The Impact of Specular Highlights on 3D-2D FR

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Impact of Specular Highlights

- State-of-the-art Face Recognition (FR) methods assume Lambertian reflectance
- We study the impact of specular highlights in FR

Contributions:

- Integration of **three different specularity removal methods** in the FR preprocessing pipeline
- Excplicit modeling of facial specularities using the **Cook-Torrance reflectance model**
- Evaluation: improved FR-performance by taking specularities into account

Specularity Removal

- Operates on normalized RGB ("chromaticities")
- Overall approach: "erosion" of the specular component → purely diffuse image

Method of Tan and Ikeuchi [2]:

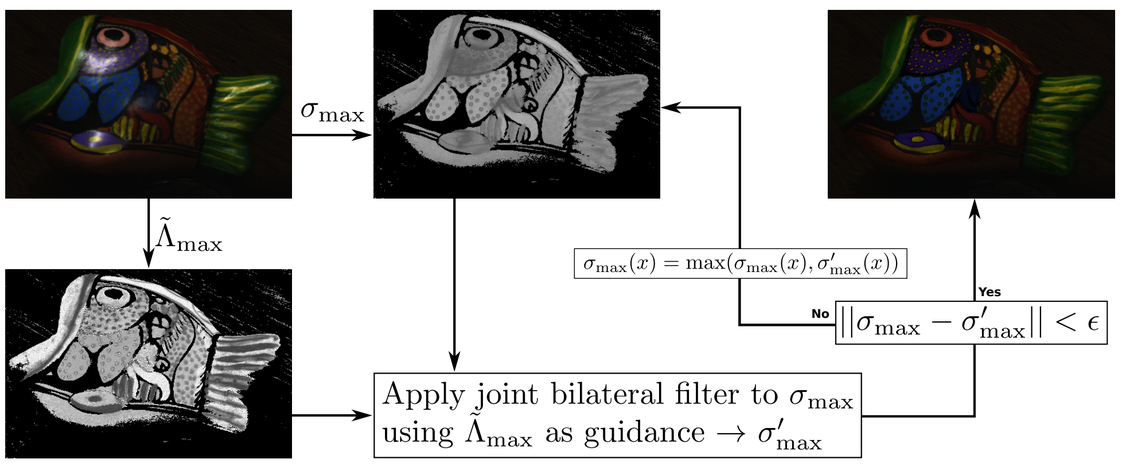
- Determine whether pixel is specular or diffuse
- Iteratively decrease specular component of each pixel by adopting the maximum chromaticity of the neighboring pixel

Method of Yoon et al. [3]:

- Compute a specular free (SF) image
- For each pair of neighboring pixels: Pixel in SF image acts as reference for specular portion of image pixel
- Specular portion determines specular-to-diffuse correction factor

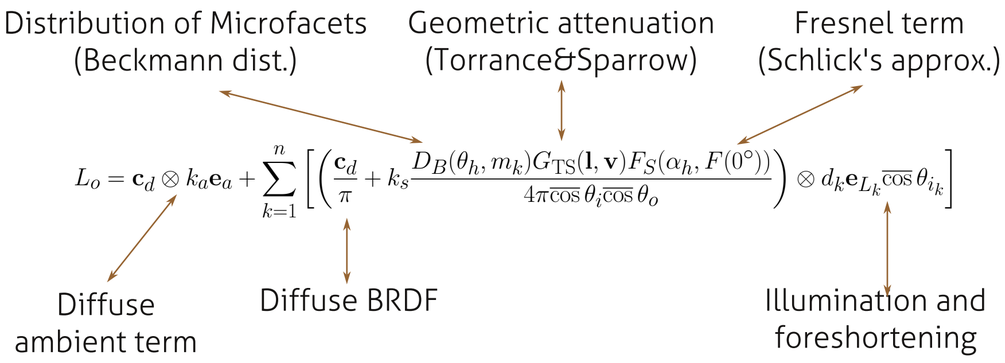
Method of Yang et al. [4]:

- Maximum chromaticity indicates mixture proportion of specular and diffuse reflectance
- Inpainting of low values of maximum chromaticity via bilateral filtering



