Hybrid Images

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Hybrid Images

Angry man

Neutral woman
Hybrid Images

What you see...

From Far Away

Up Close

I see an angry guy

It's a woman!
The quest for creating images with multiple meanings
Multiple Meanings
One global interpretation

A sunflower

Pieces of images

Multiple Meanings
Two global interpretations

Two shoes or a butterfly

Image Copyright Ian Butterworth (2002)
Multiple Meanings
Two global interpretations

Looking at the image one way, a skull appears, comprised of the woman's form and her reflection in a mirror (the outline of the skull itself).

"All Is Vanity", by C. Allan Gilbert 1873-1929.
Subtle expression
Leonardo da Vinci’s Mona Lisa

Smile

Smile

No smile

Low  Spatial frequency  High

Setlur & Gooch (2004), NPAR
Hybrid Images
Hybrid Images
How do they work?
Human Visual Perception

- Low spatial frequency
- Medium spatial frequency
- High spatial frequency

Blur image → Spatial frequency channels → Sharp image
Multiscale subband decomposition

Contrast Sensitivity Function

Blackmore & Campbell (1969)

Contrast sensitivity function showing the relationship between spatial frequency (cycles/degree) and contrast sensitivity. The graph illustrates how the contrast sensitivity decreases as the spatial frequency increases, with low sensitivity noticeable at higher spatial frequencies.
Contrast Sensitivity Function

Blackmore & Campbell (1969)

Maximum sensitivity

\[ \sim 6 \text{ cycles/degree of visual angle} \]
1 meter

10 deg.

20 cm

6 c/d * 10 deg/i

Peak sensitivity at 60 cycles/image
Peaksensitivityat12cycles/image  
6 c/d * 2 deg/i
Perception of hybrid images

8   11   17   25   38   57   85   128 c/i
Perception of hybrid images

A man or a woman?

Male dominance + Female dominance
It’s a woman!

Peak sensitivity at 60 cycles/image

Spatial Frequency

1 meter

10 deg.

20 cm
I see an angry guy.
Perception of hybrid images

1- Frequency cut = 16 cycles/image

2- Frequency cut = 36 cycles/image
Perception of hybrid images

The distance of switch is a function of

- Image size
- Cut-off frequencies for the individual images

![Graph showing high and low SF dominance in perception](image-url)
Hybrid Images
The little details that matter
Principles of Perception

The challenge is to look good in close up

- Alignment
- Perceptual Grouping
- Color
Alignment
Alignment

Cheetah

Tiger

Aligned Tiger
Alignment

Far view

Not aligned

Aligned
Perceptual Grouping

Shadows
Perceptual Grouping

Reorganization of the shadows as a motorcycle
Color in high spatial frequencies
A few examples of Applications

Especially, whenever you are “on the approach”
Changing expression

Sad  ➤ Surprised
Texture superposition
Texture superposition

Original  Cat mask  Transparency  Hybrid
Advertising
Private font

Low spatial frequencies in an hybrid can be used to mask text that will be readable otherwise.
Private font

This text can only be read by somebody close enough to the screen.
This text can be read at a distance.

Low spatial frequencies in an hybrid can be used to mask text that will be readable otherwise.
Hybrid Images
“A change on the approach”

• Images that change interpretations as a function of viewing distance

• Hybrid images are based on the band-pass characteristics of human vision
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