WHAT DO WE MEAN BY ACCURATE?

MICHELE DITARANTO
DVN | *MUNICH* | FEB. 2026

BSCA Partners

Introduction

For years, I've been working on photorealistic rendering of automotive lighting components.
The goal was clear: achieve physical accuracy through better materials, Better optics. Higher resolution. Physically-based everything.

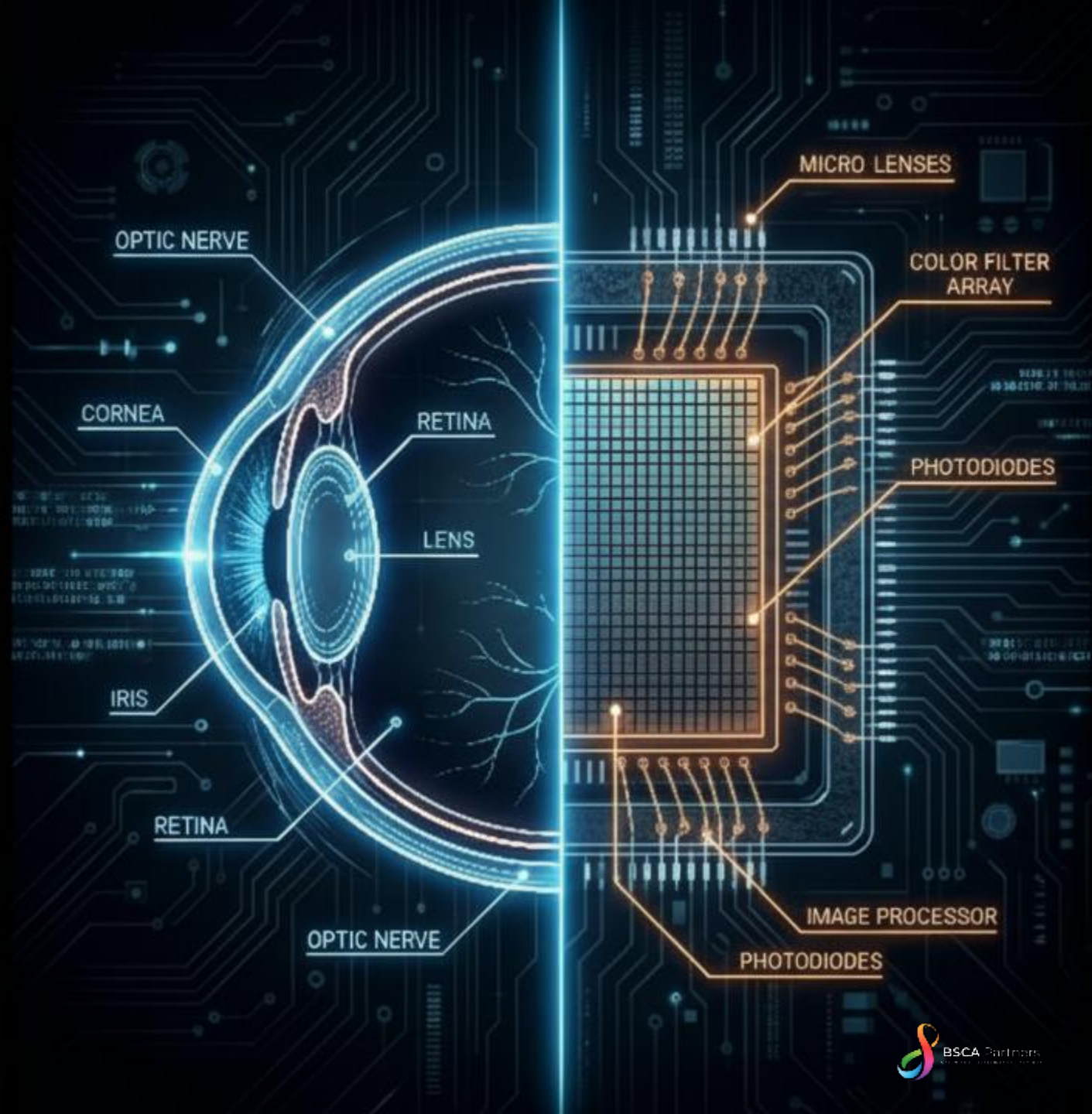
From a technical standpoint, the results were strong.
Virtual prototypes became increasingly reliable, consistent, and measurable.
They matched real cameras extremely well.

