "transform from time domain to frequency domain"

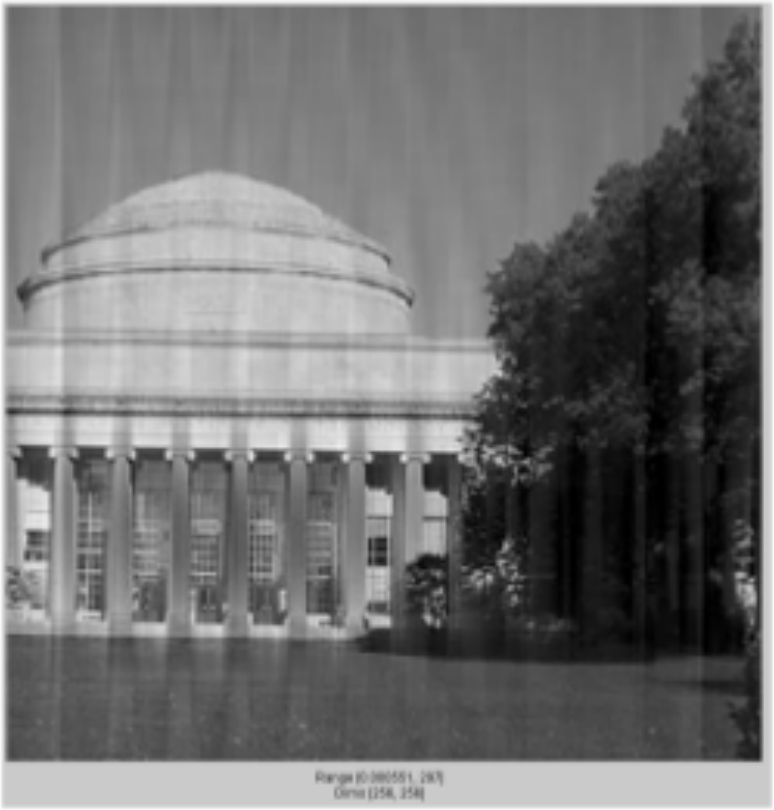
It's possible that useful information is stored in the "frequency" domain as opposed to the image ("time") domain

Fourier transform magnitude



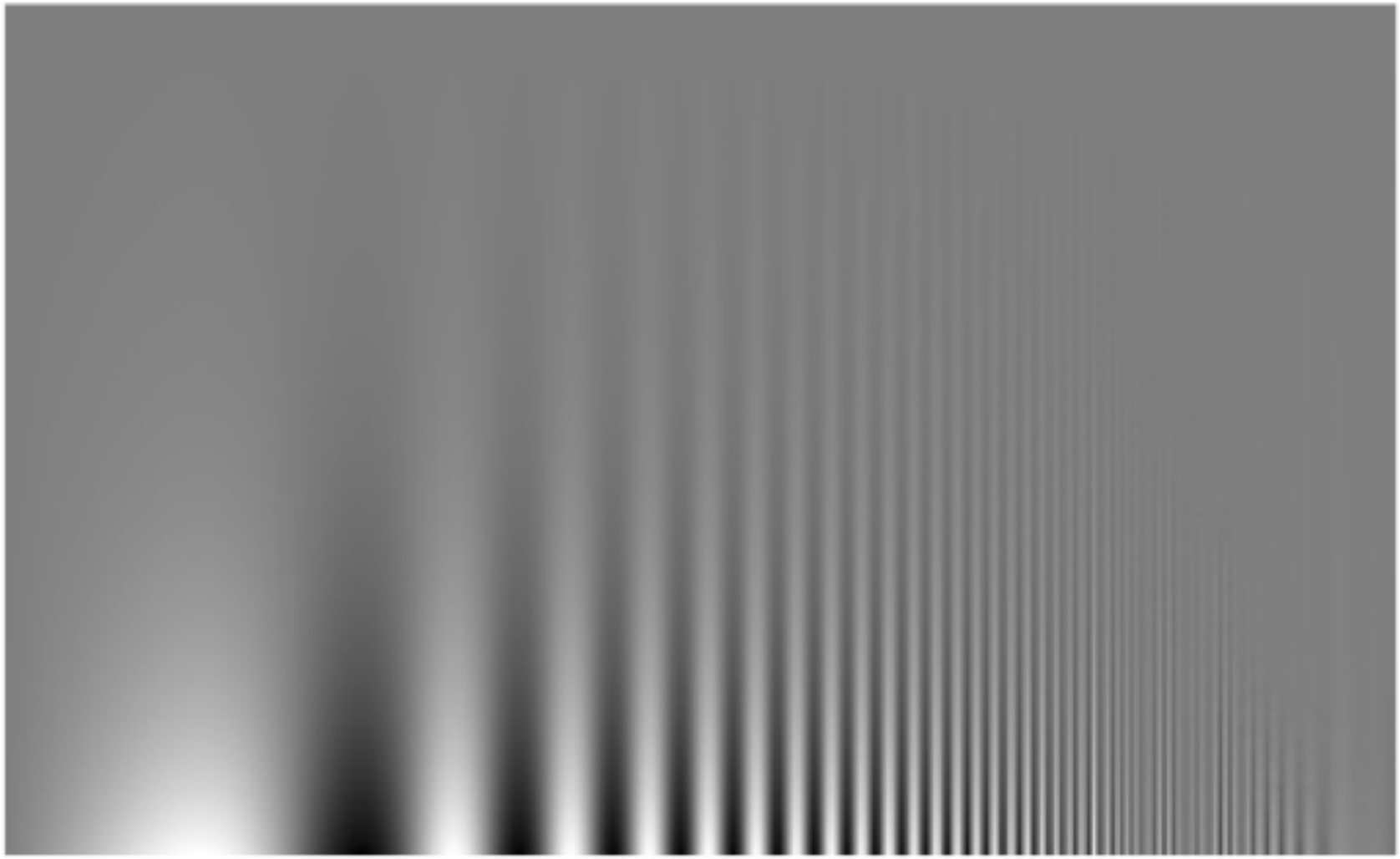
Masking out the fundamental and harmonics from periodic pillars





