

# Combination of multispectral imaging and skin autofluorescence methods for malformation classification

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## Abstract

Two method combination- multispectral imaging (using 3 wavelengths) and skin autofluorescence measurements are combined for non-invasive diagnostics of 4 pathology groups: nevi, melanomas, pigmented basal cell carcinomas and seborrheic keratosis.

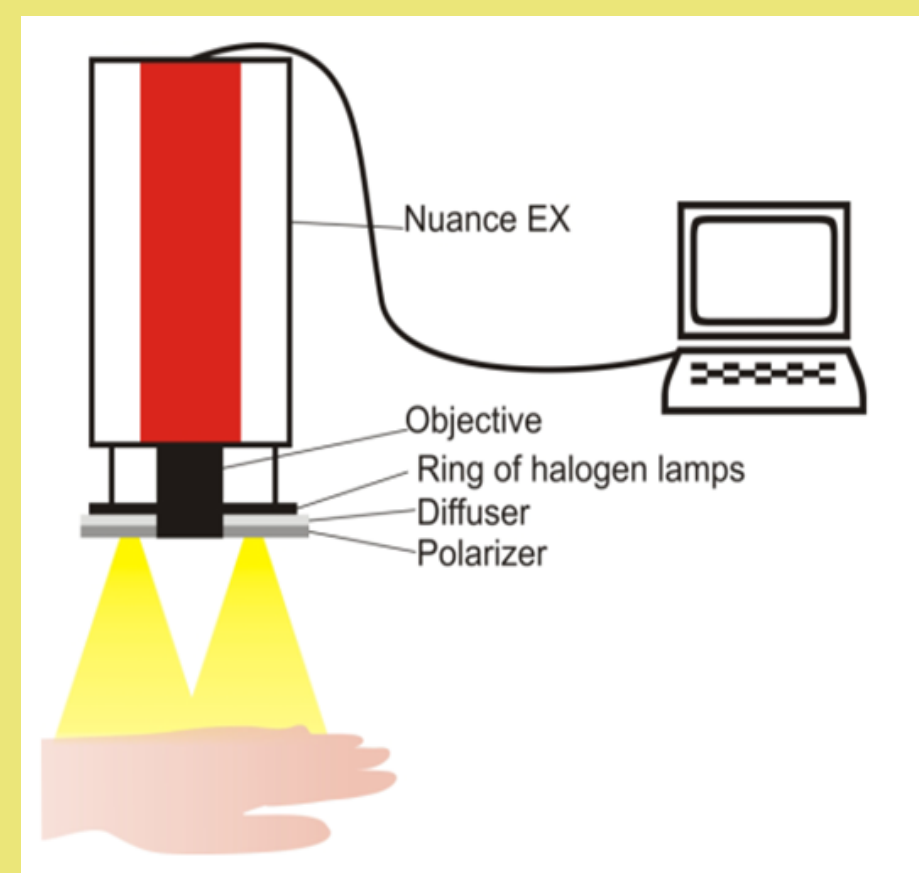
## Problematic and Actuality

- The incidence of melanoma is still rising<sup>1</sup>.
- High cost of dermatology services, long queues on state funded oncologist examinations and inaccessibility of oncologists in the countryside regions causes late tumor diagnostics and high mortality risks.
- Lack of inexpensive, easy to use skin malformation diagnostic equipment available for primary care physicians.

