

Figure 1. Schematic flow of imaging process in the image-based skin color analysis.



Figure 2. Schematic expression of a two-layered skin model.



Figure 3. Schematic expression of skin color distribution in the optical density domain of three channels.



Figure 4. Projection onto the skin color plane to remove shading.



(d) Original image(e) Melanin(f) HemoglobinA new technique with shading removal

Figure 5. The result of independent component analysis with and without shading .



(a) UV -B irradiation



(b) Melanin



(d) Methyl nicotinate application



(e) Melanin



(c) Hemoglobin



(f) Hemoglobin

Figure 6. Analysis of chromophore patterns generated by artificial treatments. UVB irradiation: (a) original, (b) melanin component, (c) hemoglobin component.

Application of methyl nicotinate: (d) original, (e) melanin component, (f) hemoglobin component.



Figure 7. Changes of relative chromophores density in accordance with UV-B irradiation. (a) Analyzed two regions of a forearm with and with out irradiation of UV-B (no.1, no.2 respectively). (b) Deference of chromophores density between two regions. (c) Deference of colorimetric values in CIEL\*a\*b\* between two regions.



Figure 8. Analysis of blood congestion on actual facial skin. (a)original image, (b)melanin component, (c)hemoglobin component.



Figure 9. Analysis of acnes on actual facial skin. (a)original image, (b)melanin component, (c)hemoglobin component.



Figure 10. Relative changes in melanin density during the 9 weeks the lightening essence was applied. Dotted line: placebo group, Solid line: sample group

## Hemoglobin density



Melanin density

Figure 11. Skin color synthesis with changes in melanin and hemoglobin densities.