A new method for simulating the visual affects of haemoglobin and melanin changes within the skin

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Background and Purpose

Non-Contact SIAscopy is now an established method for measuring Hemoglobin and Melanin concentration within the skin. It utilises a standard calibrated digital camera and flash unit as a broadband spectrometer. The images from this camera can be used as inputs into a mathematical model of the skin. This model then describes a transform between the data measured by the camera, and the histology of the skin. This allows the technique to accurately predict the concentrations of Hemoglobin and Melanin for each pixel within the image. It is then possible to alter these Hemoglobin and Melanin maps and use the model to predict the effect these changes will have on the external appearance of the skin. This image will represent the predicted affect of the changes in concentration of the two chromophores, providing valuable visualisation predicting the effects of treatments.

Method

Non-Contact SIAscopy method involves building a model of the interaction of light with the skin using the camera as a broadband spectrometer. The model is generated by calculating the absorption of the spectrum of the Color CCD of the camera combined with a lookup table of melanin and blood concentrations. This allows a mathematical link between the RGB data of the camera and the histological content of the skin to be made. Therefore, by building this model in reverse it is also possible work in the other direction and predict the changes in RGB space caused by changes in blood and melanin. As the Blood and Melanin maps produced are constructed of floating point data, this data can be changed to simulate the effects of a treatment. For example, increasing the melanin concentration over the entire face to simulate a sun tan, or decreasing blood over specific areas to simulate the treatment of thread veins.

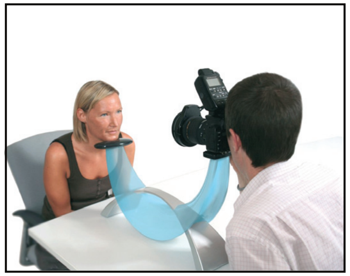


Fig 1. Non-Contact SIAscopy rig used for acquiring images.

Fig 2. Top Left, Color Image; Top Right, Hemoglobin SIAscan; Bottom Left, Geometry; Bottom Right Melanin SIAscan.

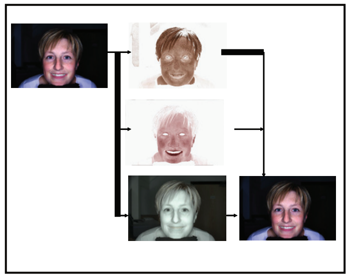


Fig 3. Flow diagram showing an image of a face being decomposed into hemoglobin, melanin and geometry before being recomposed into a color image. It is during the recomposition that the affect of changing blood and melain patterns can be introduced.

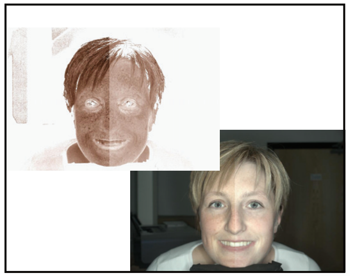


Fig 4. Facial image showing the melanin SIAscan and a reconstructed color image. Note on the right hand side the melanin content has been reduced which can be seen in the color image as smoother, brighter skin.

Fig 5. Hemoglobin images of different women. Note the increase in small vessels and disorder with age.

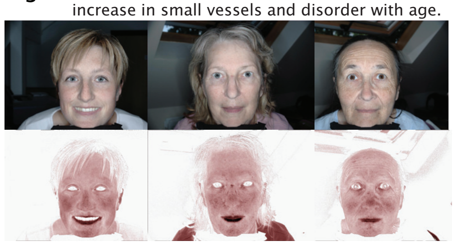
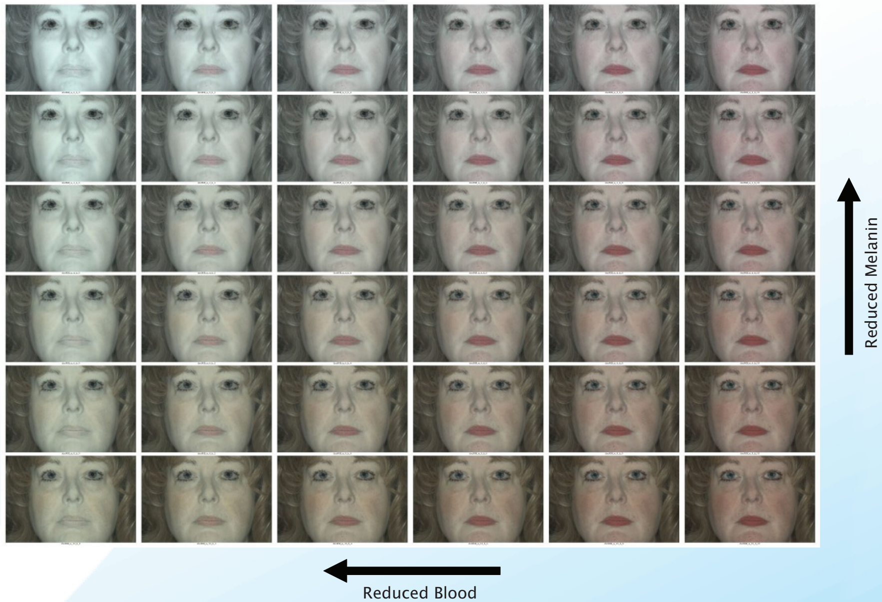


Fig 6. Melanin images of different women. Note the increase in age spots and unevenness with age.

Fig 7. Composite image showing the affect of altering hemoglobin and melanin separately. This is useful for identifying the optimum cosmetic appearance and targeting treatments at either hemoglobin or melanin.



Conclusions

Present work shows very promising results; several studies are underway to allow algorithms to be generated which can simulate the effects of various treatments. Further work will allow more algorithms to be developed, each tailored towards a specific treatment or product.

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