A bit about our perception, and some cool blending

spatial frequency = "how close things appear to each other". Think Doppler effect in an image



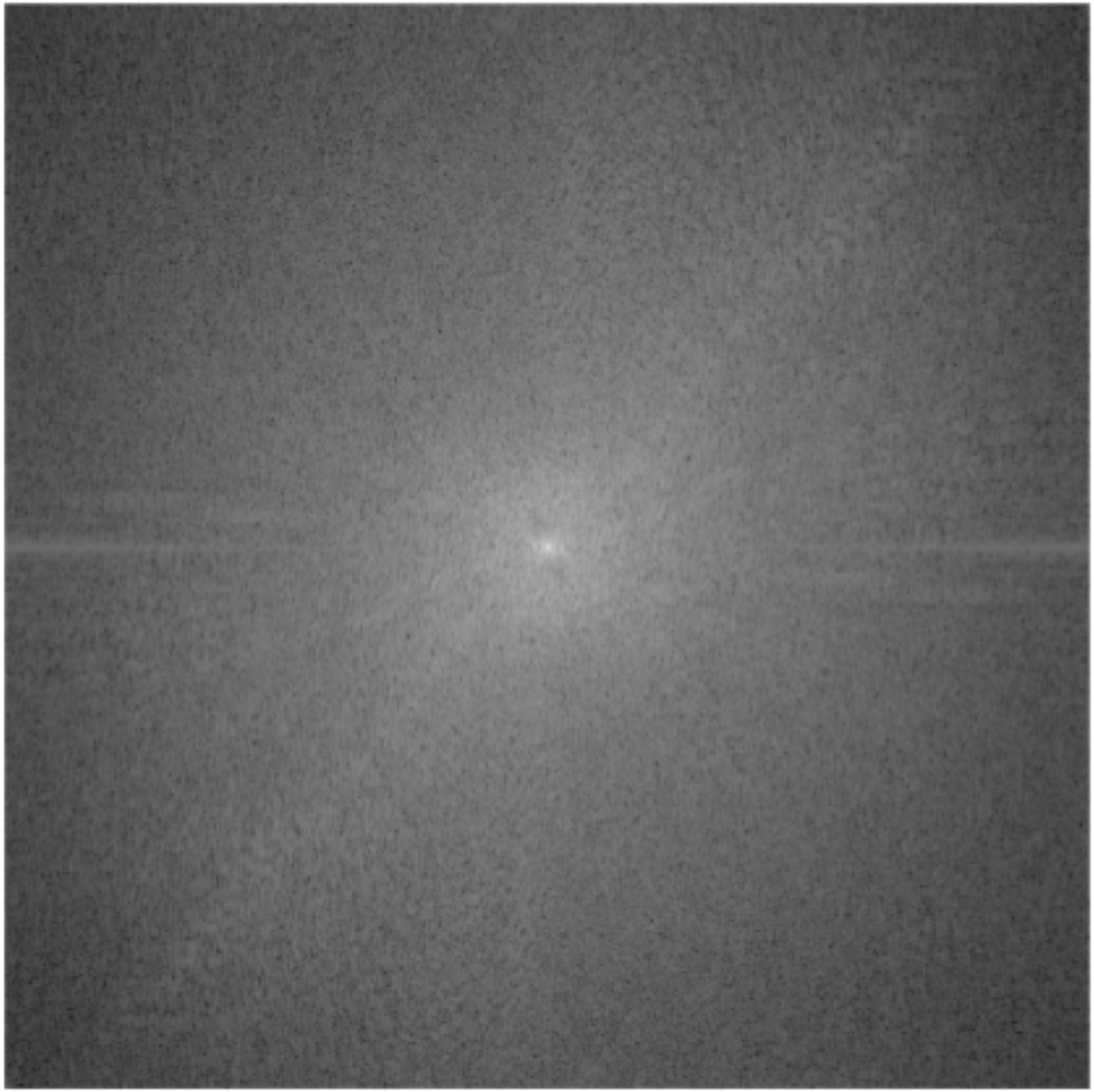
A demo of human contrast sensitivity as a function of spatial frequency. Frequency rises from left to right at a constant rate. Contrast drops from bottom to top at a constant rate. The bars are visible further up for middle frequencies, showing these are more salient to the human visual system.

