Non-contact dermoscopy for the early detection of melanoma

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Motivation

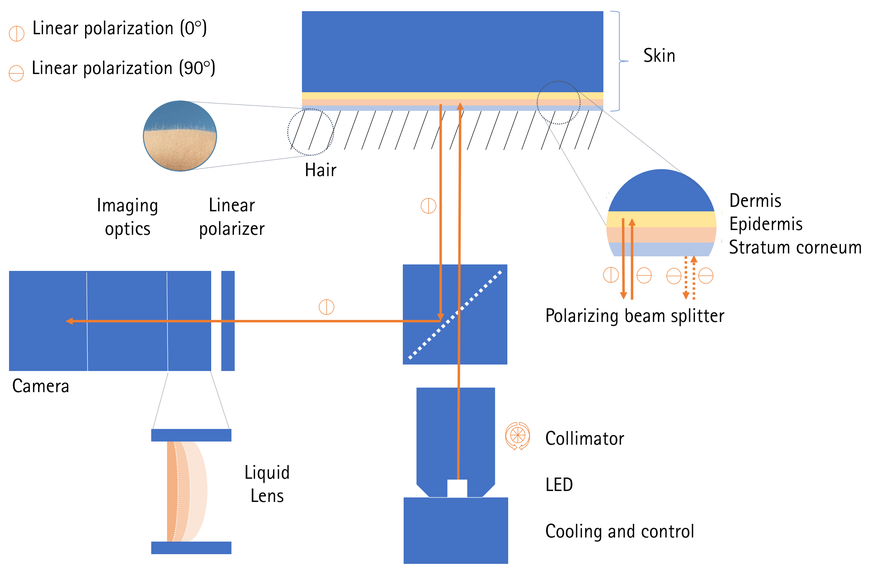
- Melanoma incidence rising for a skin types
- Deadliest type of skin cancer: responsible for 75 % of deaths from skin cancer, but highly curable at early stages
- ABCDE rule: asymmetry, border, contour, diameter, evolution

Our approach:

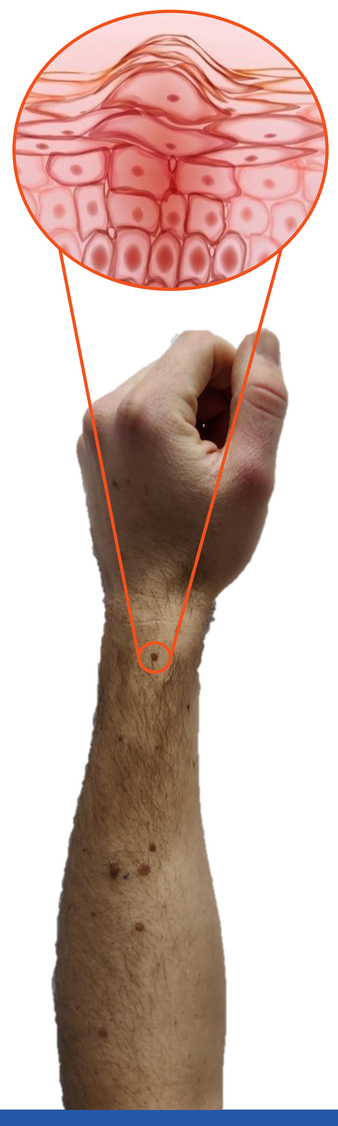
- Automated detection, acquisition and classification
- Explainable artificial intelligence (XAI)
- More contextualized and personalized diagnostics
- Clinical decision support
- Integration of various data sources: medical record, genomics, dermoscopy
- Intelligent human-computer interface

Non-contact dermoscopy

- Non-invasive skin screening
- Natural blood perfusion (color)
- Natural skin topography

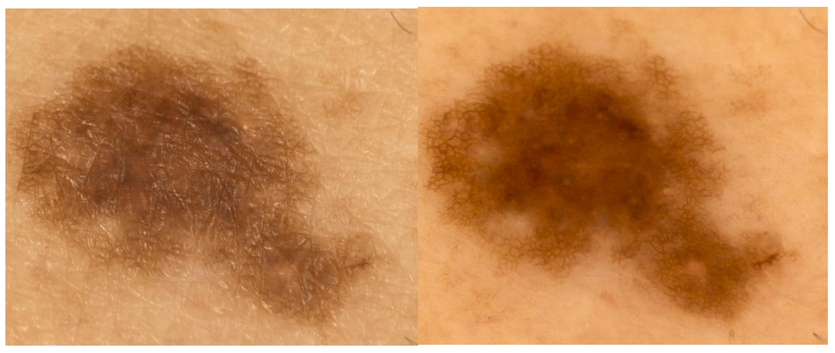


Sketch of non-contact dermoscope



Working principle

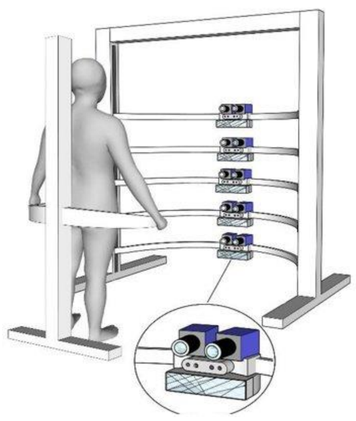
- Alternative to contact dermoscopy
- Non-contact dermoscopy
- X-polarization enables sub-skin-surface imaging: illumination with linear polarized light, orthogonal linear analyser



