CIC23 Special Topic: Material Appearance and Color

Fast and Accurate 3D Rendering Of Automotive Coatings

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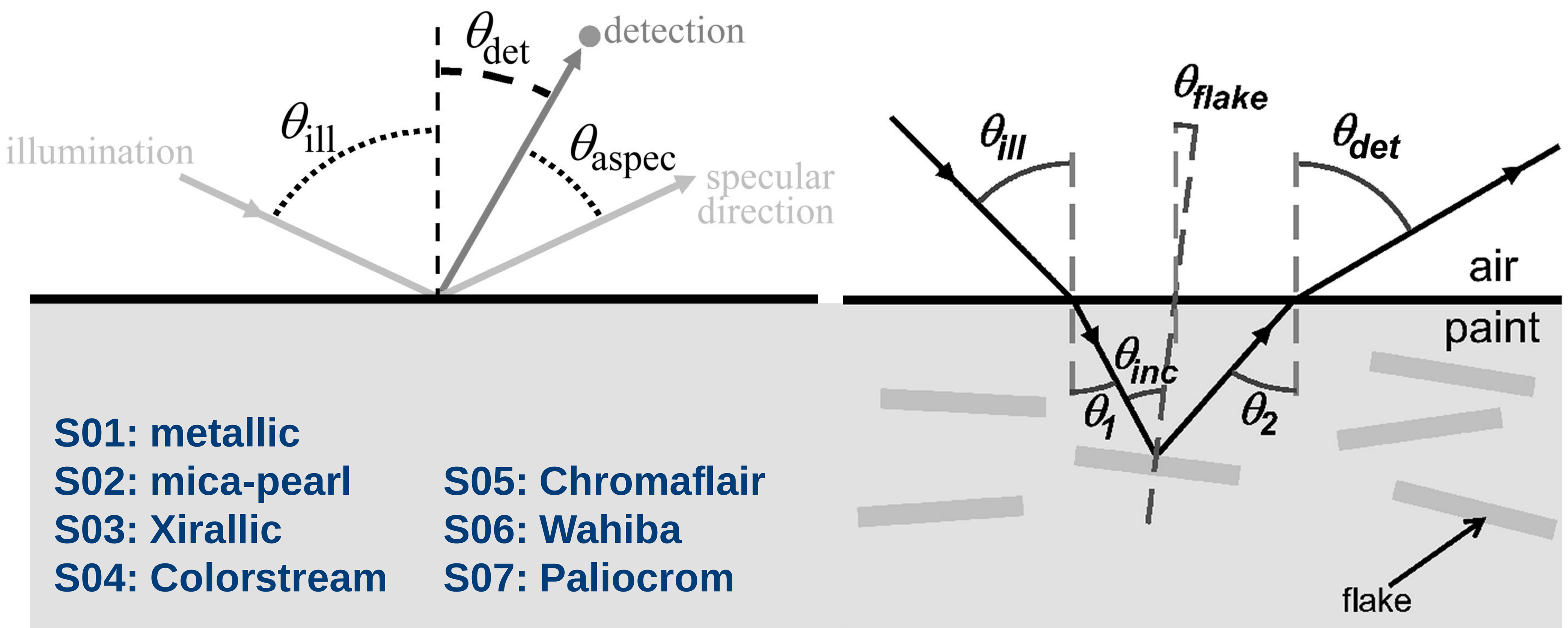
Automotive Coatings



Colors of many automotive coatings show a strong dependence on illumination/detection geometry.

Traditionally, in 3D rendering and in reflectometry this is parametrized using the so-called aspecular angle [1,2].

