WP 1: Goniochromatism

The measurement of sparkle

Alejandro Ferrero

Grupo de Medidas de Radiación Óptica (GIMRO)
Dpto. Imágenes, Visión e Instrumentación Óptica
Instituto de Óptica
Agencia Estatal CSIC
alejandro.ferrero@csic.es

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Outline

- XDReflect publications
  - Procedure for measuring sparkle
    - Results
      - Last comments

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XDReflect publications on sparkle

1. 2015, 8th February: oral presentation. B Bernad, A Ferrero, A Pons, ML Hernanz, J Campos, "**Upgrade of goniospectrophtometer GEFE for near-field scattering and fluorescence radiance measurements**" in IS&T/SPIE Electronic Imaging Conference, San Francisco, California, United States.
2. 2015, Ferrero, A., & Bayón, S. (2015). **The measurement of sparkle**. *Metrologia*, *52*(2), 317.
3. 2015, 1st May: Publication: E. Kirchner, I. van der Lans, E. Perales, F. Martínez-Verdú, J. Campos, and A. Ferrero, "**Visibility of sparkle in metallic paints,**" J. Opt. Soc. Am. A 32, 921-927 (2015).
4. 2015, 2nd July: presented poster in CIE 2015 conference (Manchester): **Measuring sparkle of effect coatings,** A. Ferrero, S. Bayón.

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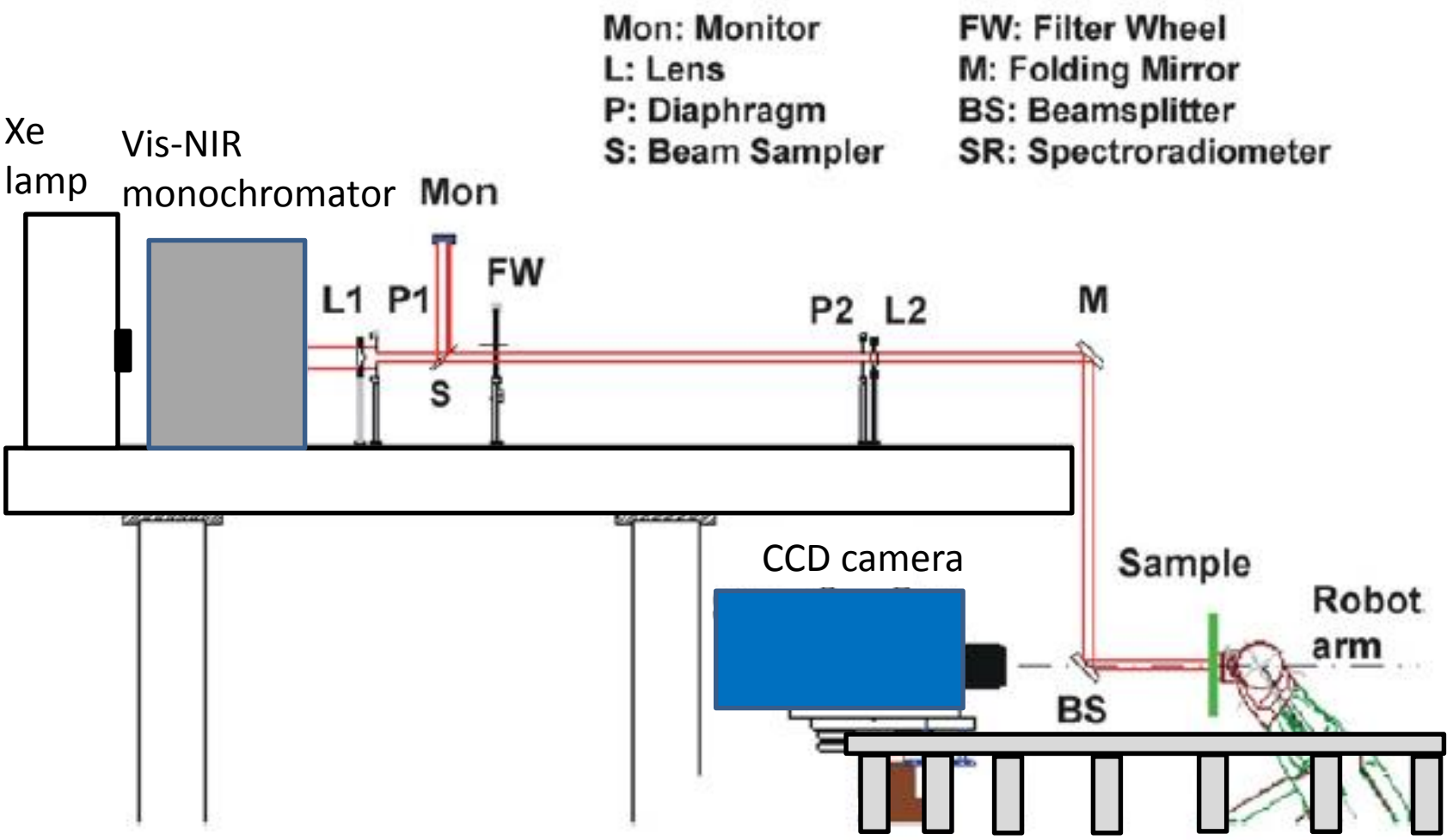
XDReflect publications on sparkle

