DEVELOPMENT OF A COLOR GRAPHIC ICON FOR IMAGE COLOR CONTENT AND COLOR SHIFT

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CONTEXT & OBJECTIVES

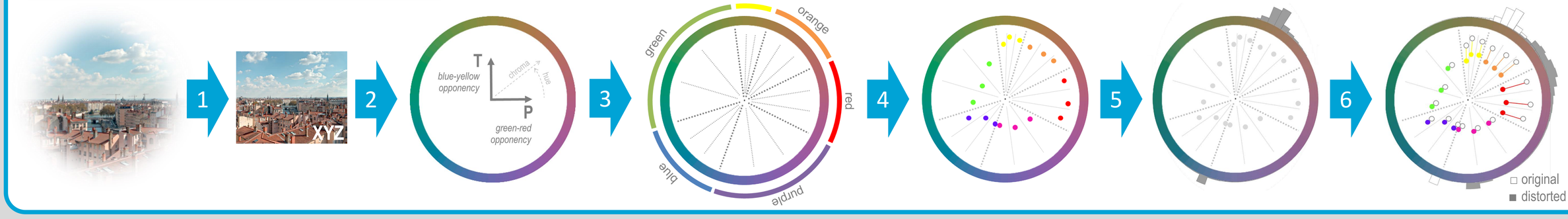
A color graphic icon which serves the decision-making process in building design

- based on recent developments in lighting color quality and adapted for real complex scenes
- providing descriptive information about the color content of a real scene and potential color shifts due to illuminant and/or glazing changes

DEVELOPMENT OF THE ICON

1. Acquisition of the XYZ coordinates of the studied scene
2. Application of iCAM06[1] color appearance model for predicting visual appearance of the complex scene and representation of the scene's color content in the PT plane of IPT color space
3. Division of the PT plane in 18 bins (6 principal color bins [a] divided in 3 equal parts)
4. Calculation of mean P and T for each bin to inform on chroma/hues of the scene
5. Construction of a circular histogram to inform on scene's color distribution
6. Superposition of the color content of the original scene and that distorted by a glazing/light source change

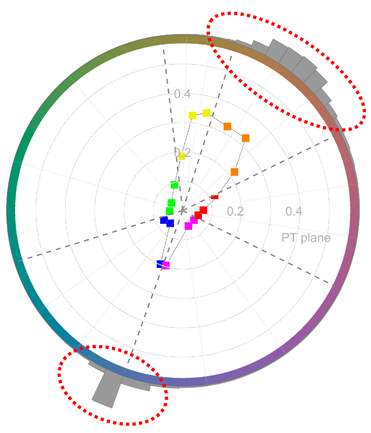
THE ICON STEP BY STEP



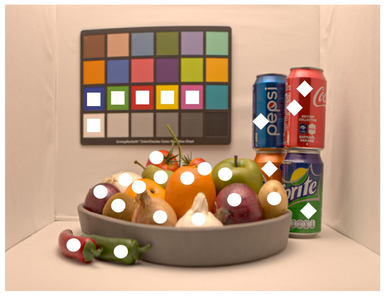
COLOR CONTENT ANALYSIS

Example #1 : real scene

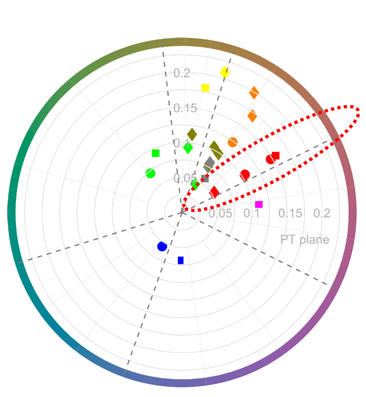
In this real-world scene viewed through a clear glazing in a building, we observe a large unsaturated bluish component (~sky) and a more saturated orange one (~buildings/roofs). Green, blue-green, purple-red, and red hues are unsaturated and poorly represented.



Example #2 : lab context

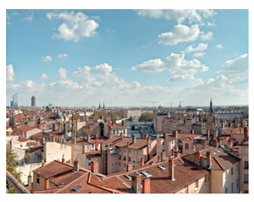


In this example, rather than analysing the scene by color bin, we analyze elements (■ macbeth chart, ♦ cans, ● fruits/vegetables).
We observe that red elements are not in the red principal color bin and that questions the division of the color space.