Hybrid Images

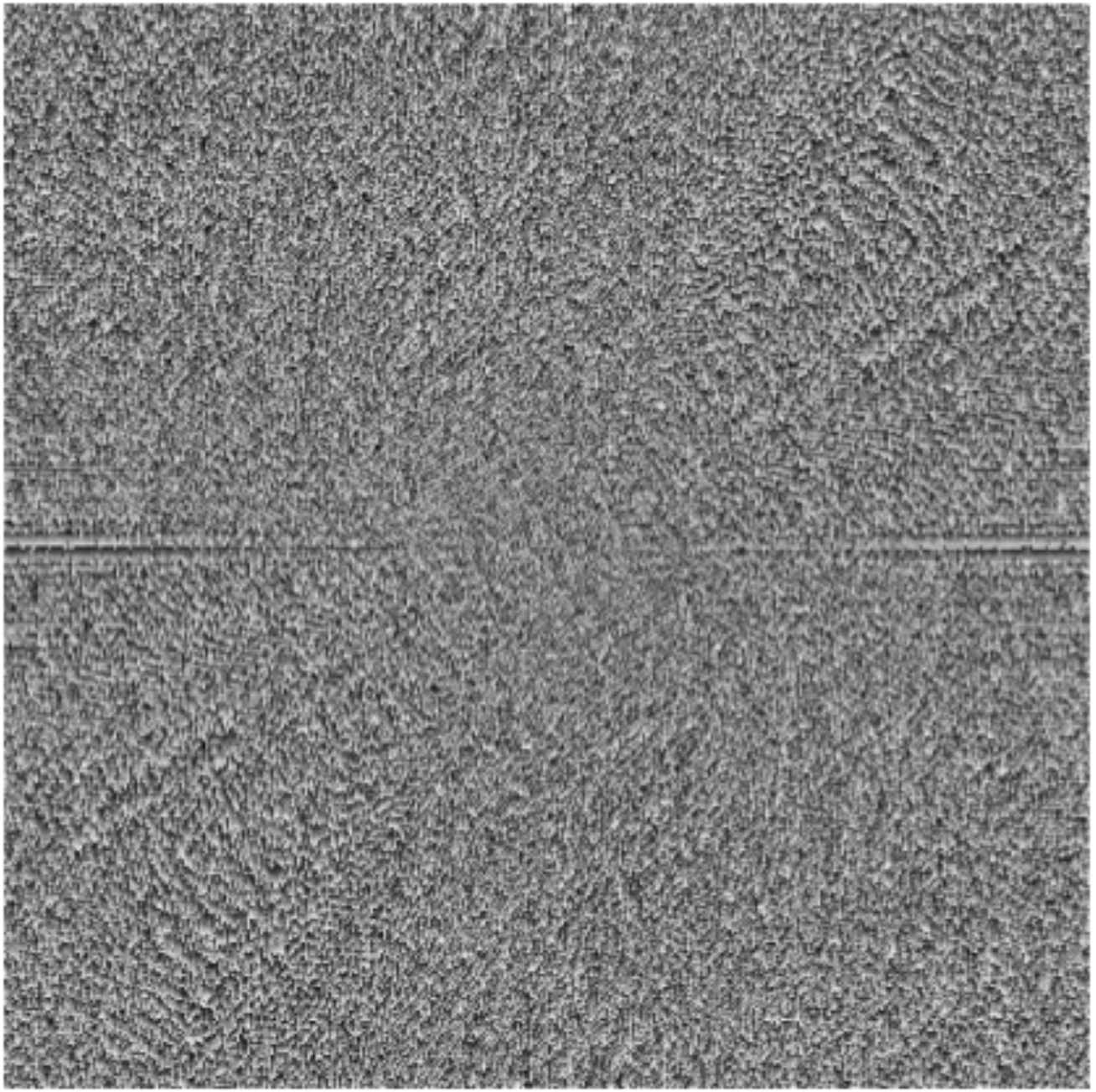
Fourier: Magnitude and Phase

- all natural images have the same magnitude transform