5. 2015, **"The minimum number of measurements for colour, sparkle, and graininess characterisation in gonio-apparent panels"**, Chorro, E; Perales, E; Burgos, FJ; Gómez, O; Vilaseca, M; Viqueira, V; Pujol, J; Martínez-Verdú, FM, Coloration Technology, Volume 131, Number 4, 1 de agosto de 2015, pp. 303-309(7), **Publisher:** Blackwell Publishing.

6. 2015, **"Influence of the Effect Pigment Size on the Sparkle Detection Distance,"** Gómez, O; Perales, E; Chorro, E; Viqueira, V; Martínez-Verdú, FM.; Ferrero, A; Campos, J, Color and Imaging Conference, Volume 2015, Number 1, October 2015, pp. 175-179(5), **Publisher:** Society for Imaging Science and Technology

7. 2016, **Brightness and sparkle appearance of goniochromatic samples**,. Iacomussi P.; Radis M.; Rossi G., Electronic Imaging, Volume 2016, Number 9, 15 de febrero de 2016, pp. 1-6(6), **Publisher:** Society for Imaging Science and Technology.

8. 2016, Sep: Póster in 4th CIE Expert Symposium on Colour and Visual Appearance, Prague, Czech Republic**: "Correlations between concentration of effect pigments, optical measurements and visual assessment of sparkle**," O. Gómez, E. Perales, E. Chorro, V. Viqueira, FM. Martínez-Verdú, A. Ferrero, J. Campos.


Mon: Monitor
L: Lens
P: Diaphragm
S: Beam Sampler
FW: Filter Wheel
M: Folding Mirror
BS: Beamsplitter
SR: Spectroradiometer
Xe lamp
Vis-NIR monochromator
Mon
L1
P1
FW
S
P2
L2
M
CCD camera
Sample
Robot arm
BS

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Measuring sparkle of effect coatings

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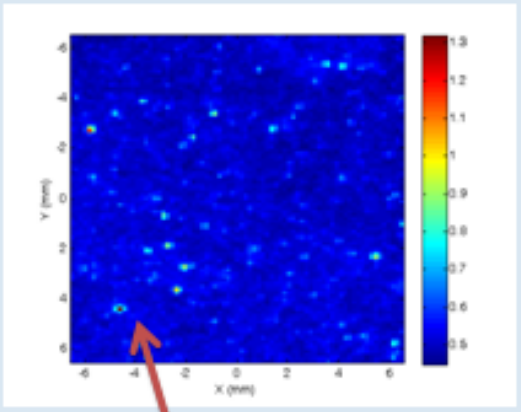
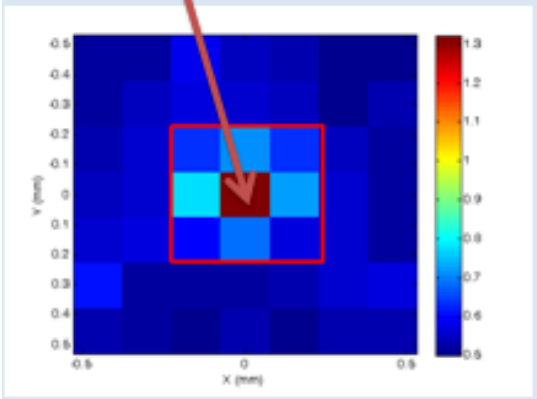
Methodology

