International Imaging Industry Association

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What are CPIQ's objective image evaluation testing philosophy and methodologies?

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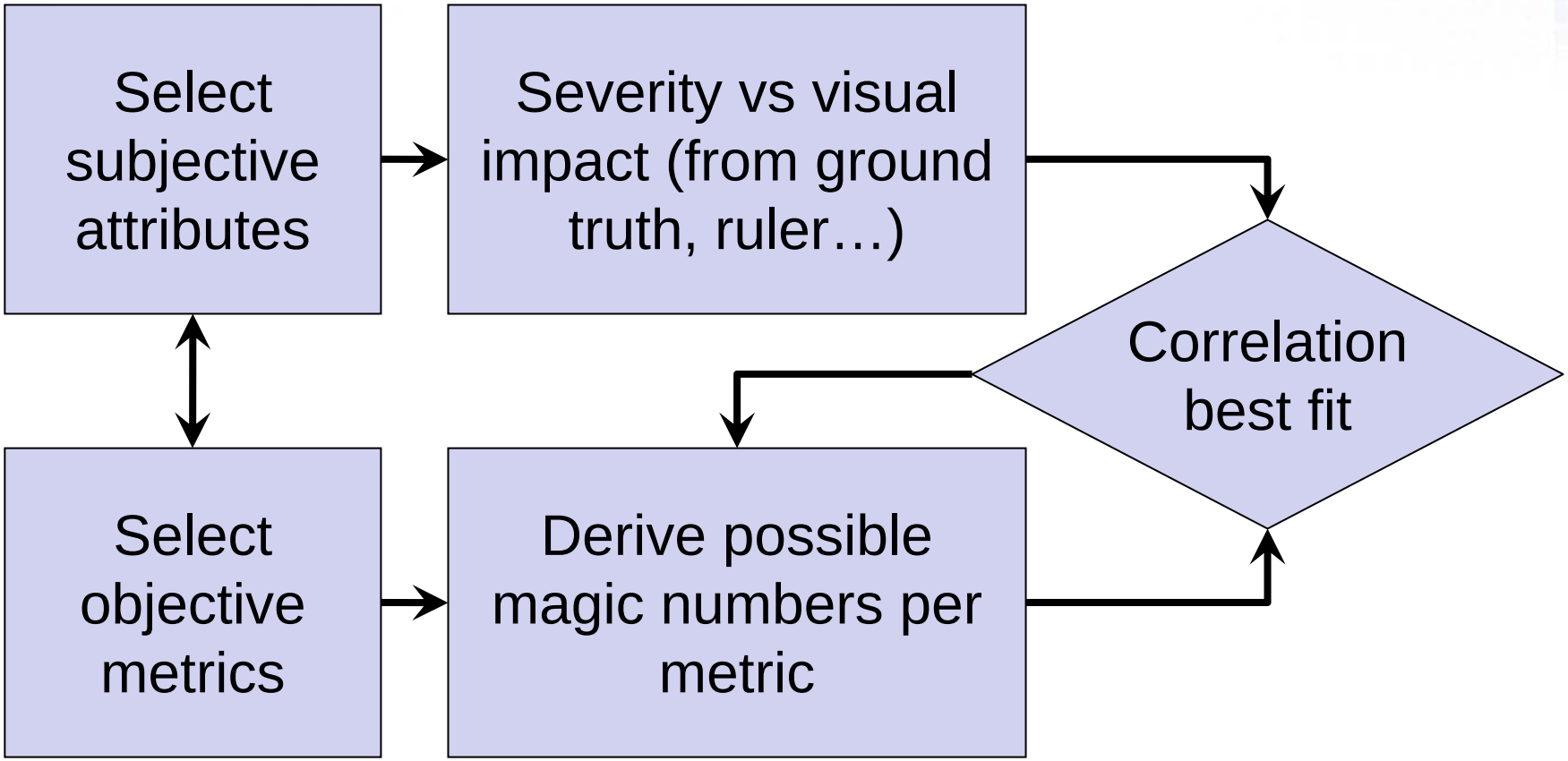
Defining objective metrics: philosophy

- Metrics to support the subjective consumer-based IQ scoring system
  - Characterize camera artifacts that impact visual perception
  - Establish correlation with subjective attributes
  - Characterize artifacts relevant to consumer photography
- Metrics to help the industry designing better product
  - Meet repeatability and productivity required by the Industry
  - Metrics and tools that engineers can use to design better quality camera modules