But over time, a pattern emerged.
When those same components were evaluated by human observers, the perceived outcome sometimes differed from what the images suggested.

Not because the simulation was incorrect,
but because the reference system was incomplete.

Human Vision vs Camera Capture

- Why Seeing Is Not Recording



Why It Matters

- What we see
- What cameras record
- Why they differ

We often say a photo doesn't look like what we saw. That's not a technical failure, it's a perceptual mismatch between human vision and camera capture.

Human Vision Is a System

- Eye + brain
- Adaptive and contextual

THE EYE IS ONLY THE SENSOR. VISION ACTUALLY HAPPENS IN THE BRAIN, WHICH INTERPRETS, CORRECTS, AND ENHANCES WHAT WE SEE IN REAL TIME.

Camera Vision Is a Device

- Sensor
- Fixed parameters
- Physical measurement

A CAMERA MEASURES LIGHT OBJECTIVELY USING A SENSOR. ANY “INTERPRETATION” COMES LATER THROUGH SOFTWARE, NOT DURING CAPTURE.

Dynamic Range

- Eye handles bright & dark
- We effectively do HDR in our brain, constantly.
- Camera is limited

HDR image

Single exposure

THE HUMAN EYE CAN PERCEIVE DETAIL IN VERY BRIGHT AND VERY DARK AREAS ALMOST SIMULTANEOUSLY.

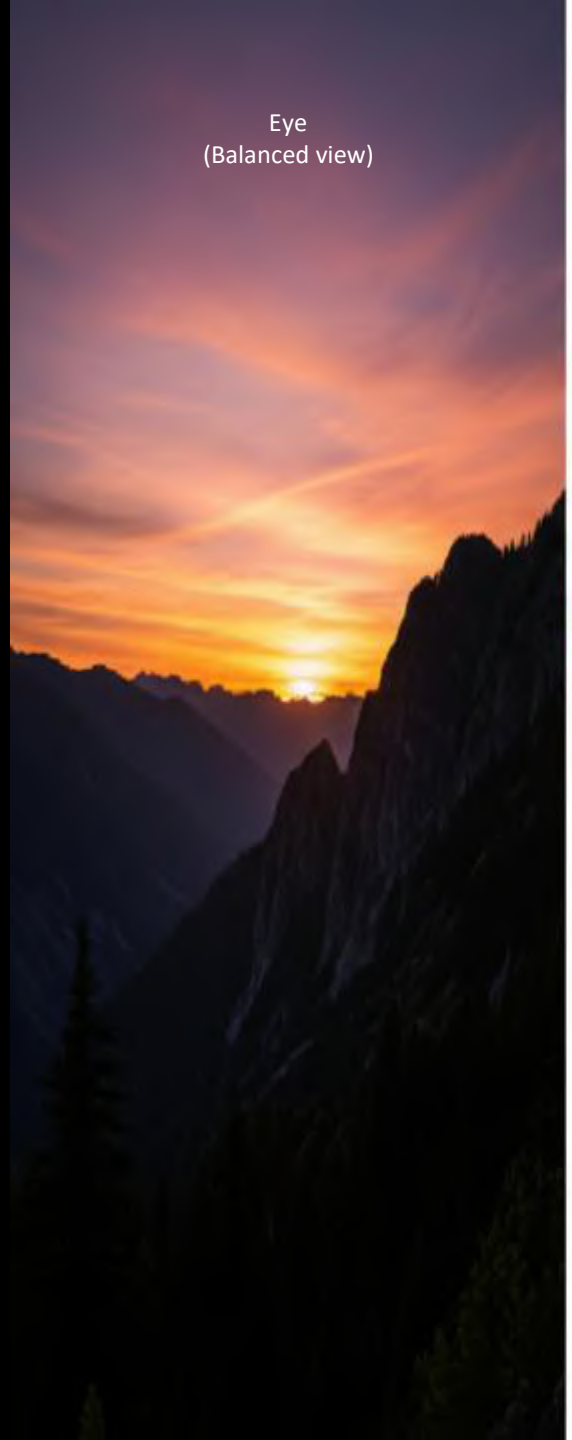
CAMERAS MUST CHOOSE, OFTEN LOSING DETAIL IN ONE AREA.