- try mixing up phase and magnitude from two different images

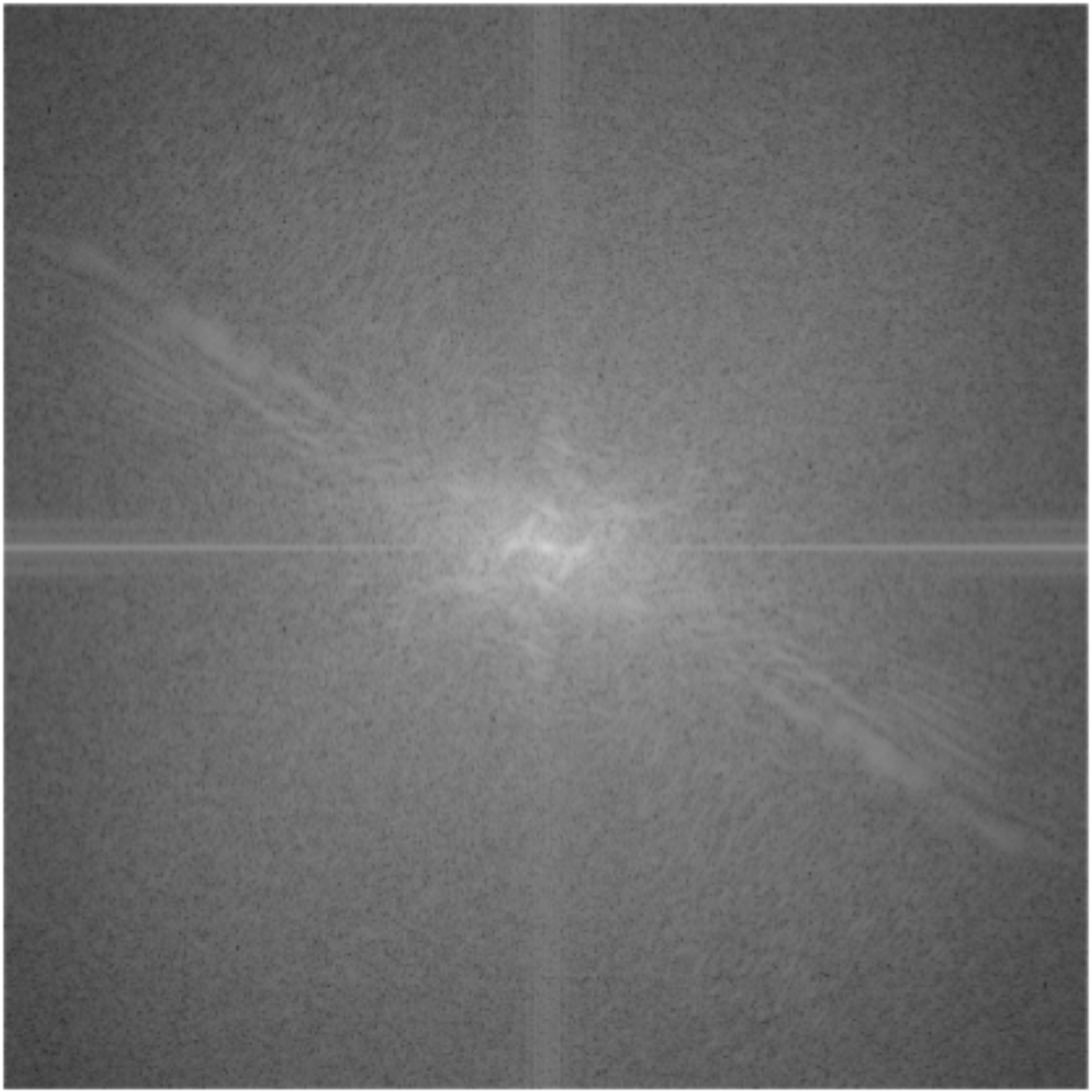
This is the magnitude transform of the cheetah pic