Matching objective & subjective a parallel approach



Objective vs subjective

Subj. Attributes / Objective Metrics	Colorfulness	Lightness	Sharpness	Details	Geometry
Exposure		✓		✓	
Shading (light & color)	✓	✓			✓
Chromatic aberrations	✓		✓	✓	
Distortion					✓
Sharpness			✓	✓	
Resolution (MTF)			✓	✓	
Texture preservation			✓	✓	
Dynamic & tonal range	✓	✓		✓	
Noise	✓		✓	✓	
White-balance	✓				
Color fidelity	✓				
Color sensitivity	✓			✓	

Camera components & metrics

Optics	Distortion Shading LCA	Sharpness Resolution
Sensor	Noise Color shading	Dynamic range Spectral response
Processing (ISP)	Exposure White-balance Demosaicing De-noising	Sharpening Tone rendering Color rendering

Which magic numbers for each artifacts ?

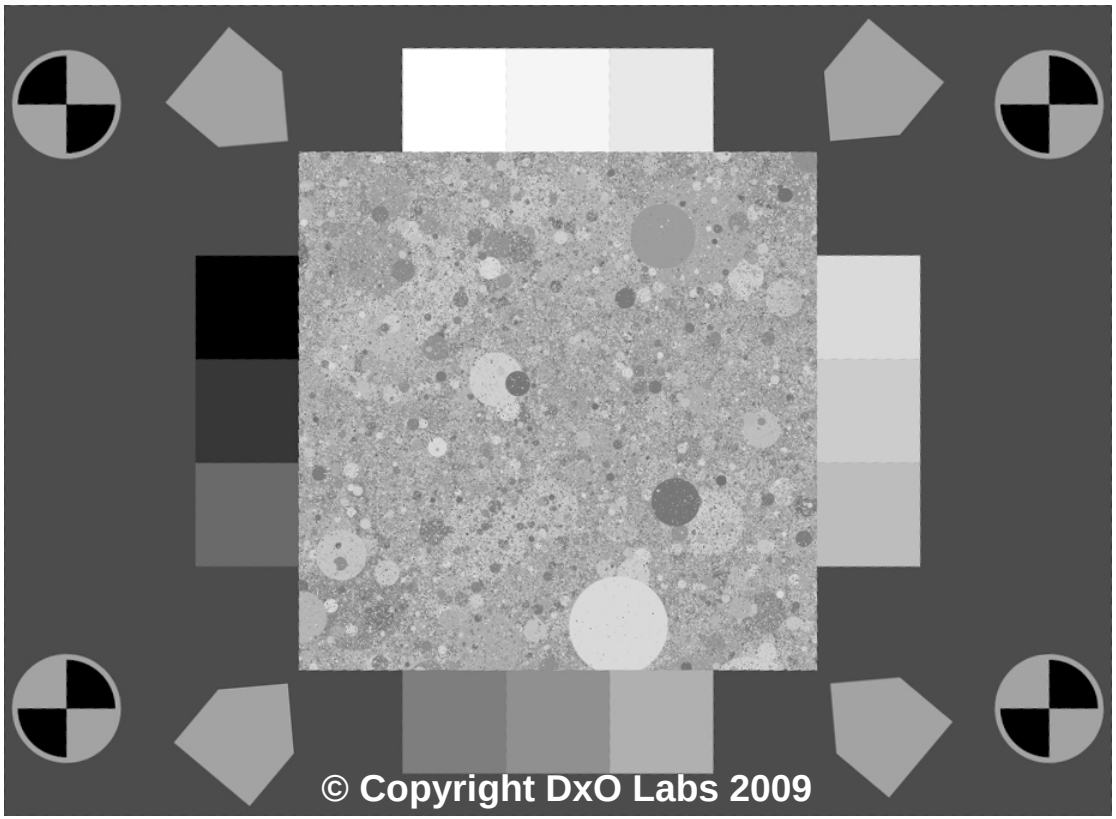
Color shading	• Max value • Area of image field with values > threshold…
Lateral chromatic aberration	• Max distance between RGB magnification (throughout the image field) • Area of image field with values > threshold…
Distortion	• Arc value at a certain position • TV distortion • Profile gradient at a position (to be defined)…
Edge sharpness	• Max value • Average slope • Acutance…
Texture preservation	• Power spectrum at given freq. • Energy ratio (noise/target texture)…

Repeatable / highly productive testing methodologies

- A small set of targets
  - as many parameters per target
- Precise protocols (testing conditions)
- Highest automation
- Cope with wide resolution range
  - VGA to 12Mp

Tough to reproduce consumer scenes in the lab !

