A new LIP framework metric applied to analysis of multispectral acquisition of in-vivo skin.

Joris, Corvo[1,3] and Michel, Jourlin[2] and Josselin, Breugnot[3] and Thierry, Lépine[2] and Sylvie, Bordes[3]

[1]MINES ParisTech, PSL-Research University CMM-Centre de Morphologie Mathématique

[2]LHC - Laboratoire Hubert Curien Université de Saint-Etienne

[3]SILAB, Digital Imaging Platform, ZI de la Nau, 19240 Saint-Viance France

j.corvo@silab.fr joris.corvo@mines-paristech.fr

Keywords

Logarithmic Image Processing model (LIP), multispectral imaging, Asplünd distance, LIP contrast, in-vivo skin imaging.

Introduction

The LIP (Logarithmic Image Processing) model has been developed by Jourlin et al[1] in 1988 and has proved its efficiency in various fields (industrial, medical, cosmetic applications, …).

More recently, a new metric based on Asplünd metric in the LIP framework has been presented in [2] and a color version of this model has been proposed by Jourlin in [3] and a variant by Gouinaud in [4], showing the interest in developing this model.

For both gray-level and color LIP of Jourlin's model, a metric has been defined using the Asplünd distance. Several applications revealed this distance efficiency. In particular, thanks to the LIP model properties, the distance has a great sensitivity on low-light images.

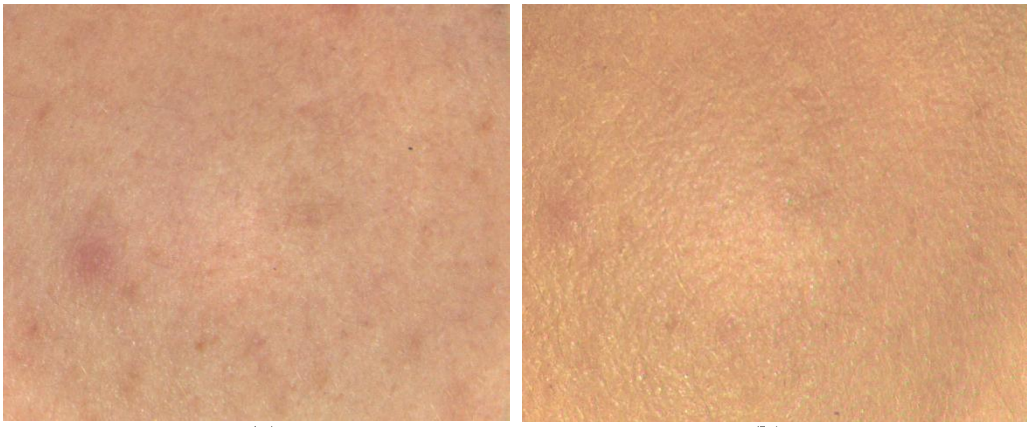
Our purpose here is to build a multispectral/ hyper spectral metric based on the LIP model in order to analyze multispectral skin images from cosmetology.

Materials and Methods

A set multispectral reflectance cubes acquired in-vivo on human skins used to study the effect of a foundation make-up. Images were acquired before and after application of the makeup for each 31 people of the panel. Data were taken with a 6 hour time-tracking to follow the product degradation. The multispectral images homogeneity depends theoretically on the amount of make-up lying on the skin.

We extended the Asplünd distance to multispectral images in order to keep the same sensitivity in high and low gray levels of spectral images. From this distance, we redefined classical functions such as global to pixelwise multispectral contrast and region growing. Those functions are used to identify the influence of the make-up on the images homogeneity.

In order to evaluate skin homogeneity before and after makeup application, we decided to apply a region growing algorithm, initialized at the same seed and stopped at a same similitude level. The metric driving such a growing is a multispectral Asplünd metric. The regions obtained after makeup are significantly larger (Fig. 1 and Fig. 2), which shows the homogenization role of the makeup.



(a) (b)

Figure 1. Colour representation from multispectral images without (a) and with (b) foundation make-up

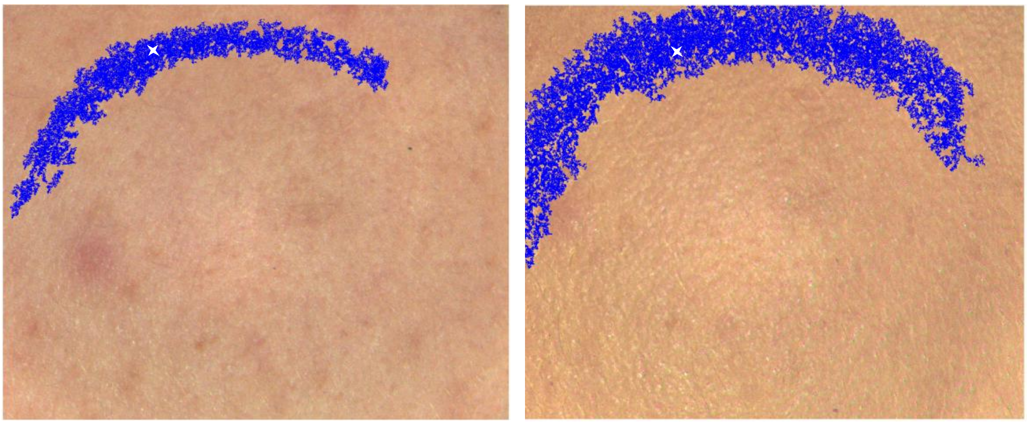


Figure 2. Example of multispectral Asplünd LIP based region growing on the previous images

