OLÉ: Facial Imaging System with Overhead Lighting Environment

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A novel imaging system with an open-air, Overhead Lighting Environment (OLÉ) for clinical assessment of facial skin aging attributes.

Introduction

Visualization and assessment of facial skin aging attributes requires images captured using both uniform and directional illumination. Historically, facial skin imaging is accomplished using closed imaging environments for illuminating the subject with uniform diffused lighting, while eliminating unwanted effects of ambient light. A closed environment is also ideal for fluorescence and absorption imaging, as it simplifies analysis algorithm development and allows evaluation of the subject's entire face. However, direct illumination and secondary reflections may reduce contrast of skin topographical features.

Natural lighting, under which a subject's face is typically perceived, is overhead and directional. Directional/raked lighting reveals surface texture by illuminating features facing the light, while creating shadows for those facing away. The illumination angle of the raked lighting can be tuned for better visualization of features oriented in a certain direction, or it can be facial region specific.

OLÉ® Imaging System

We present the OLÉ Imager (Figure 1): An Overhead Lighting Environment (OLÉ) imaging system which emulates how the subject's face is perceived by the human eye in everyday settings. The OLÉ Imager combines a high-resolution digital color camera with application-controlled xenon flash sources for standardized facial imaging.

The imaging system canopy provides overhead lighting that illuminates the subject's face with vertical and oblique raked light that mimics natural lighting and enhances

FIGURE 1: ***Canfield's OLÉ Imager combines a high-resolution digital color camera with application-controlled xenon flash sources for standardized facial imaging.***

FIGURE 2: ***Multi-modality images (left to right): white light, cross-polarized, and parallel-polarized.***

topographical skin attributes (e.g., fine lines, wrinkles, and texture). With no secondary reflections, the OLÉ Imager also provides better axis-based polarized lighting, used for analysis of sub-dermal skin attributes (e.g., pigmented spots) (Figure 2).

Industry standard perspectives of the face (frontal and oblique views) are captured by rotating the canopy around a stationary subject.

A configurable software application driving the OLÉ Imager provides study-specific workflow. It controls the image capture settings across subjects and time points for repeatable clinical trial imaging (Figure 3). Real-time analysis of color standards in the captured images ensures the highest level of consistency in image quality.

Measurement of facial skin aging attributes is achieved post-capture using VAESTRO®, an integrated and scripted image analysis application. These facial skin aging attributes include: wrinkles and fine lines, pores, texture and visible spots from the standard raked image, evenness, Red (hemoglobin) and Brown (melanin) features from RBX® processed cross-polarized images (Figure 4), and shine and oiliness from parallel-polarized images.

Conclusion

With open environment, raked and obliquely oriented illumination, the OLÉ Imager emulates how the subject's face is perceived by the human eye in everyday settings. Consistency and reliability of the imaging system is demonstrated using measurement of color standards within the captured image frame. Examples showing detection and measurement of wrinkles, fine lines, texture, and pores demonstrated the imaging system's capability in objectively evaluating skin aging attributes. The OLÉ Imager will improve both visual and objective assessment of facial skin attributes in clinical studies.