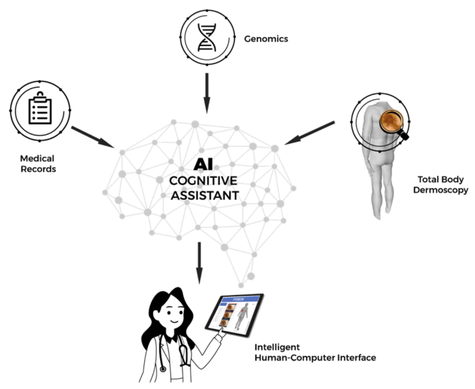
Left: without X-polarization; right: with X-polarization

Intelligent Total Body Scanner (iToBoS)

- iToBoS (Intelligent Total Body Scanner for Early Detection of Melanoma)
- Development of an AI diagnostic platform
- Computer Aided Diagnostics (CAD) tool to integrate various data sources such as medical records, genomics data and in vivo imaging.



Sketch of total body scanner

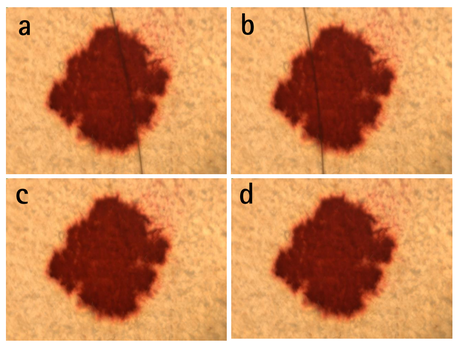


AI cognitive assistant

Results

Hair removal

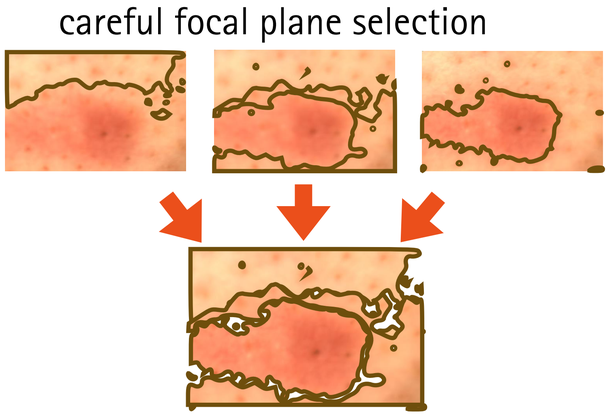
- Classical methods: based on interpolation
- Novel method: inpainting with real-values



Novel digital hair removal
a: input image 1; b: input image 2;
c: hair digitally removed;
d: ground truth

Focus-Stacking

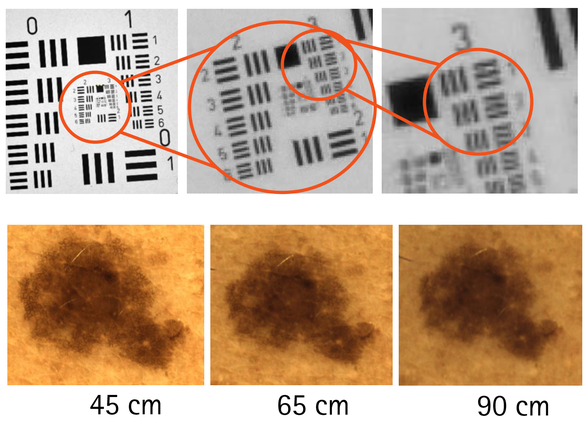
- Stack of images from different focal planes
- All-In-Focus-image
- Enhanced depth of field
- Hair removal based on bokeh by careful focal plane selection



Principle of All-In-Focus-image for dermoscopy

Image quality analysis

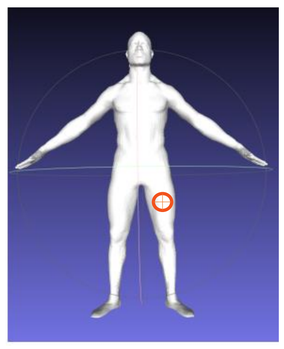
- Target resolution: 20 µm
- USAF calibration target
- Working distance-resolution trade-off



Upper row: image quality analysis with USAF target
lower row: dependency of working distance and image quality

Virtual patient

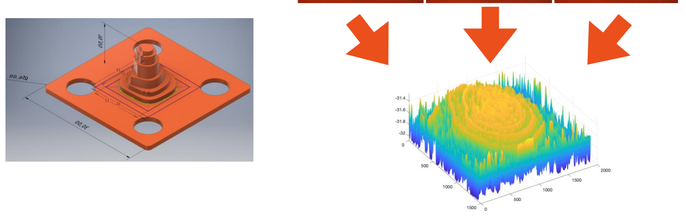
- 3D patient avatar
- Lesion body mapping
- Keypoint-based



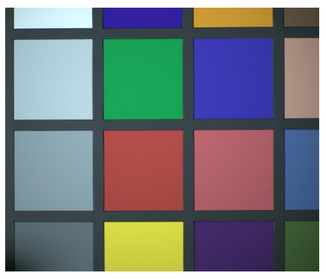
Lesion mapping on virtual patient

Future work

- Focus-Stacking: hair removal and topological evolution analysis
- Color calibration
- Lesion detection
- Automated lesion body mapping using keypoints
- LiDAR based autofocus



upper row: focus-stacking with 3D printed dummy
lower row: depth map for topological evolution analysis



Color calibration

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