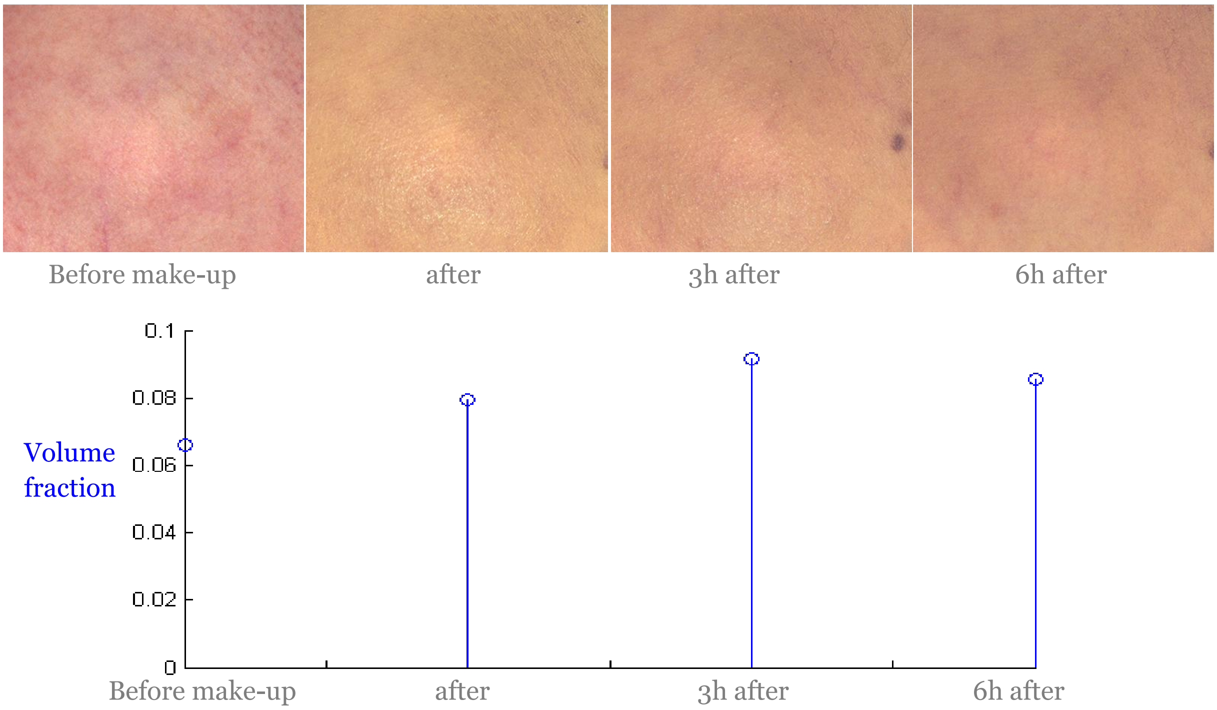


Figure 3. Evolution of colour representation of multispectral images with foundation make-up and homogeneity evaluation by the LIP region growing average volume fraction

Results and Discussion

The proposed Asplünd multispectral LIP distance produces interesting results for our cosmetic application. Average results show that, regarding our distance, skin images are more homogenous when the foundation make up is applied. It is even possible to notice that the maximum homogeneity is reached 3h after the foundation make-up application which is coherent with the images observation. This phenomenon is explained by the radiance induced by the foundation make-up.

Conclusion

We define a multispectral distance based on the LIP model. The analysis of multispectral acquisition of in-vivo skin with make-up is an example of application that proves the metric efficiency. The next steps are to compare predictions on the make-up degradation without metric and other classical distances.

References

[1] M. Jourlin and J.-C.Pinoli, A model for logarithmic image processing," Journal of Microscopy, vol. 149, no. 1, pp. 21{35, 1988.

[2] Asplünd's metric defined in the Logarithmic Image Processing (LIP) framework: A new way to perform double-sided image probing for non-linear grayscale pattern matching, M. Jourlin, , E. Couka, , B. Abdallah, , J. Corvo, , J. Breugnot, Pattern Recognition, Volume 47, Issue 9, September 2014, Pages 2908–2924

[3] Jourlin, M., Breugnot, J., Itthirad, F., Bouabdellah, M., Closs, B., 2011. Chapter 2 - logarithmic image processing for color images. In: Hawkes, P. W. (Ed.), Advances in Imaging and Electron Physics. Vol. 168 of Advances in Imaging and Electron Physics. Elsevier, pp. 65 – 107.

[4] H. Gouinaud, Y. Gavet, J. Debayle, and J.C. Pinoli. Color Correction in the Framework of Color Logarithmic Image Processing. In Proceedings of the 7th IEEE ISISPA, Dubrovnik, Croatia, pages 129--133, 2011.