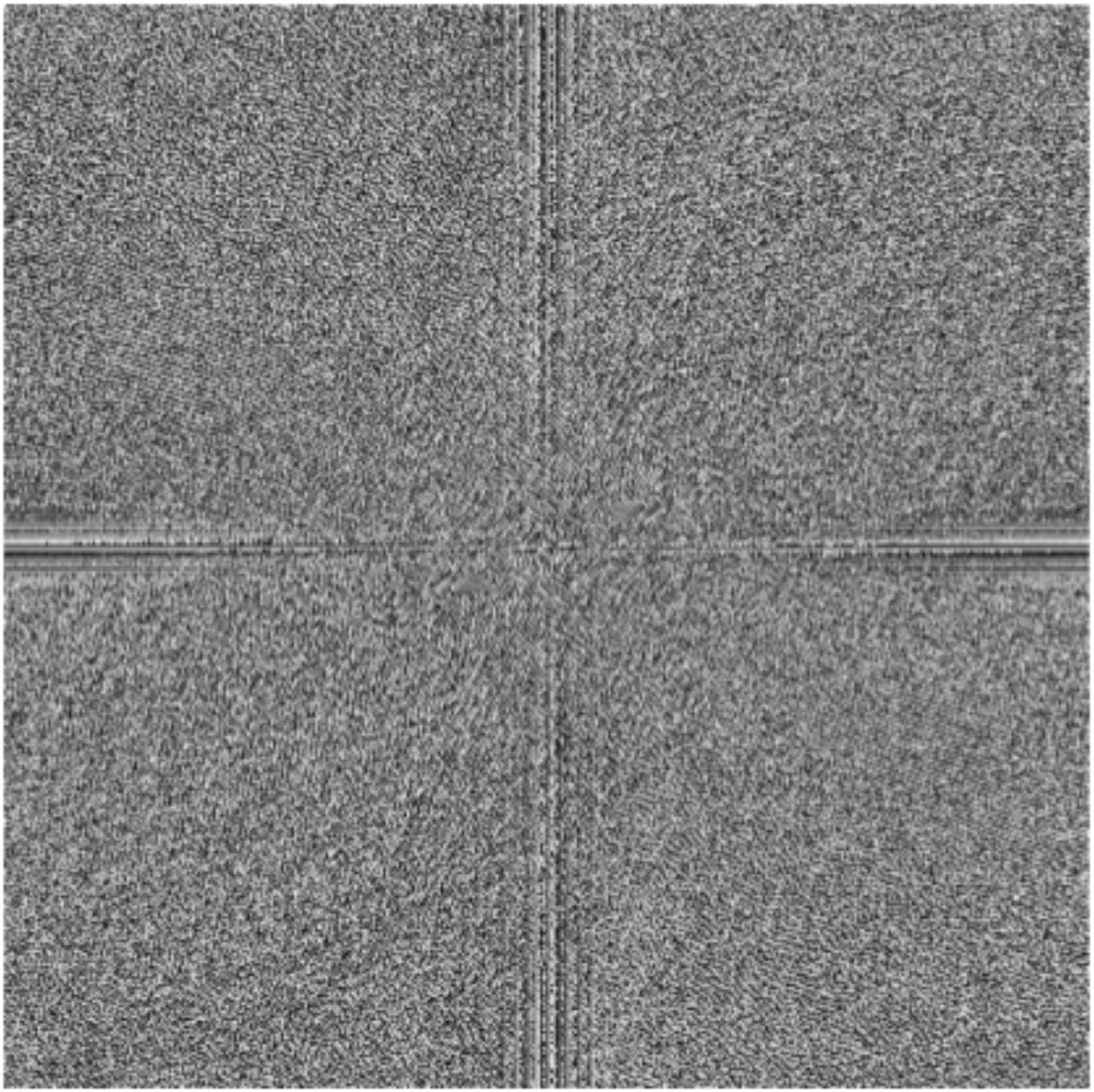
This is the phase transform of the cheetah pic