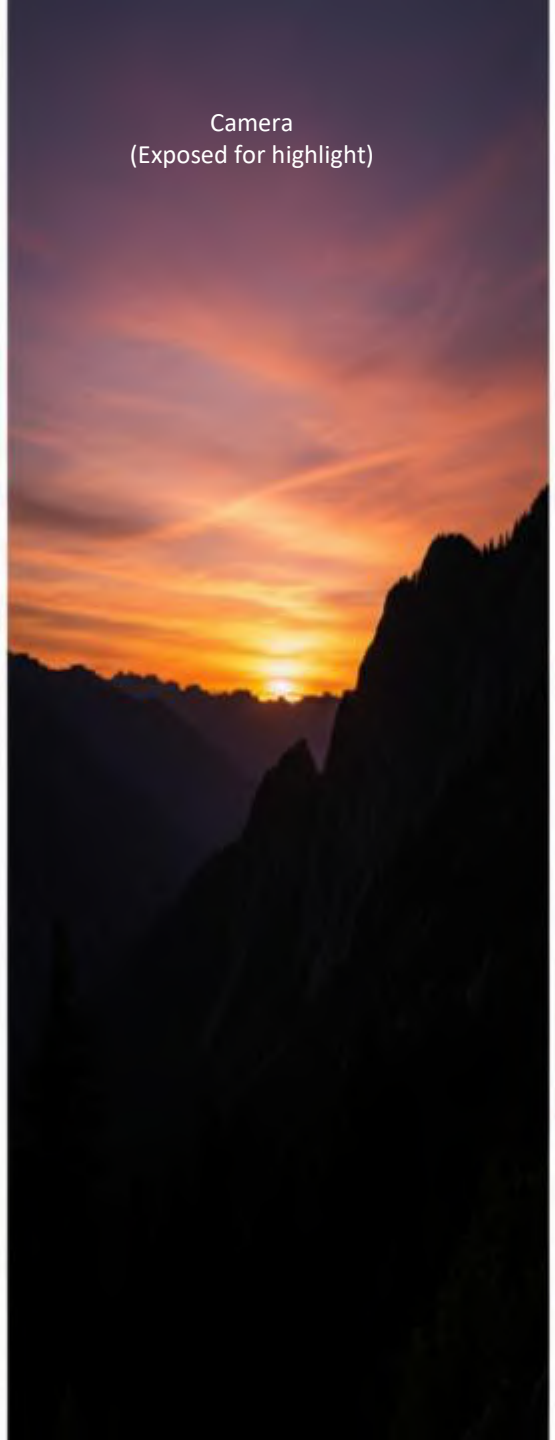
Local Adaption

- Local vision
- Global Exposure
- One setting limit

YOUR EYES ADAPT DIFFERENTLY TO DIFFERENT PARTS OF A SCENE.

CAMERAS APPLY A SINGLE EXPOSURE SETTING TO THE ENTIRE IMAGE.