Image of an effect coating within a 13 mm × 13 mm squared area.





1. Measurement of the instrumental flux

Instrumental fluxes of the image.

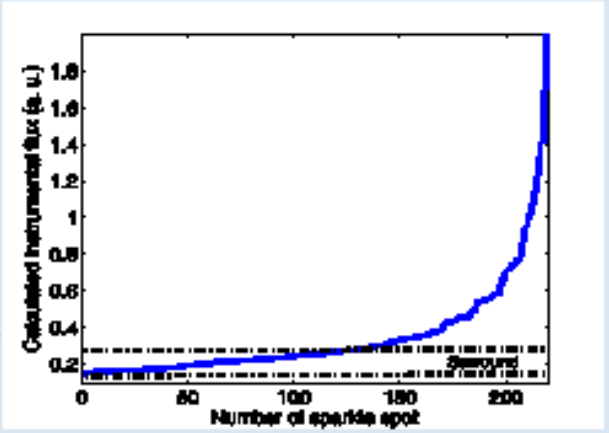


Image of a single sparkle within an area of interest of 1 mm × 1 mm. Values of the pixels within the red square are summed.

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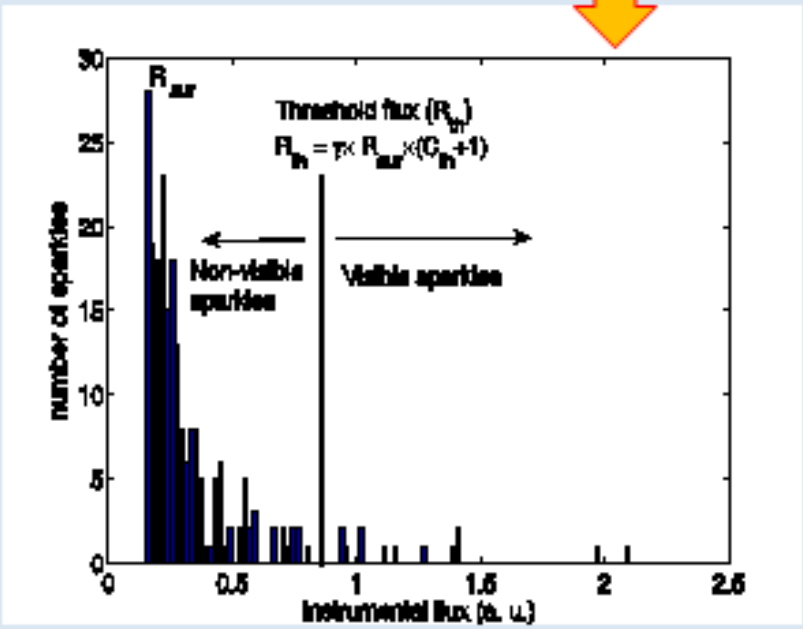
2. Determination of the flux threshold

R: Instrumental flux (DN).
R_{sur}: Instrumental flux for surround (the most frequent value of R.
C_{th}: Contrast threshold: the contrast which was detected with a probability of 50 percent, due allowance having been made for chance success.
R_{th}: Flux threshold: the lower flux for which the corresponding sparkle is visible.
γ: Scaling factor for R_{sur}: = A_{FOV}/A_a.
A_{FOV}: Field of view area of the photoreceptor.
A_a: Area of the aperture (red square).