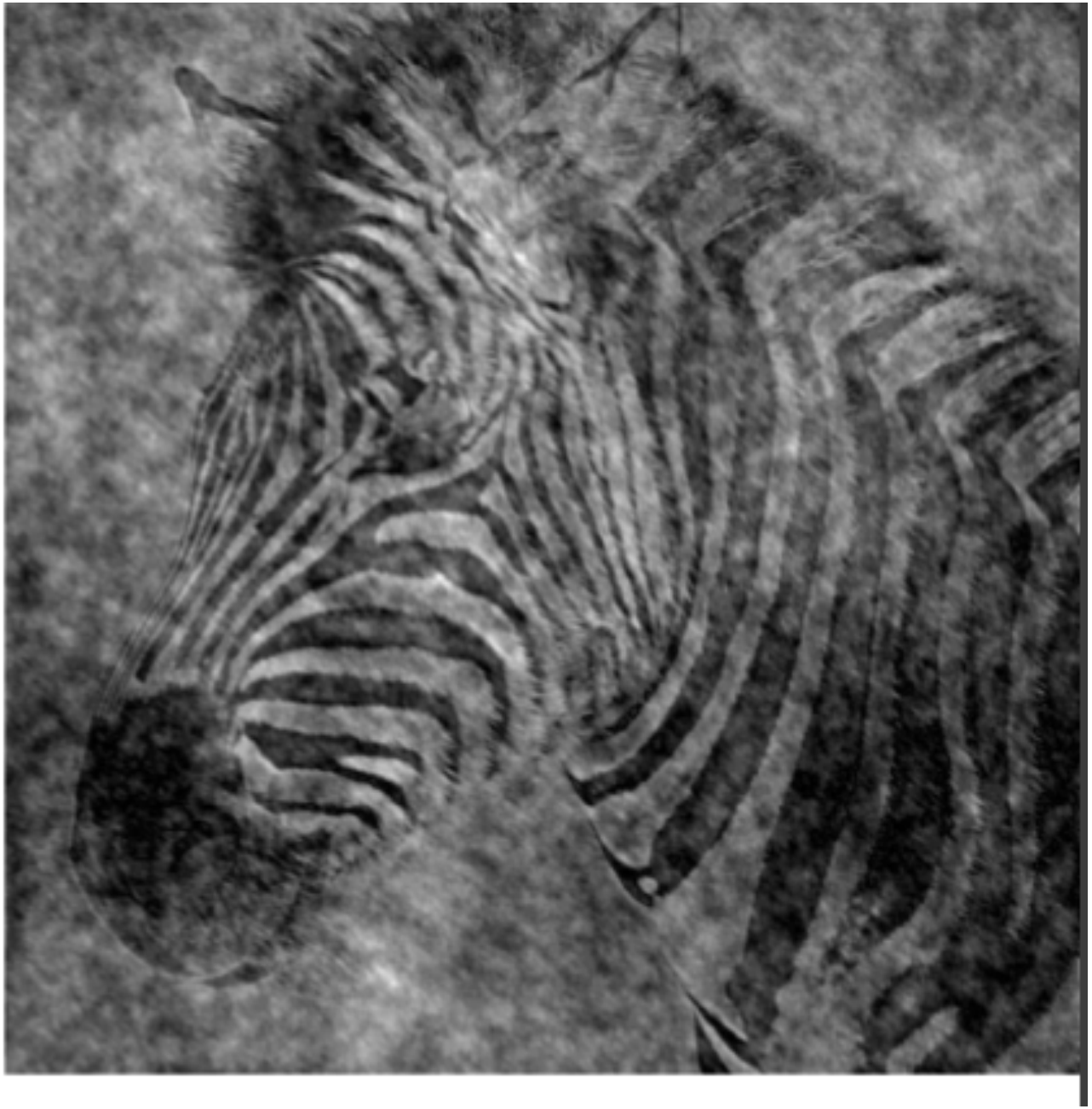
This is the magnitude transform of the zebra pic