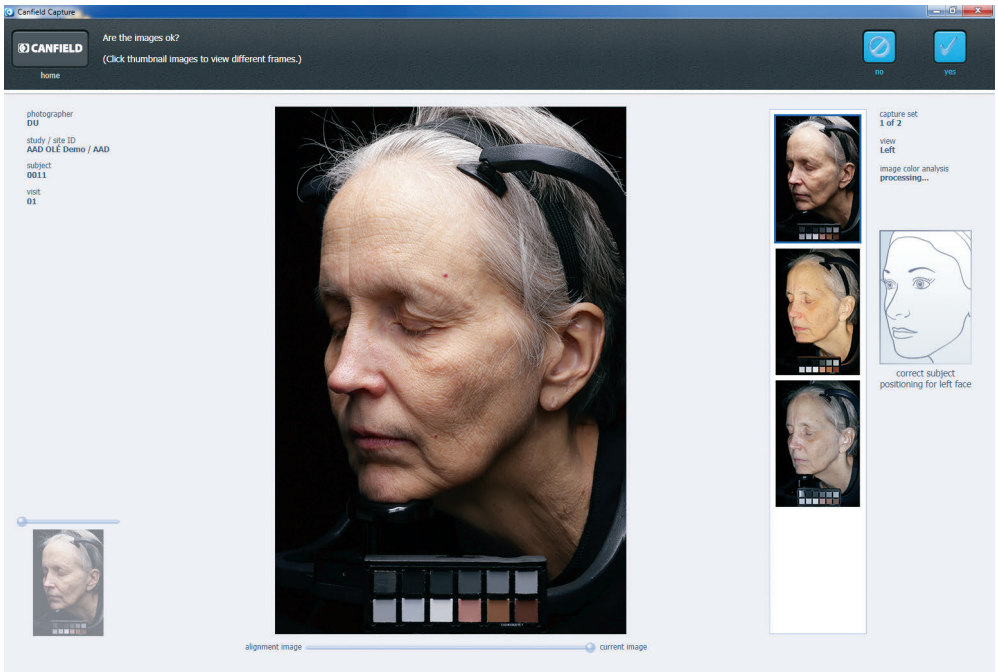


FIGURE 3: ***Configurable, wizard-driven software application locks study-specific image capture settings to secure repeatable performance. Real-time assessment of color standards by comparison with expected measurements and tolerances provides image quality and consistency feedback to the technician.***

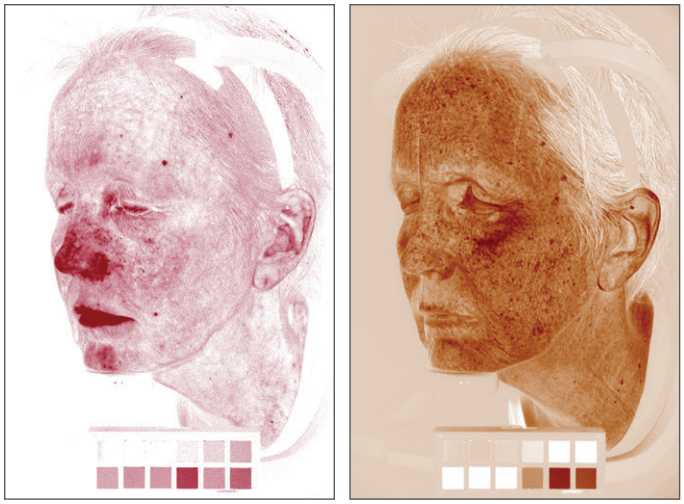
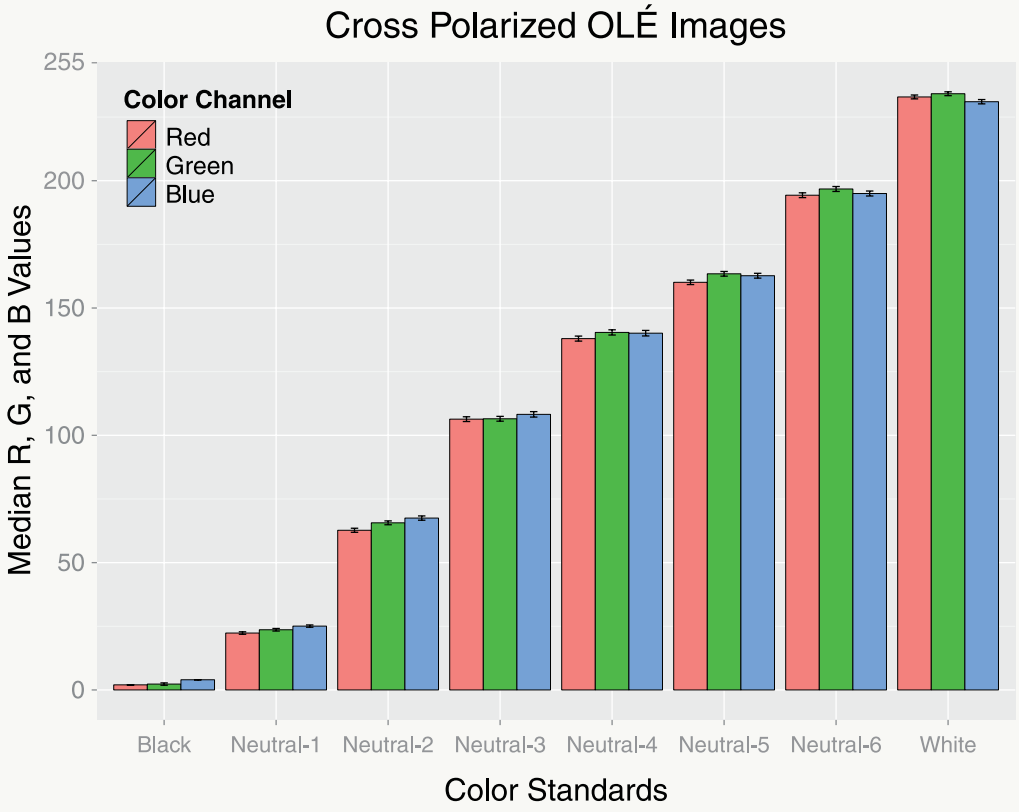