Specular Reflection Model

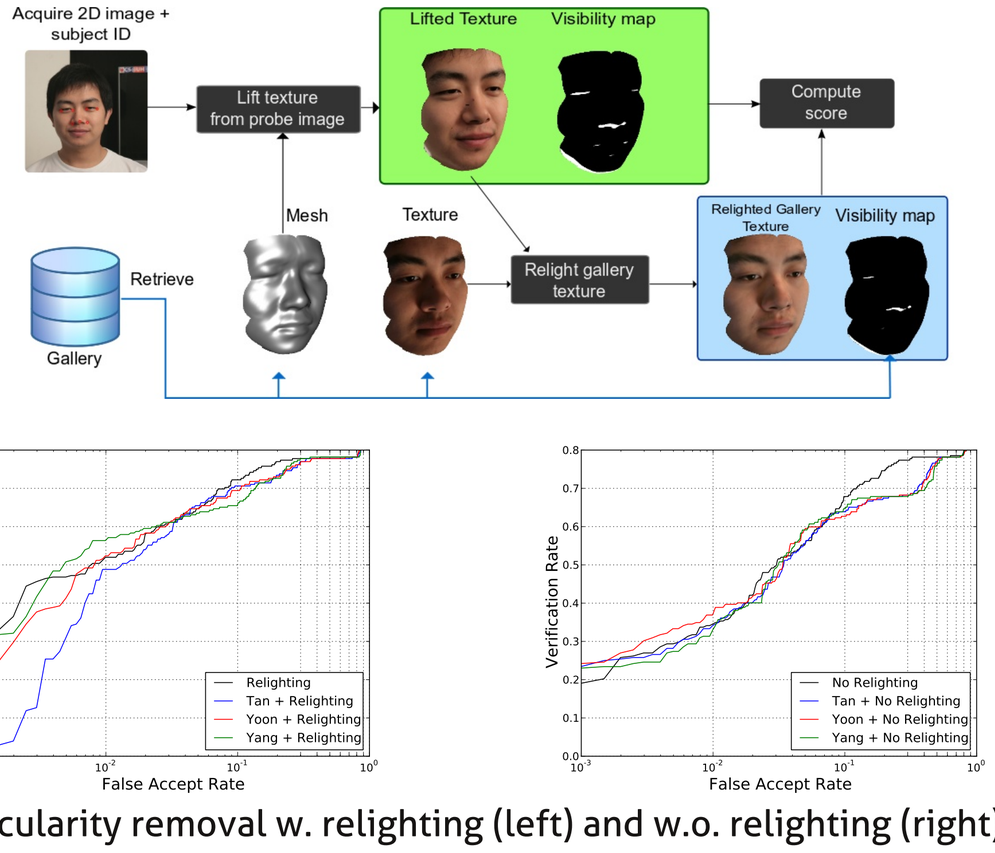
- Specular BRDF w. multiple point light sources, Cook&Torrance[5]



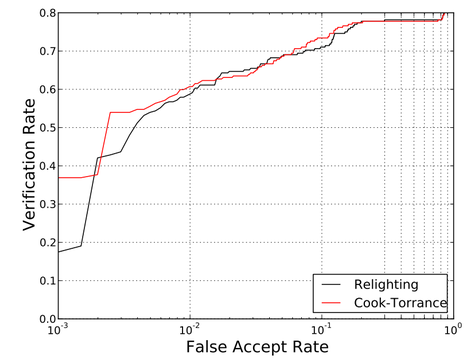
- Parameters estimated via enhanced simulated annealing

Evaluation

- UHDB30, 9 subjects, 22 outdoor, 7 indoor sessions, 2268 comparisons; 1 indoor session as gallery, rest as probe
- FR Framework based on Toderici et al. [1]



Specularity removal w. relighting (left) and w.o. relighting (right)



Results of incorporating Cook-Torrance BRDF into 3D-2D FR

Conclusions:

- SR techniques improve FR rate only slightly
- Most improvement for SR when omitting costly relighting step
- Incorporating a physics-based model for the specular reflectance: improvement of 19% at 10^{-3}FAR

References

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