Example of determination of the instrumental flux threshold.

$$C = \frac{R - \gamma R_{sur}}{\gamma R_{sur}}$$

$$C_{th} = \frac{R_{th} - \gamma R_{sur}}{\gamma R_{sur}}$$

$$R_{th} = \gamma R_{sur} \left(C_{th} + 1 \right)$$

The contrast threshold depends on the surround luminance, and therefore, on the reflectance of the surround and on the illumination **(Blackwell 1946, Crumey 2014, Kirchner 2015).**

3. Ensemble contrast and density of sparkle spots

Only the sparkles spots with instrumental fluxes R above the flux threshold R_{th} are used to calculate the **relevant quantities (Ferrero 2015):**

1) **Ensemble contrast:** Median of the contrasts of the accounted sparkle spots.

2) **Density of sparkle spots :** Number of accounted sparkle spots by area.

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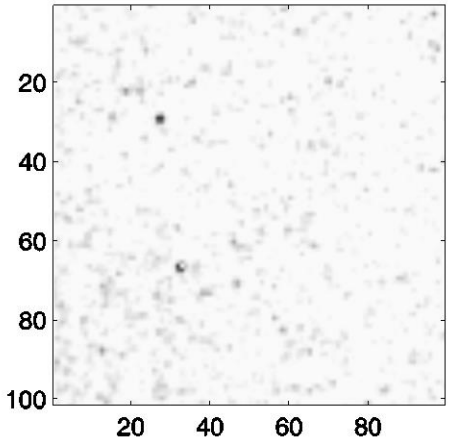
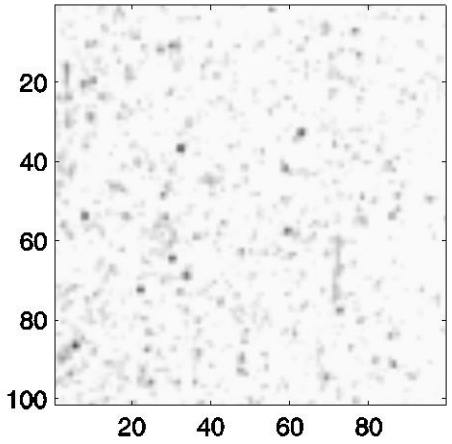
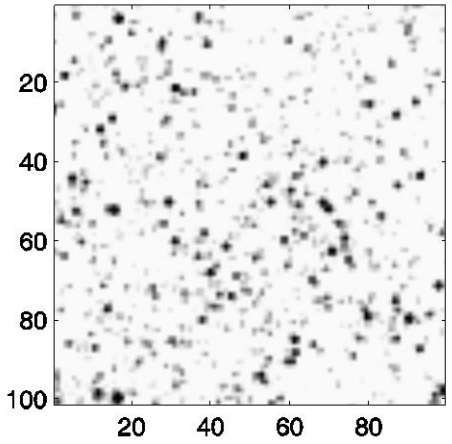
Sample #1; $\theta_i = 0^o$; $\theta_s = 10^o$



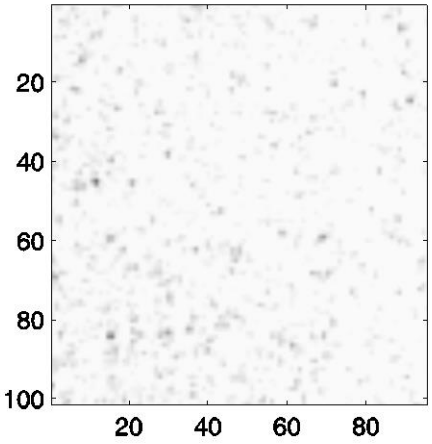
Sample #2; $\theta_i = 0^o$; $\theta_s = 10^o$