FIGURE 4: *VAESTRO image analysis enables RBX® transform for separation of pigmentation into Red (hemoglobin) (left) and Brown (melanin) (right).*

Reproducibility and Reliability



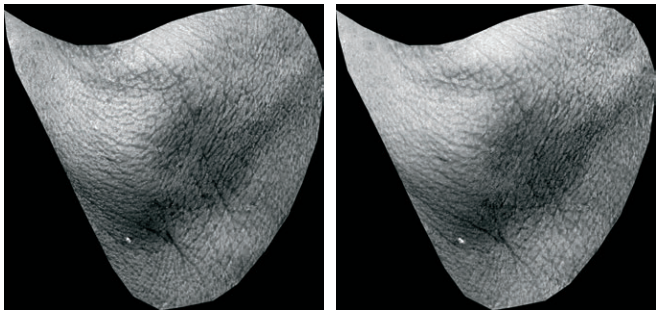
Reproducibility and reliability of VAESTRO imager is evaluated by measuring median color intensities of the color standards within the captured standard, cross-polarized, and parallel-polarized images (n=704 each). An average standard deviation of less than 1 gray level was observed in R, G, and B intensity measurements.

Quality of polarization evaluated as a ratio of median intensity measured on the reflective metal chip in cross and parallel polarized images indicates attenuation of spectral reflectance by a factor of 30.

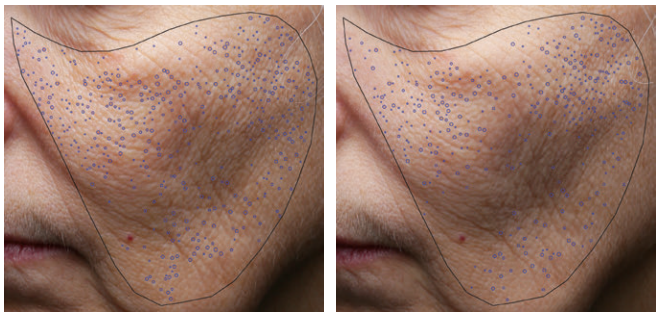
Image Analysis Using VAESTRO

Before Treatment **After Treatment**

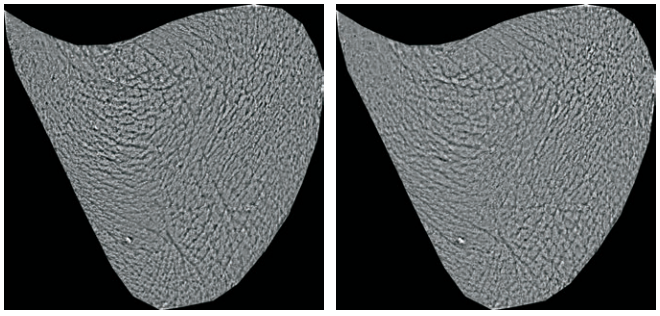
White light



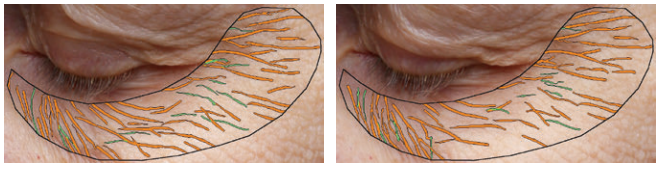
Skin micro-relief



Pore detection



Skin Texture maps



Wrinkle and Fine Line detection

Pre-treatment and 30 minutes post-treatment images of a subject treated with a hydrating and skin tightening topical cream were analyzed for wrinkles, fine lines, texture, and pores. Reduction due to topical treatment: Wrinkles = .95%, Fine Lines = 12.2%, Texture = 20.18%, Pores = 22.26%

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