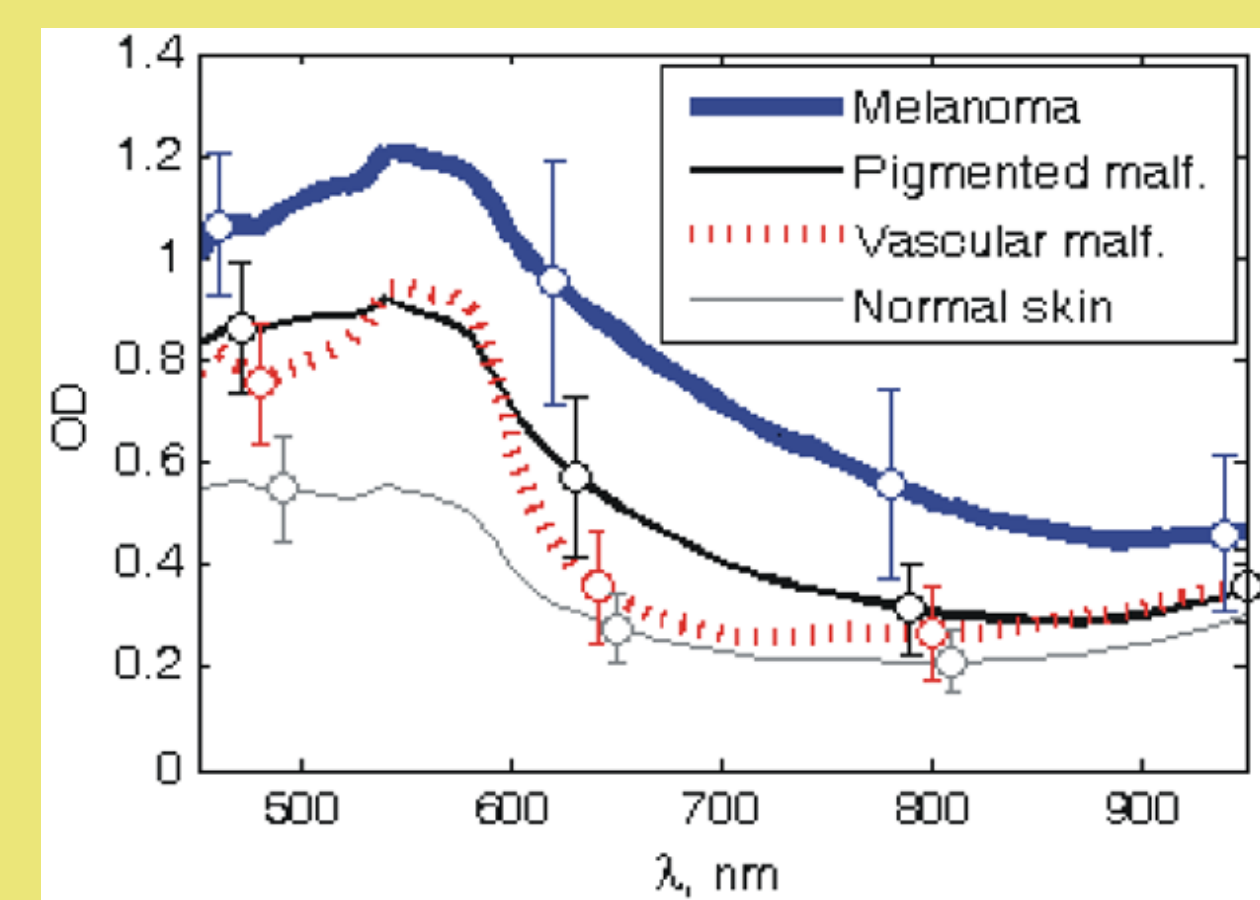
## Aim of Study

To develop inexpensive, easy to use skin malformation diagnostic equipment for primary care physicians.

## Multispectral imaging Equipment and Method



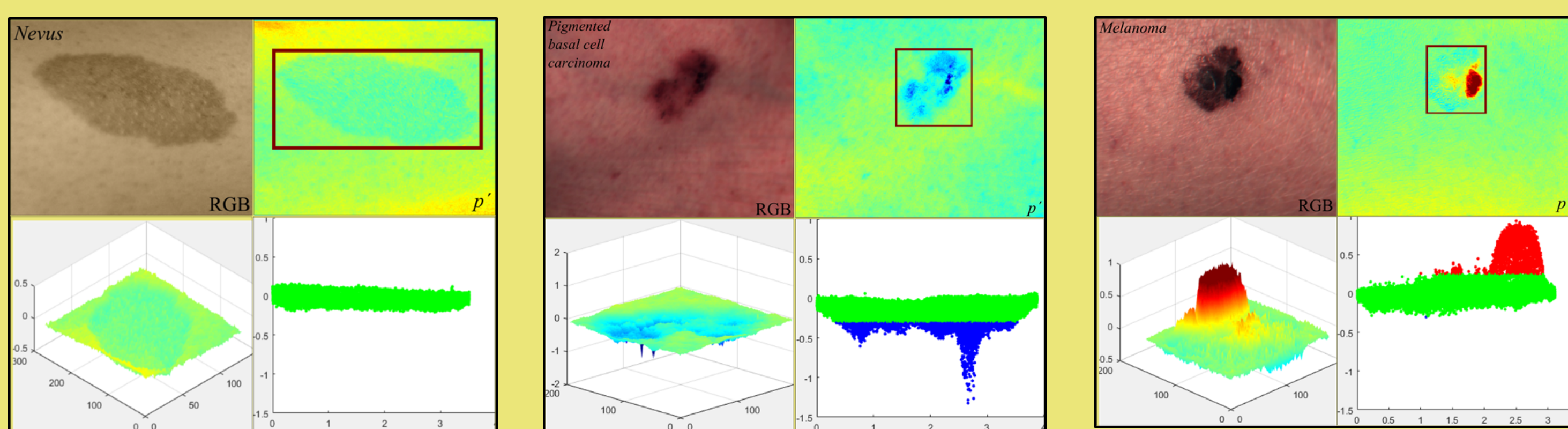
Multispectral camera with liquid crystal filter  
Spectral range: 450- 950 nm, step 10 nm  
 $I_0(\lambda)$ - intensity from white paper reference placed on skin surface;  
 $I(\lambda)$  - intensity from interested region of skin;  
 $OD(\lambda) = - \lg[I(\lambda)/I_0(\lambda)]$