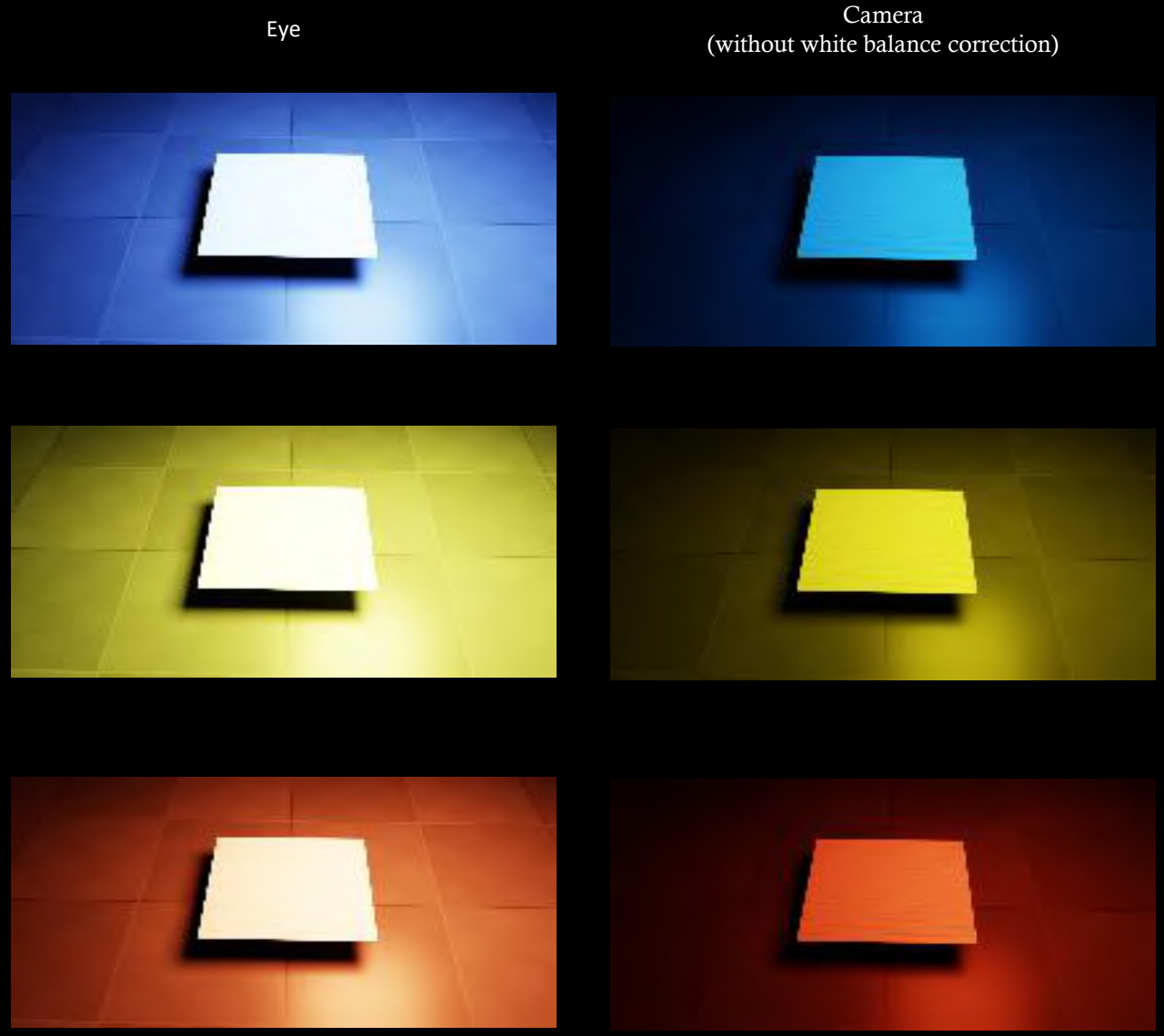


Color Perception

- Color constancy
- Lighting changes
- Stable perception

A camera records absolute color values.

Humans perceive colors relative to surrounding colors and lighting.



Camera color capture

- White balance and sensor limits
- Sensor-based color
- Possible errors

Humans perceive colors as stable, even under different lighting conditions.

Cameras rely on white balance, which can easily be incorrect.