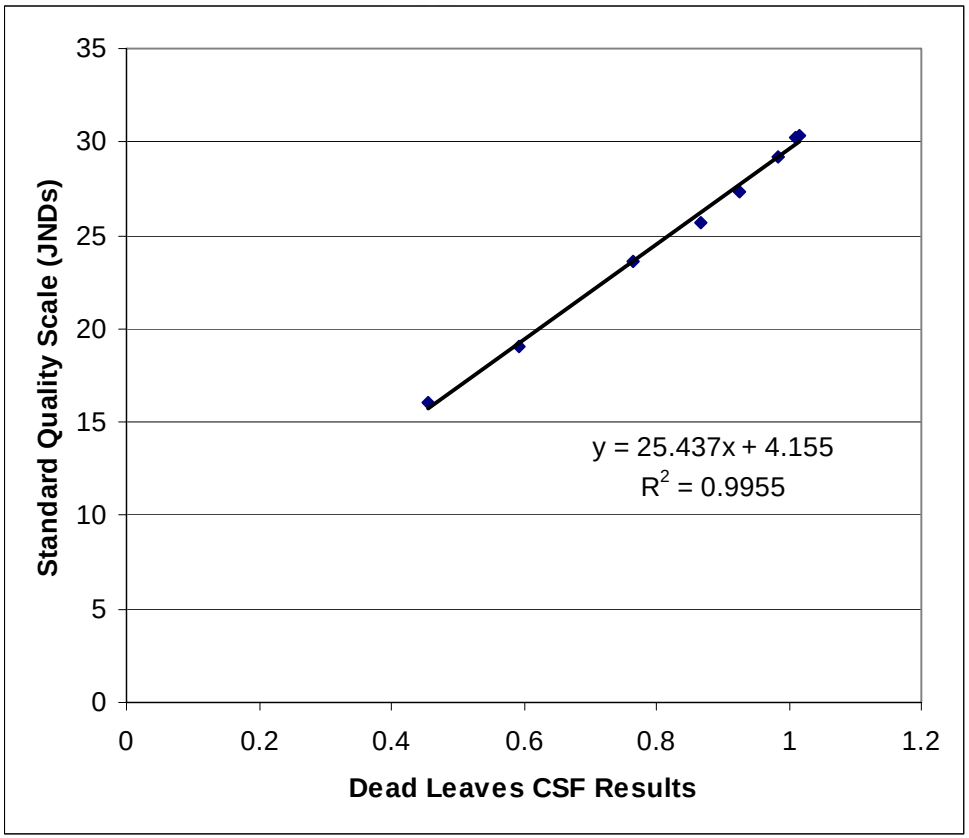
Target to match key (challenging) properties of natural scenes



Dead leaves model (proposed by DxO Labs)