This is the phase transform of the zebra pic



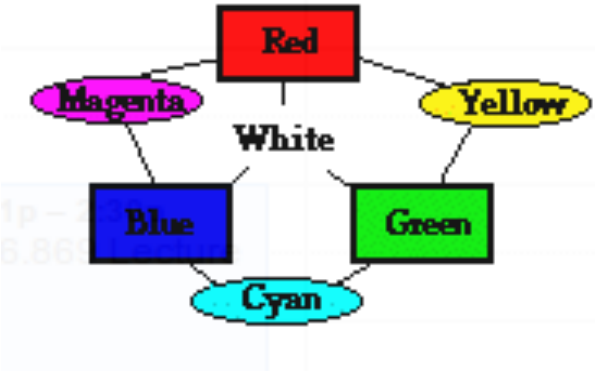
Reconstruction with zebra phase, cheetah magnitude



Reconstruction
with cheetah phase,
zebra magnitude

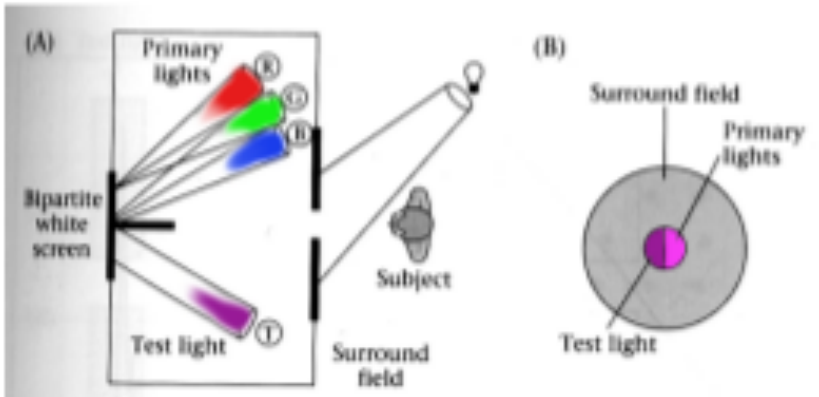
Colors and color addition

R + G + B = W

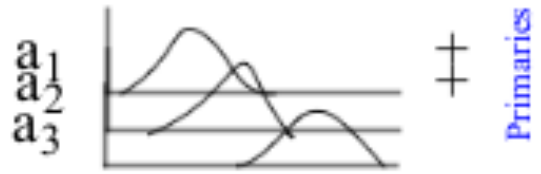


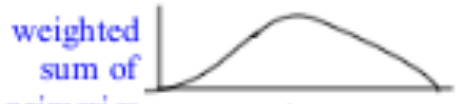
To measure a color

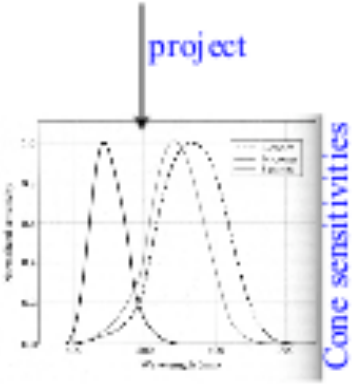
1. Choose a set of 3 primary colors (three power spectra).
2. Determine how much of each primary needs to be added to a probe signal to match the test light.