<sup>2</sup>Diagnostic parameter based on 3 wavelengths:  
 $p = OD_{650} + OD_{950} - OD_{540}$   
Normed to healthy skin:  
 $p' = p - p_{skin}$

## Results

Overall 47 dermatologically confirmed nevi, 6 histologically confirmed pigmented basal cell carcinomas and 30 histologically confirmed melanomas were inspected.

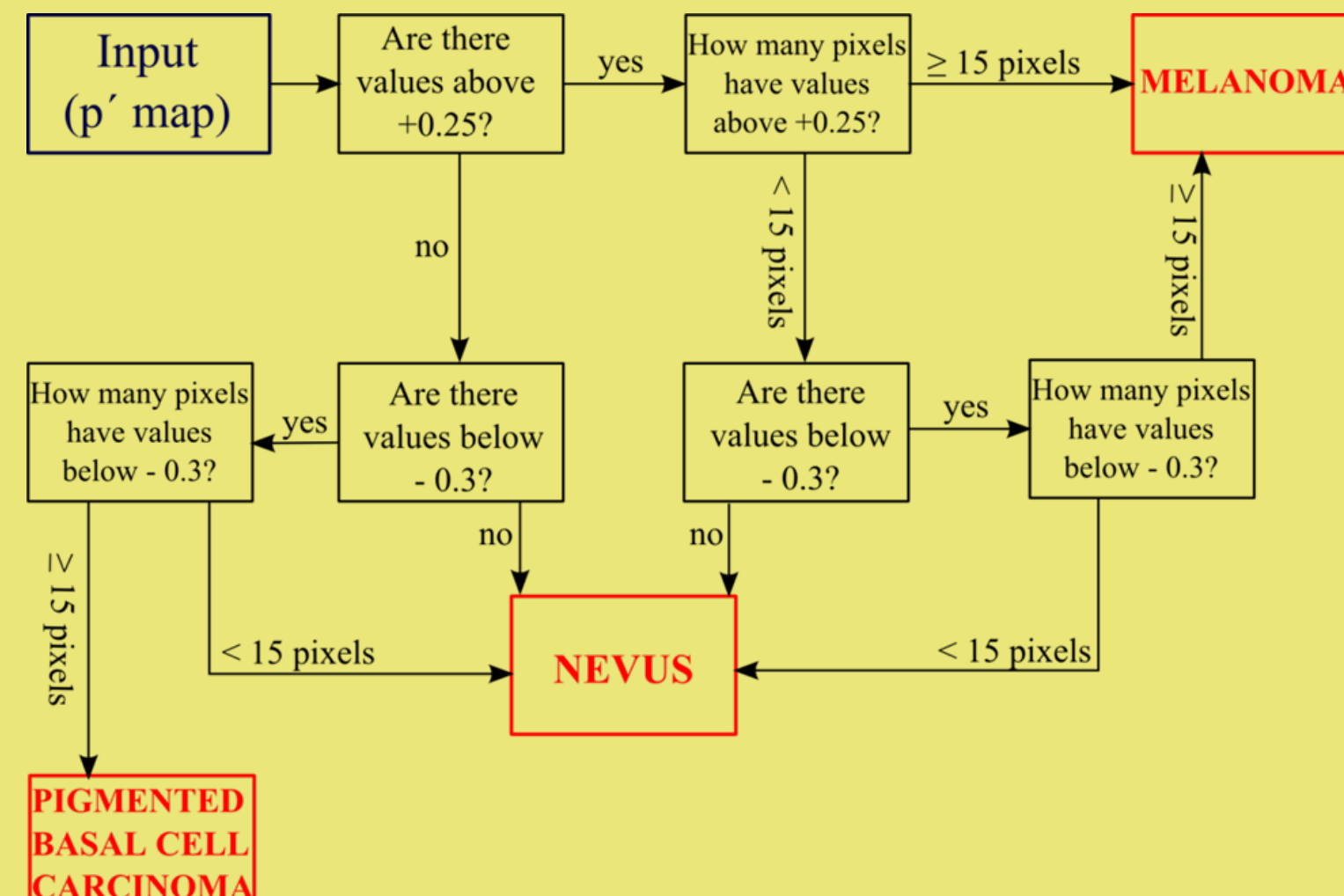