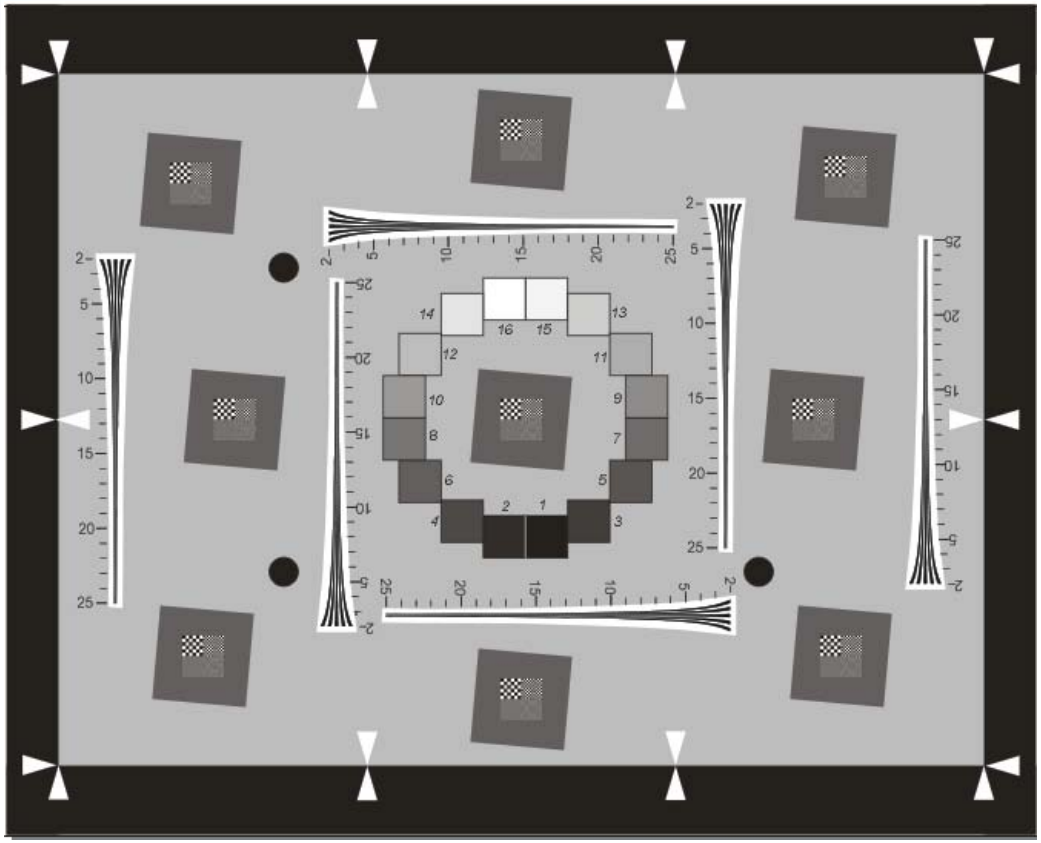
- Scale invariant
- Rotation invariant
- Reproduce occlusion
- Arbitrary contrast
- PS fits natural texture

When physics meets psychophysics



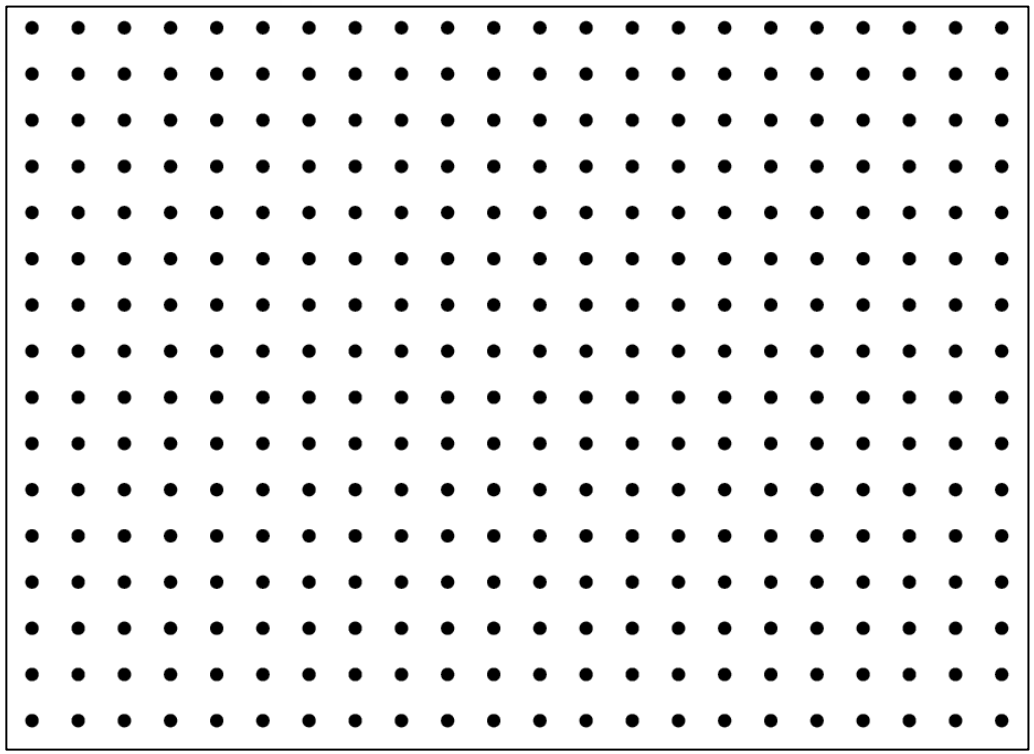
Dead leaves model
subj. = f(obj.)
Excellent linear fit
$R^2 = 0.9955$