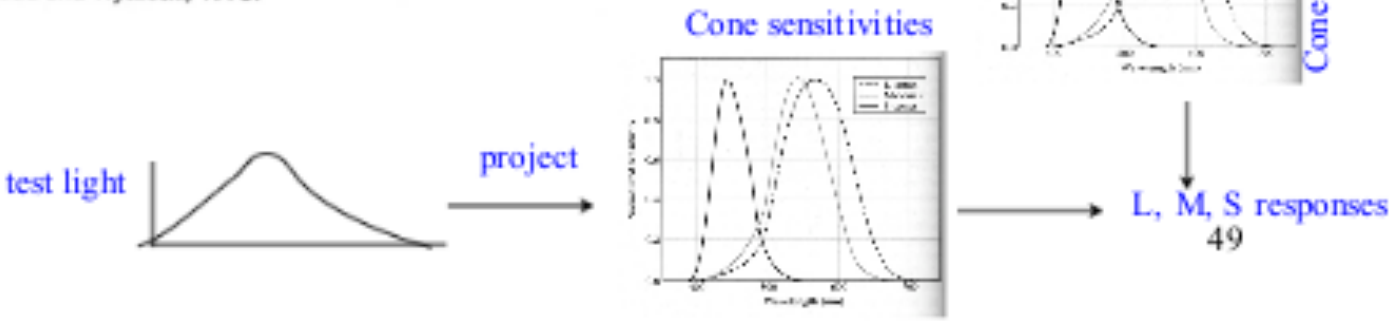


4.10 **THE COLOR-MATCHING EXPERIMENT.** The observer views a bipartite field and adjusts the intensities of the three primary lights to match the appearance of the test light. (A) A top view of the experimental apparatus. (B) The appearance of the stimuli to the observer. After Judd and Wyszecki, 1975.

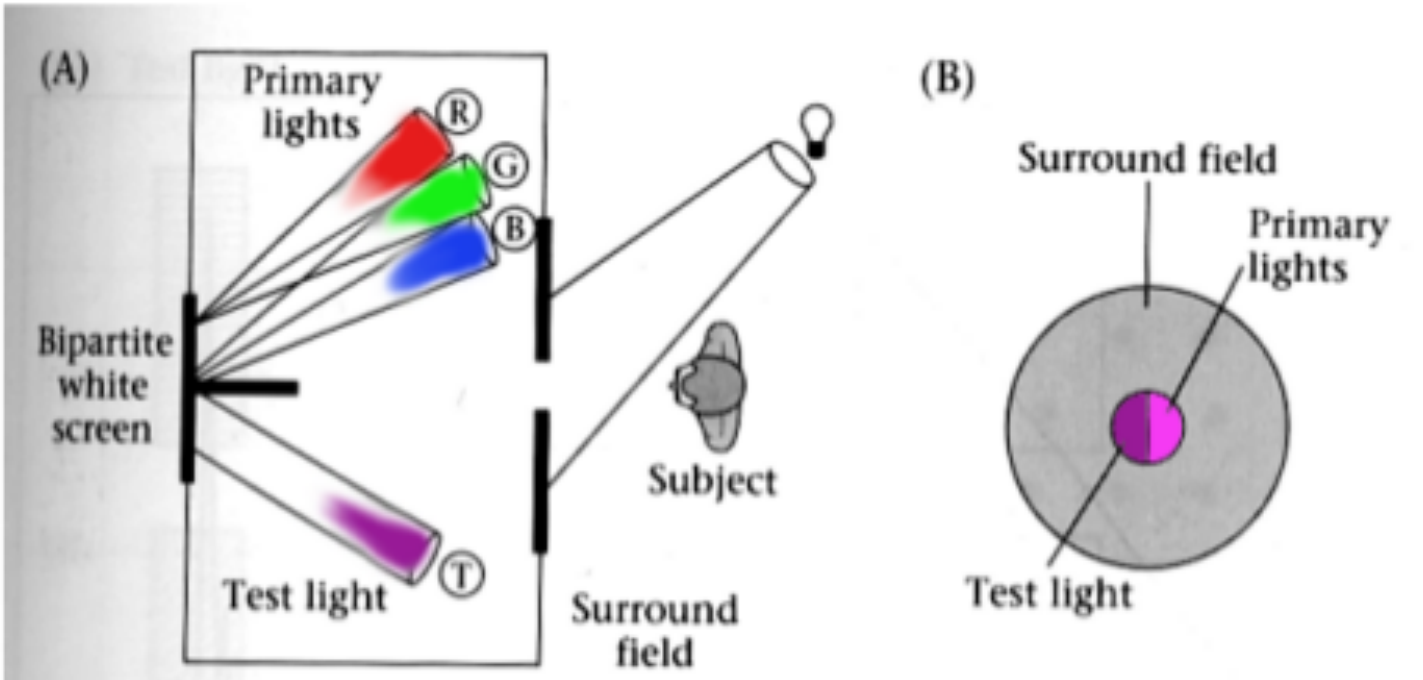








Color matching experiment



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Foundations of Vision, by Brian Wandell, Sinauer Assoc., 1995

Color matching with positive amounts of the primaries

Match the sensors' response to the target light to the sum of responses to the primary lights