When Colors Turn White

- Cone saturation
- Perception of white
- Cameras behave differently

The cones specific to that color reach their maximum biochemical response limit.

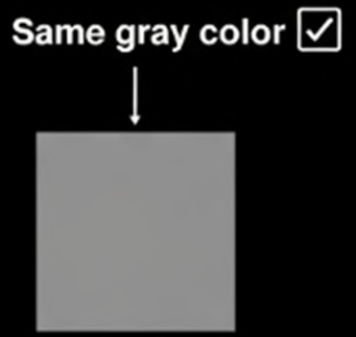
When all cones (L, M and S) are activated simultaneously and at their maximum capacity, the brain can no longer distinguish the color and interprets the combined signal as blinding white.

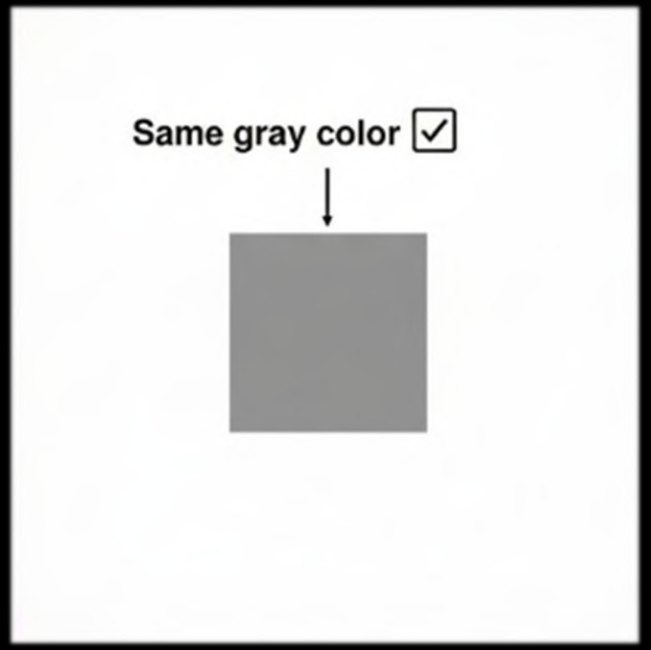
Contrast perception

- Relative contrast
- Context-driven
- illusions

Our brains focus on contrast and edges.

Two identical brightness values can appear completely different depending on context.