COLOR SHIFT ANALYSIS

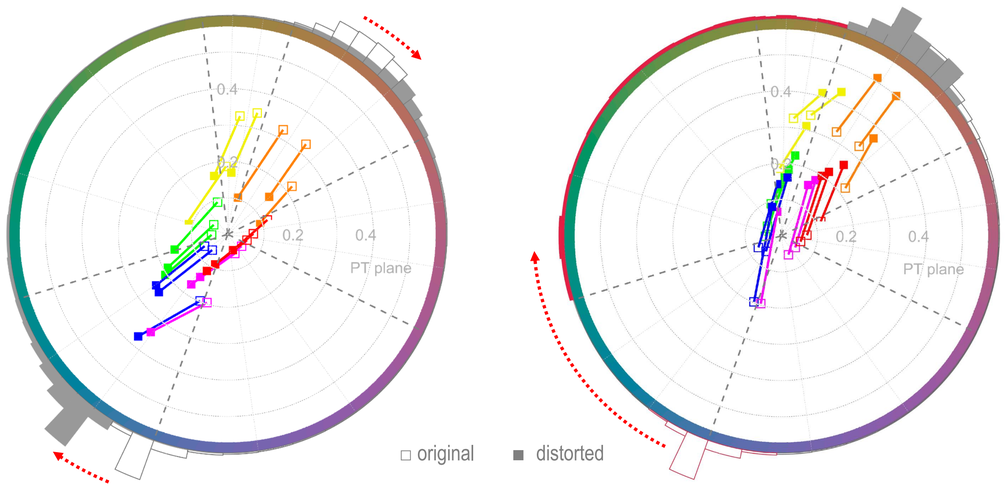
#1a : blue tinted glass



a shift from purple-blue toward a bluish and more saturated hue is observed for the sky (probably appreciated by the occupant) - the orange component becomes pinkish (less saturated+more reddish)

#1b : bronze tinted glass

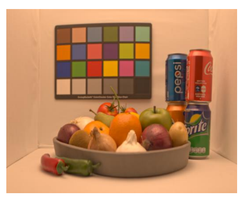
the blue component of the scene disappears in favor of low saturated green and yellow - the orange component becomes more saturated



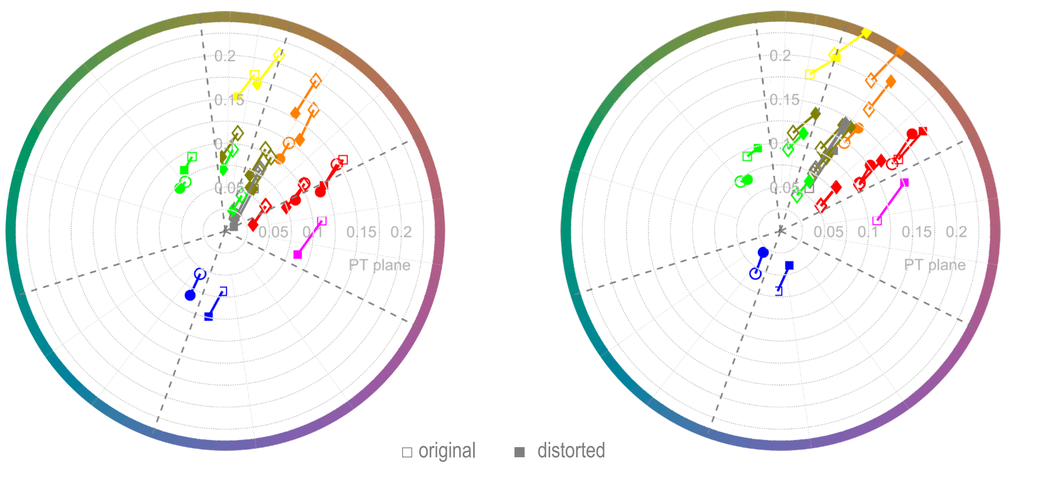
#2a : 6500K

a loss of color saturation is observed for the majority of the studied elements except blue ones - orange and blue elements shift very weakly in hue

#2b : 2700K



red, orange and yellow elements are more saturated contrary to blue ones - green elements shift toward yellow - yellow elements shift toward orange



CONCLUSIONS & FURTHER WORK

The present study raises questions about:

- the validity of available CAMs (color appearance models) for complex environments, and their parametrization (*Which level of chromatic adaptation?)*
- the need to normalize trichromatic coordinates in the case of complex scenes (*Which ref. white ?*)
- the choice of an appropriated color space for the analysis of color content of complex scenes
- the division of the color space and the link with color naming and context effect (*Not taking into account the intensity channel is it a reasonable simplification?*)

The work will continue in comparing objective analyses based on the graphic icon with:

- color naming
- perception of color distortion
- traditional information given in technical sheets (CRI, CCT, tint)

Note.
[a] The boundaries of the 6 color bins were first determined in Munsell Notation based on the work by Hansen et al.[2]. XYZ and IPT coordinates of Munsell color chips were then calculated under D65, based on their reflectance spectra. Resulting hue angle of the boundaries are: 26° for red-orange (5R), 72° for orange-yellow (10YR), 97° for yellow-green (10Y), 197° for green-blue (5BG), 250° for blue-purple (5PB) and 334° for purple-red (10P).

References.
[1] Kuang, J., Johnson, G. M., & Fairchild, M. D. (2007). iCAM06: A refined image appearance model for HDR image rendering. Journal of Visual Communication and Image Representation, 18(5).
[2] Hansen, T., Walter, S., & Gegenfurtner, K. R. (2007). Effects of spatial and temporal context on color categories and color constancy. Journal of Vision, 7(4).