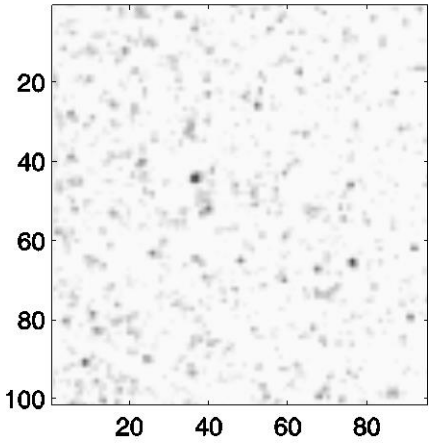
Sample #3; $\theta_i = 0^o$; $\theta_s = 10^o$



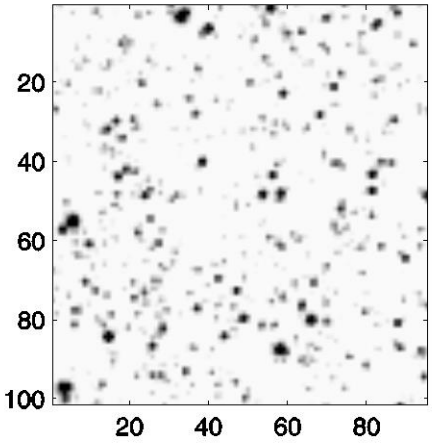
Sample #1; $\theta_i = 0^o$; $\theta_s = 20^o$



Sample #2; $\theta_i = 0^o$; $\theta_s = 20^o$



Sample #3; $\theta_i = 0^o$; $\theta_s = 20^o$



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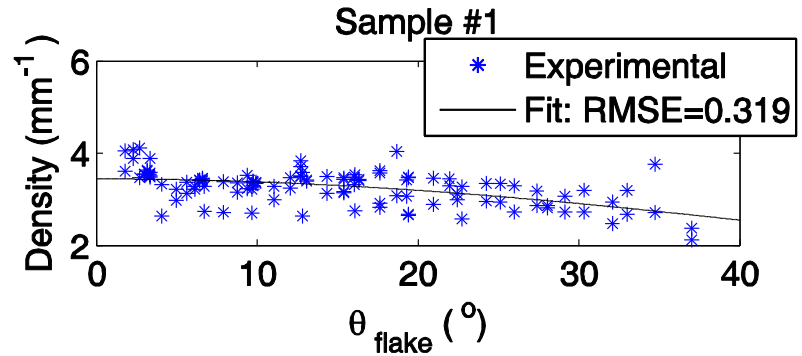