SFR adapted to Cameraphones



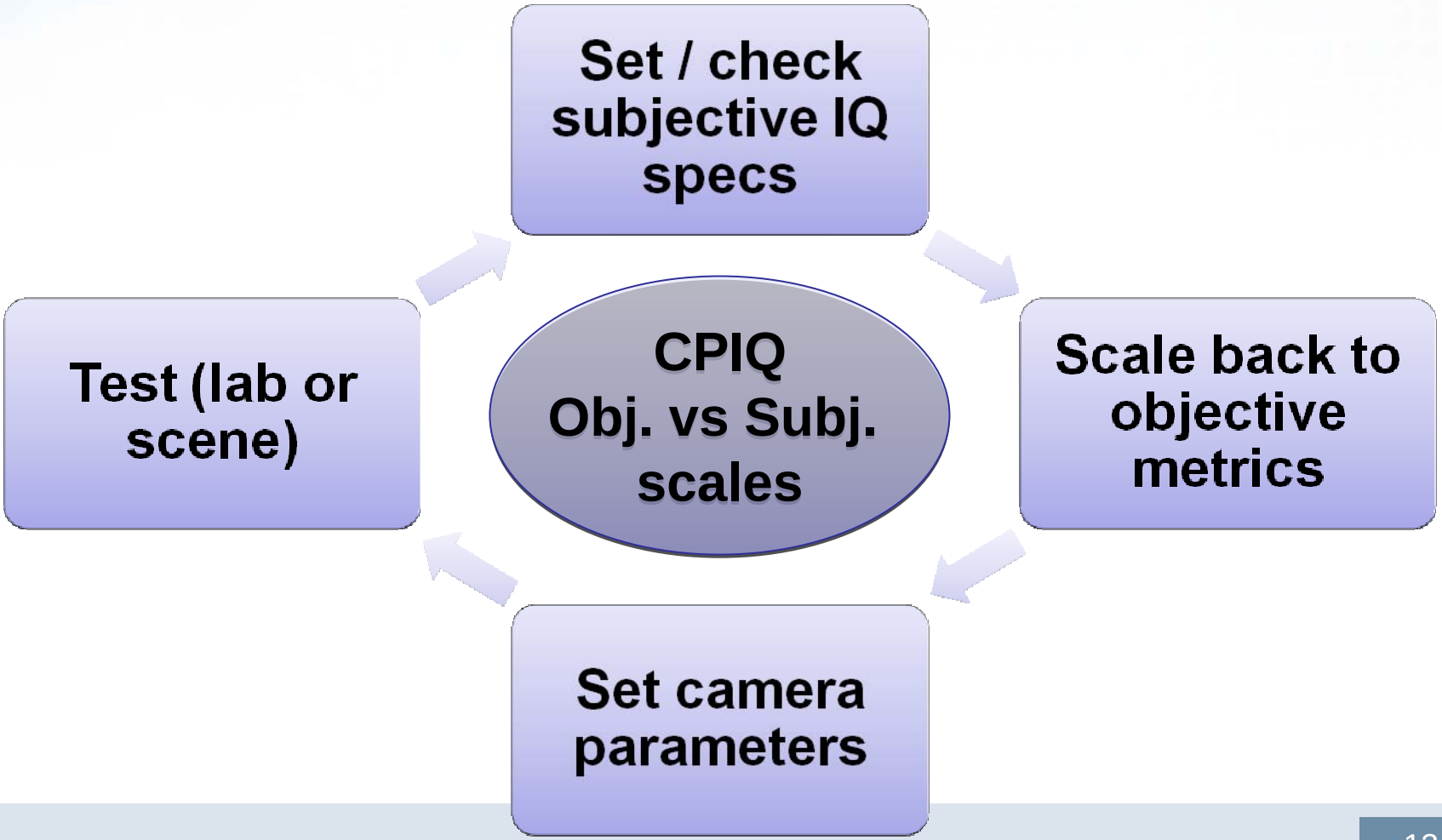
Leveraging existing standard #12232 : OECF / Multi-point SFR & resolution limit

Simple multi-purpose targets



Dot target
(proposed by DxO Labs)
High productivity target:
Distortion
Chromatic aberrations
Color shading

Ultimate camera tuning tool



Thank you!

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