Image quality enhancement for skin cancer optical diagnostics

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Outlines

- Skin cancer non-contact diagnostics
- Common quality flaws and their prevention
- Image quality in skin cancer diagnostics
- Enhancing images
Why skin cancer?

Why optical diagnostics?
Changes in the risk of dying from cancer, 2010 relative to 2000
Wavelengths’ skin penetration depth
“Almost 100% will survive their cancer for 5 years or more after they are diagnosed at Stage #1”

vs

“Almost 10% men and 25% women will survive their cancer for 5 years or more after they are diagnosed at Stage #4”

*Statistical Information Team at Cancer Research UK
Proposed system

D.Blizņuks, D.Jakovels, I.Saknite, J.Spigulis “Mobile platform for online processing of multimodal skin optical images”
Diagnostic algorithm

- Healthy skin and nevi, the parameter $p' \in [-0.3; 0.25]$, *green and yellow hues*;
- For melanomas, $p' > 0.25$, *red and orange hues*;
- For basal cell carcinoma, $p' < -0.3$, *blue and cyan hues*.

Imaging system

- illuminating light source,
- lens and filters,
- camera sensor and sensor data readout hardware,
- image storage format.
Illumination stability

Ultraviolet 405nm vs 525nm LED illumination change in time

For photobleaching algorithms, long (>20s) exposures required
Lens and filter impact

- Reduction of the amount of light,
- Changing scenes’ depth of field,
- Light reduction on periphery (vignetting),
- Distortions (barrel/pincushion),
- Sharpness reduction (MTF chart),
- Differences in wavelength transfer (chromatic aberrations).
Imaging sensor light response
Non-uniform light field effects

a) Uniform field
b) Vignette effect
c) Unequal light field, affecting final diagnostic result
False positive melanoma diagnosis
Image frequency separation

High frequencies of skin image: a) 5 px, b) 20 px, c) 120 px
Low frequencies of skin image: d) 5 px, e) 20 px, f) 120 px
Skin image high pass filtering

Original skin image

High pass filter
Filtered image obtaining correct diagnosis
Further work and challenges

- Examined objects should be smaller and have higher spatial frequency (sharper edges) than unwanted light.
- Filter parameters should be found empirically.
- Obtaining filtering parameters from image segmentation results.
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