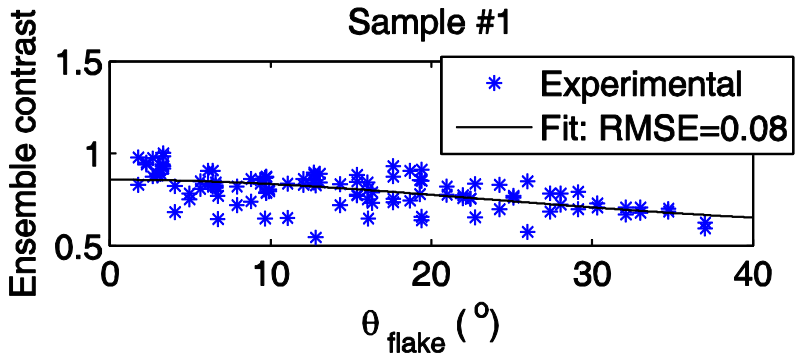

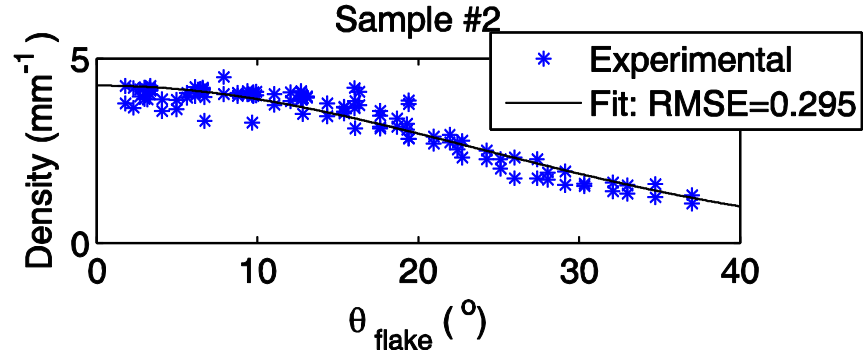

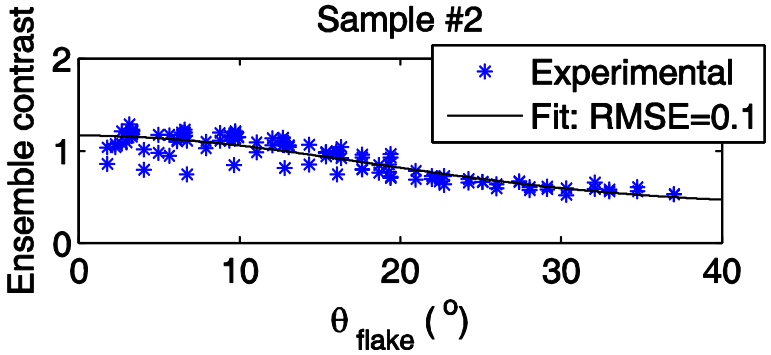

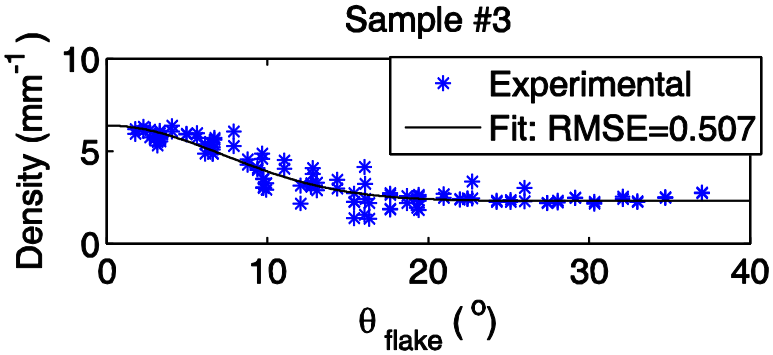

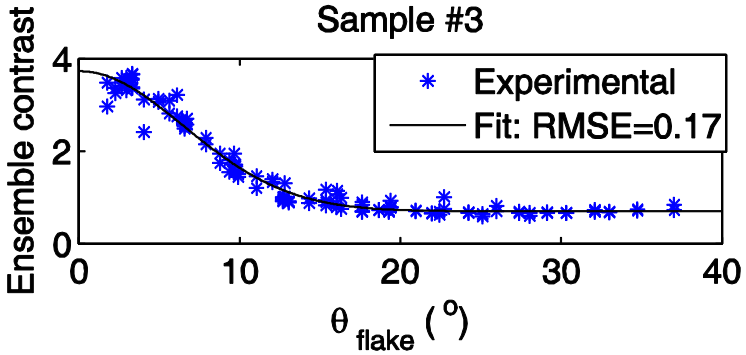

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Descriptors

Sample	Max. contrast	Max. density/mm^{-2}	Visibility inconstancy	Anisotropy
#1	0.86 ± 0.16	3.45 ± 0.60	0.17 ± 0.26	0.16 ± 0.25
#2	1.16 ± 0.20	4.27 ± 0.60	0.49 ± 0.24	0.56 ± 0.20
#3	3.73 ± 0.34	6.38 ± 1.00	0.81 ± 0.13	0.64 ± 0.22