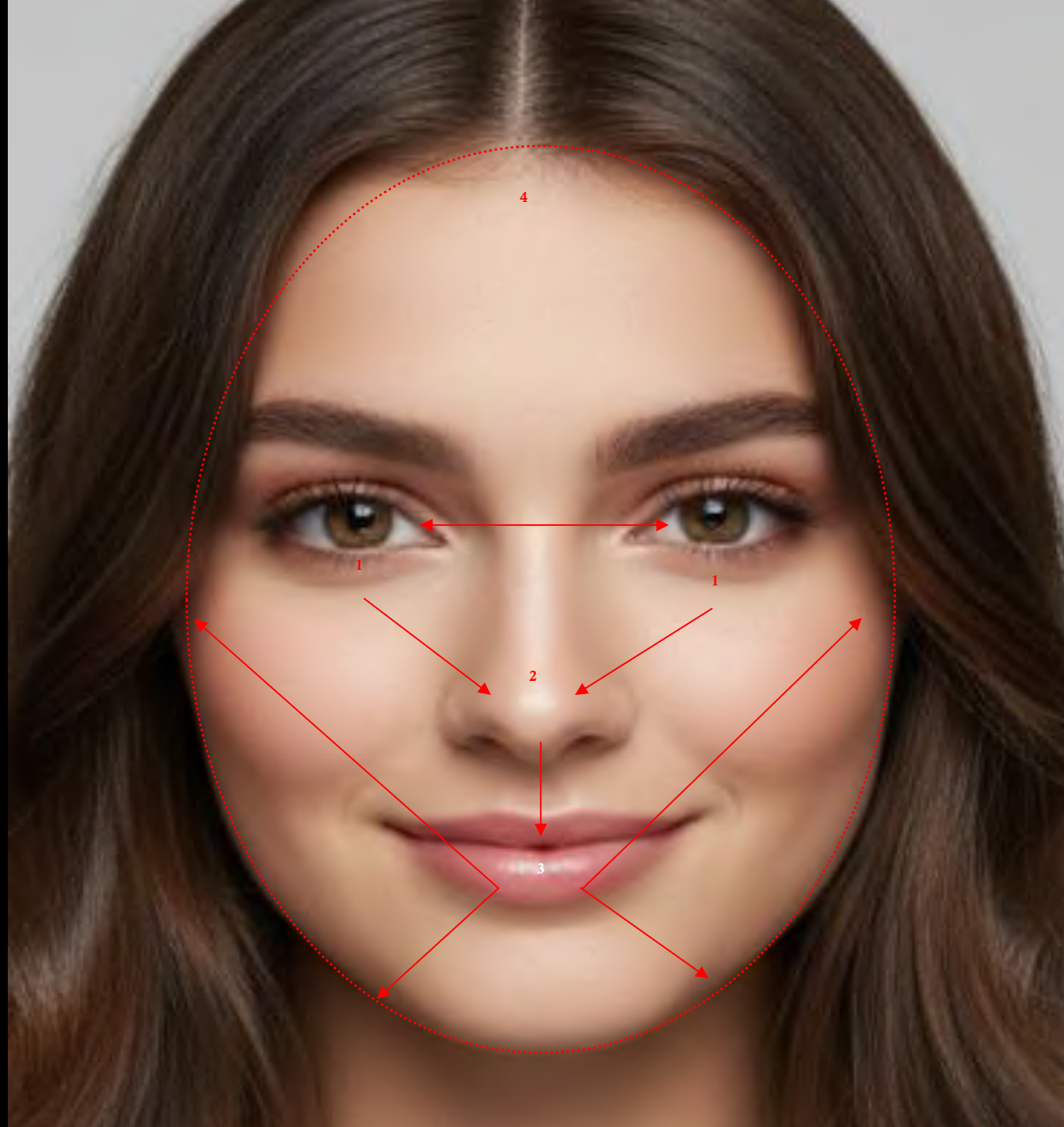




Sharpness & focus

- Eye scans
- Brain reconstructs
- Camera freezes

When we look at a face, our eyes do not move smoothly but rather follow a scan path: a sequence of rapid ballistic movements called saccades, interspersed with moments of relative immobility called fixations.



