**Motivation**

- Early detection of malignant skin cancers, in particular melanoma, is crucial as it would drastically change the patient’s prognosis for greater survival.
- Unfortunately, clinical diagnosis of skin lesions is difficult, even for experienced dermatologists (mainly due to subjectivity of visual interpretation, and especially for clinically equivocal pigmented lesions).
- The challenges in clinical diagnosis of skin cancer have provoked interest in development of automated computer–based skin lesion analysis systems. This study is yet another attempt towards that goal.

**Contributions**

- The main contribution of this paper is that a new colour space is proposed and used in supervised learning to achieve excellent malignant vs. benign lesion classification.
- We have proposed a new colour-feature $\eta$ which is aimed at apprehending underlying biological factors which are involved in human skin colouration, i.e. melanin and haemoglobin, in dermoscopy images.
- The advantage of the new feature, in addition to its biological underpinnings, lies in removing the effects of confounding factors, such as: light colour, intensity falloff, shading, and camera characteristics.
- This is a step towards building a more reliable computer-aided diagnosis system for skin cancers. This can provide clinicians with an objective second opinion.

**Method**

1. Assume the intensity values at pixel $(x, y)$ are represented by the function $R_k(x, y) = \omega(x, y) \int E(x, y, \lambda) S(x, y, \lambda) Q_k(\lambda) d\lambda$ where $k$ indexes R,G,B channels.
2. Obtain the band-ratio 3-vector chromaticity $c_k(x, y) = R_k(x, y)/\mu(x, y)$ where $\mu(x, y) = (\prod_{k=1}^3 R_k)\bar{1}$, the geometric-mean at each pixel.
3. Take the log of the (geo–mean) chromaticity: $\psi_k(x, y) \equiv \log c_k(x, y) = -\rho_m(x, y)(m_k - m_p) - \rho_b(x, y)(b_k - b_p) + w_k - (c_k - c_p)(1/T)$
4. Reshape $\psi_k(x, y)$ into a $N$-by–$K$ matrix $\psi$ where $N$ is the number of pixels and $K = 3$.
5. Project the log–chromaticity image data ($\psi$) onto the 2-D plane orthogonal to $(1, 1, 1): \phi = U^T \psi$ where $U$ is any $3 \times 2$ transformation matrix onto that 2-D subspace.
6. Run ICA on the 2-D plane $(\phi - \bar{\phi})$ to find independent components (source) data $\eta$ (and separating matrix $W$).

**Imaging Model**

**Experiments and Results**

**Conclusion**

- The new colour-feature vectors $\{\eta_1, \eta_2, \eta_3\}$ combined with geometric-mean vector, $\mu$, is proposed as a new colour-space MHG (abbreviation of melanin, haemoglobin and geometric-mean).
- In our experiments, MHG is shown to produce excellent results for classification of Malignant vs. Benign; Melanoma vs. Benign; and Melanoma vs. Spitz Nevus.
- Moreover, in the lesion segmentation task, $\mu$ is shown to improve the segmentation.
- Future work will include experimenting with different learning algorithms and strategies, in particular the option of multi-class classification. Also, exploration of effects of using other features.

**Contact Info**

For more information visit: [http://www.cs.sfu.ca/~amadooei](http://www.cs.sfu.ca/~amadooei)

or contact us at: amadooei, mark, msa68, stella@sfu.ca