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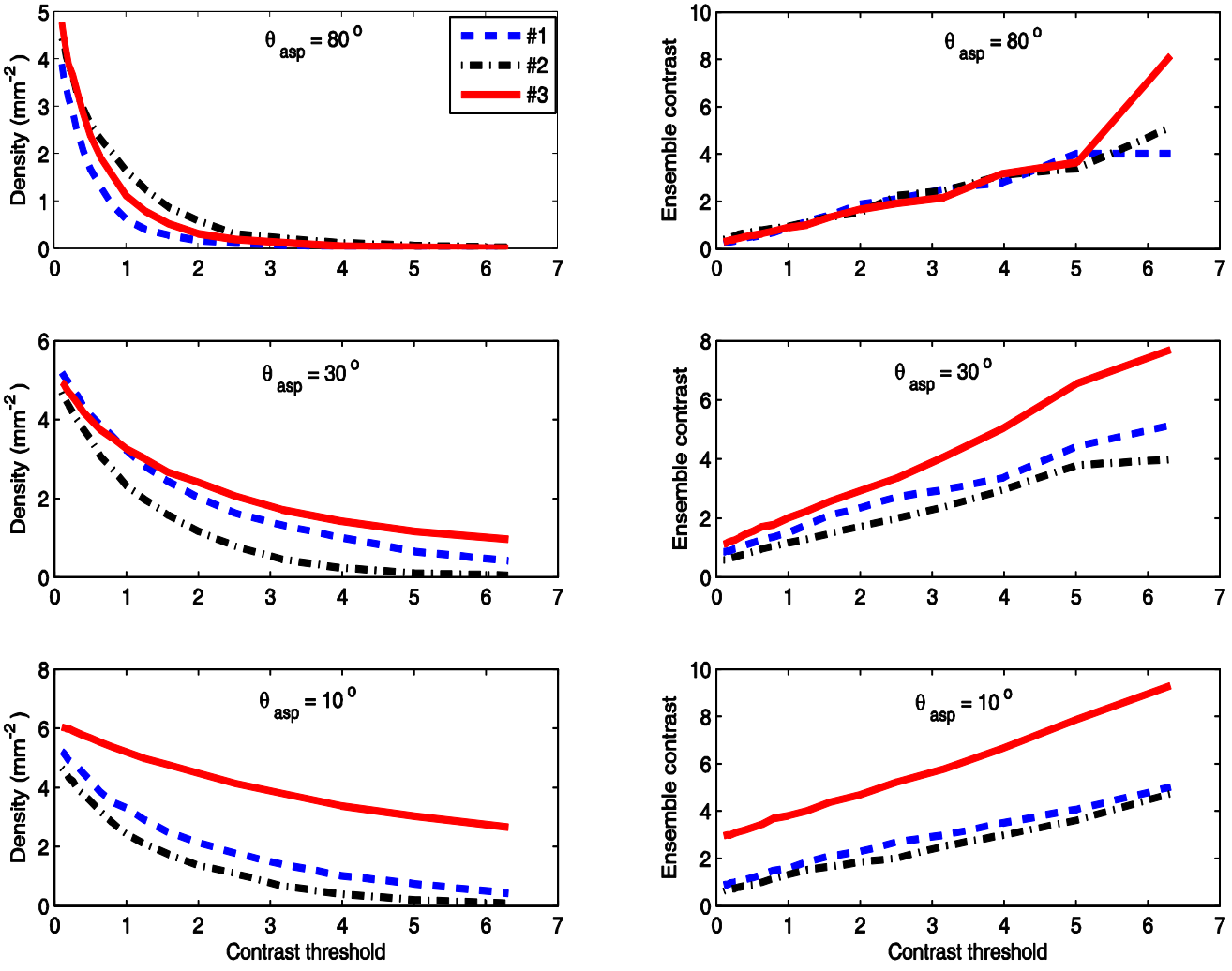

Last comments

- **Two descriptors** for sparkle were proposed for a given geometry (**density and ensemble contrast**). A third descriptor may be included to describe uniformity of sparkle spots in the images (difference betweeen glitterig and sparkle).
- **Two additional descriptors** are proposed to describe the variation with the geometry (**visibility inconstancy and anisotropy**).
- Descriptors have to be at least **bidimensional**, since they depend on **distance** and on surround **luminance** (Richard Blackwell).

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