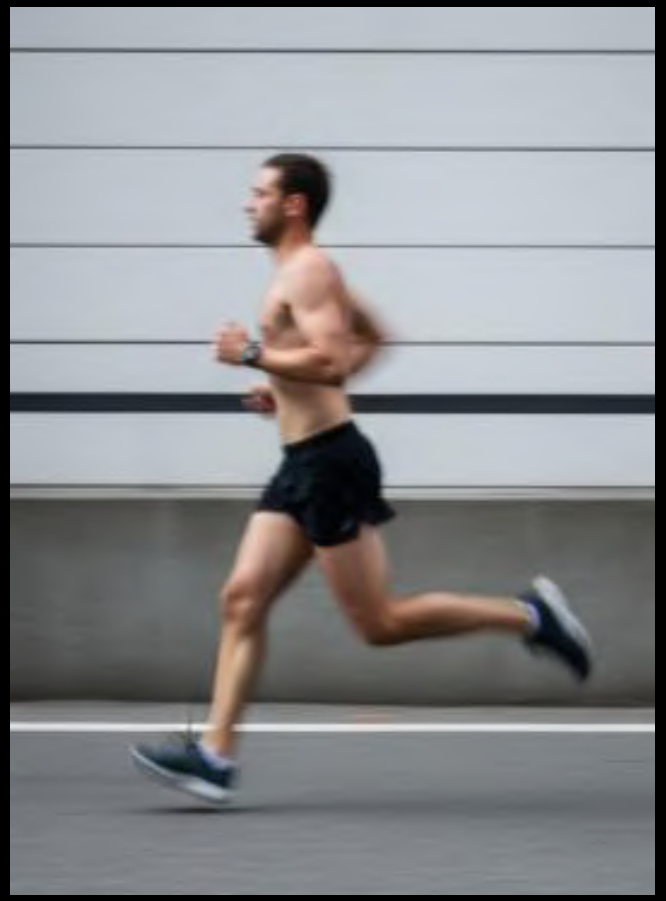
Motion & Time

- Continuous motion
- Discrete frames
- Blur or freeze

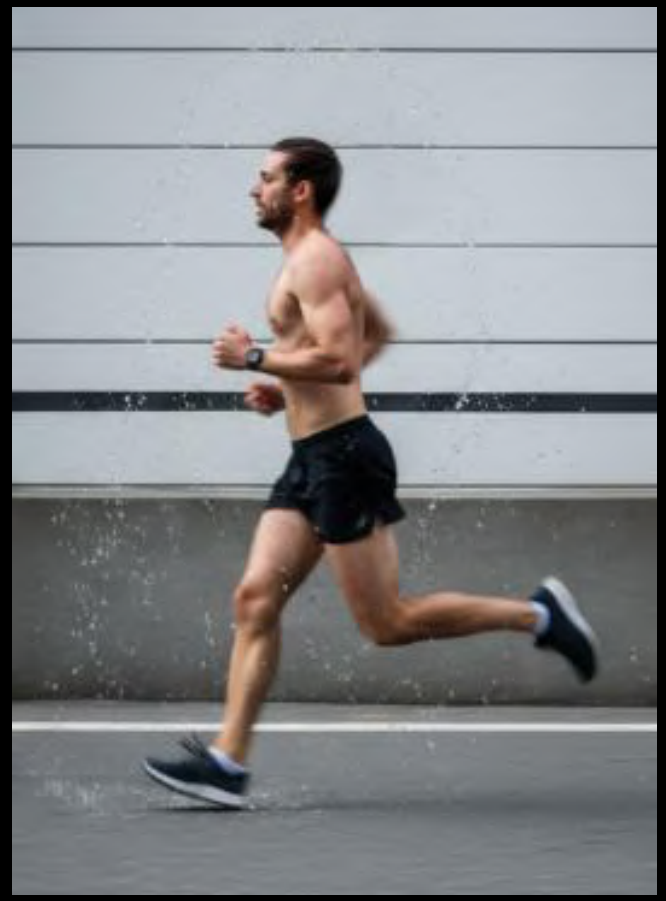
Humans perceive motion smoothly over time.

Cameras sample time in discrete moments, which can look unnatural.

Motion blur
(slow shutter speed)



Frozen
(fast shutter speed)



Noise Perception

- Brain filters noise
- Sensors amplify it

In low light, the brain suppresses visual noise.

Cameras amplify sensor noise, making images look worse than what we perceive.

Human eye
(clera perception)

Camera photo
(High ISO noise)

Subjetivity

- Expectations
- Experience
- emotion

Human vision is influenced by expectations, memory, and emotion.

Cameras are unbiased, which can be a disadvantage when humans judge the result.

Warm (confort)

Cold (isolation)

Real comparison

- Same scene
- Two outcomes
- Key differences

This comparison shows how a scene that feels balanced to the eye appears underexposed, flat, or color-shifted in a photo.

Human perception (interpreted)

Raw camera sensor (linear data)

Implications

- Photography
- Automotive
- AI

Any system where machines capture images for humans, or train AI, must account for perceptual differences.

Key Points

- Overcome traditional approach of virtual cameras
- Synthetic data set, train AI
- AI can drive virtual camera

The human eye interprets reality.
Cameras measure it.

Bridging this gap is essential to create images and systems that truly look right to people.

BSCA Partners

Unlimited Performance Provider

Thank you