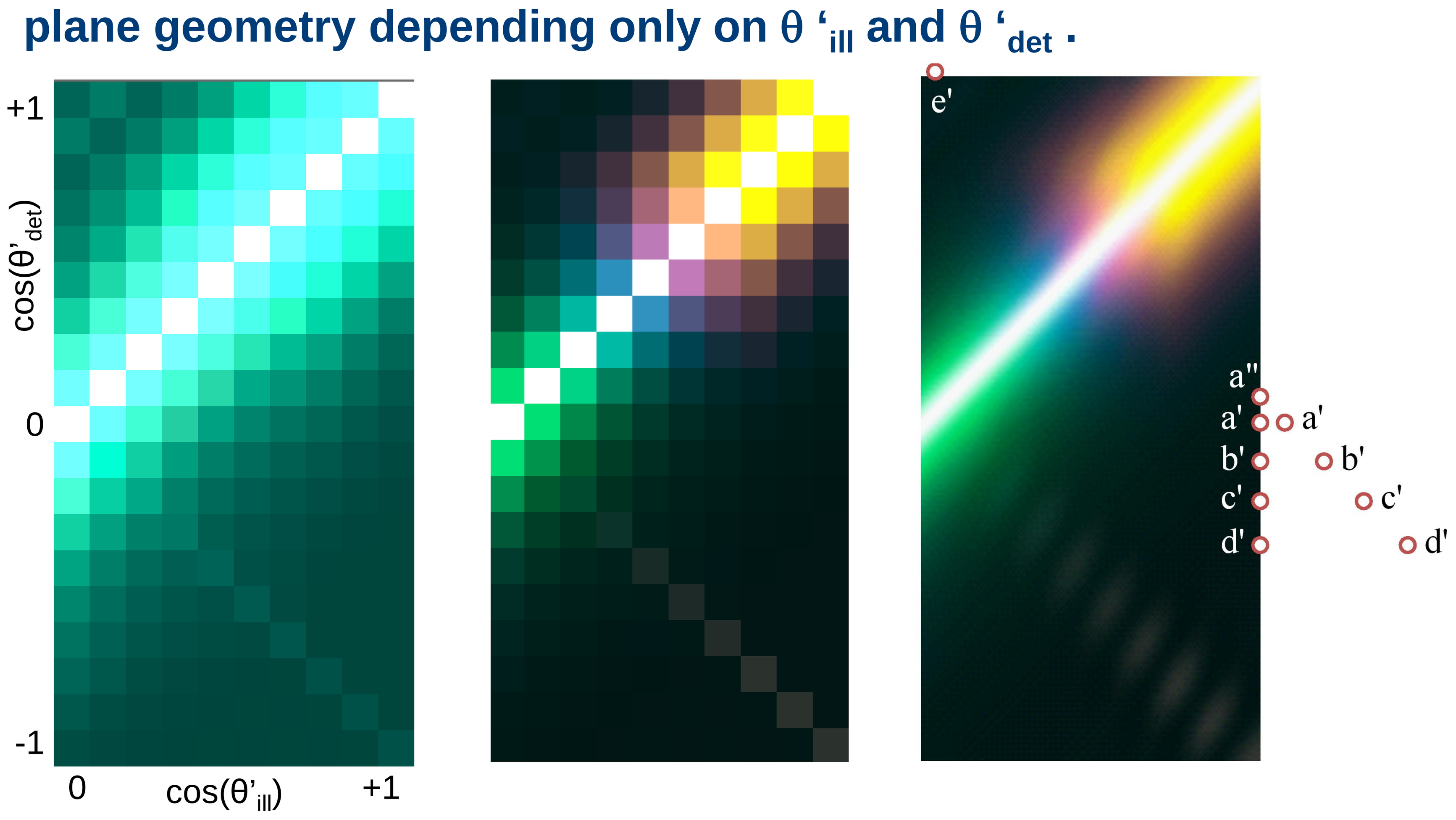
In previous work, we showed that the aspecular angle is only reasonable for metallic coatings [3].

For interference coatings, a new 2D parametrization proved much more accurate: Flake Based Parameters / Isolines.

L*	IL01	IL02	IL03	IL04	a*	IL01	IL02	IL03	IL04	b*	IL01	IL02	IL03	IL04
S01	0.1	0.2	0.2	0.9	S01	0.3	0.3	0.3	0.2	S01	0.2	0.3	0.2	0.6
S02	0.5	0.8	0.5	0.7	S02	0.7	0.9	0.7	0.3	S02	0.6	0.6	0.4	0.2
S03	1.1	1.0	0.8	0.8	S03	1.8	1.8	1.2	0.4	S03	1.4	1.2	1.1	0.4
S04	0.7	0.4	0.5	0.7	S04	0.6	0.4	0.4	0.3	S04	0.5	0.4	0.5	0.4
S05	1.0	1.2	1.0	1.6	S05	0.4	0.4	0.3	1.5	S05	0.6	0.9	0.8	0.9
S06	0.4	0.7	0.5	1.0	S06	0.4	0.6	0.4	0.4	S06	0.5	0.8	0.5	1.1
S07	0.9	0.4	0.7	1.4	S07	0.3	0.3	0.3	0.3	S07	0.4	0.3	0.3	0.5

3D Rendering Using Isolines

Using Flake-Based Parameters and isolines, any illumination / detection geometry can be converted into an equivalent in-plane geometry depending only on θ'_{ill} and θ'_{det}.



Reflection data from BRDF instrument on (a) typical metallic: Silberline Sparkle Silver (b) extreme interference: Chromaflair Green-Purple, (c) same after interpolation.

BRDF instrument is GEFE, at CSIC in Madrid.
448 geometries: 8 polar angles 0°-10°-…-70° for illumination and detection. And 7 azimuthal angles 0°-30°-…-180°.

Isoline based interpolation showed an issue when the equivalent angle θ'_1 or θ'_2 exceeds the critical angle:

$$\theta'_{1,2} \geq \theta_{crit} = \arcsin\left(\frac{n_{air}}{n_{coat}}\right)$$

Possible solutions: (i) Clipping by complex analysis. The arcsin function can be analytically continued; arcsin(x) for x>1, (ii) Vector analysis in the colormap.

Results and Conclusions

We used the proposed method by programming it in a 3D graphics shader. Examples of results are shown below, again for the typical metallic and the extreme interference coatings.

Resulting 3D Renderings using the isoline method.

Conclusion: The proposed isoline method results in a fast and accurate 2D mapping for rendering of automotive coatings. It can be effectively programmed in a 3D graphics shader.

References

[1] G.W. Meyer and C. Shimizu. Computational automotive color appearance. In: Eurographics 2005: 217-222. [2] P. Dumont-Bècle, E. Ferley, A. Kemeny, S. Michelin and D. Arquès. Multi-texturing approach for paint appearance on virtual vehicles. Proc. Driving Simulation Conference:123-133, 2001. [3] E. Kirchner, A. Ferrero, Isochromatic lines … for effect paints. J. Opt. Soc. Am. A 31:1861-1867, 2014.