$p'$  values for:  
• nevi [-0.3; +0.25]

• pigmented basal cell carcinomas do not reach + 0.25 and have values under - 0.3

• melanomas are above +0.25 and can be in combination with values under - 0.3

## Scheme for automatic diagnosis:



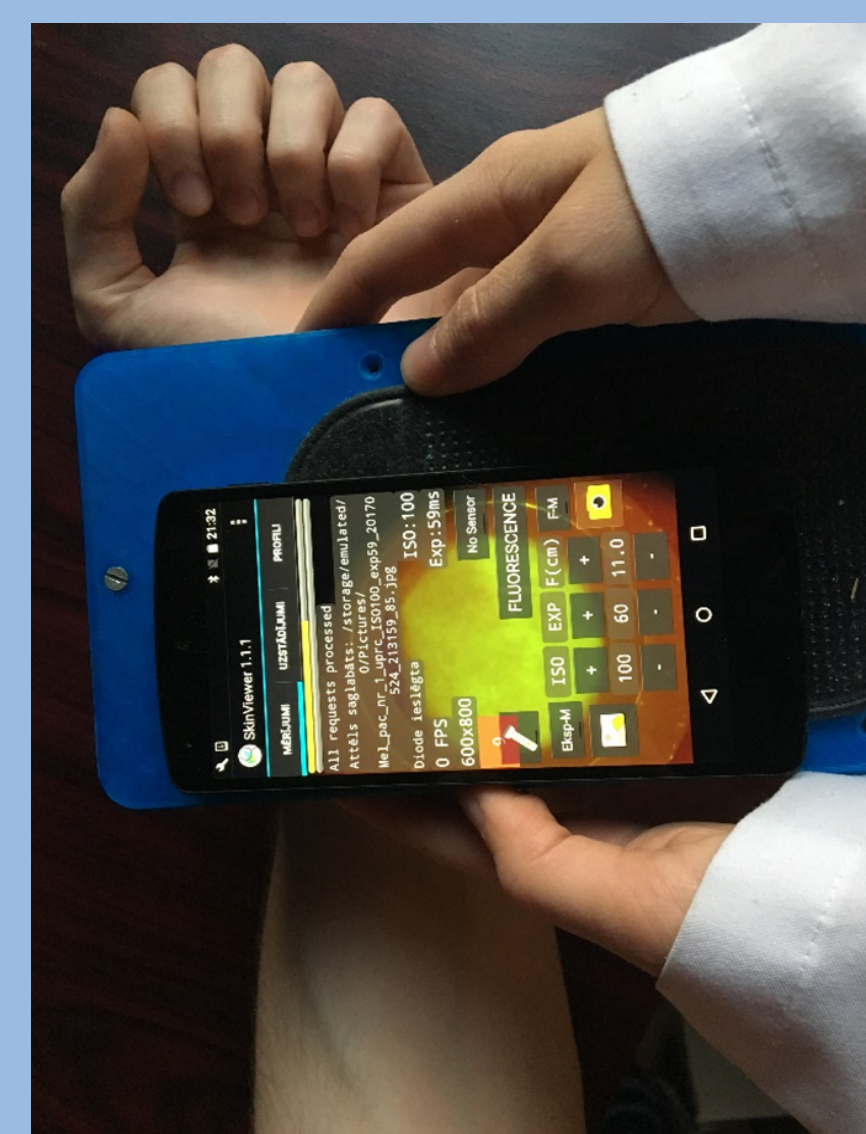
Separation of melanomas from nevi and basal cell carcinomas:

Sensitivity 97%; Specificity 96%

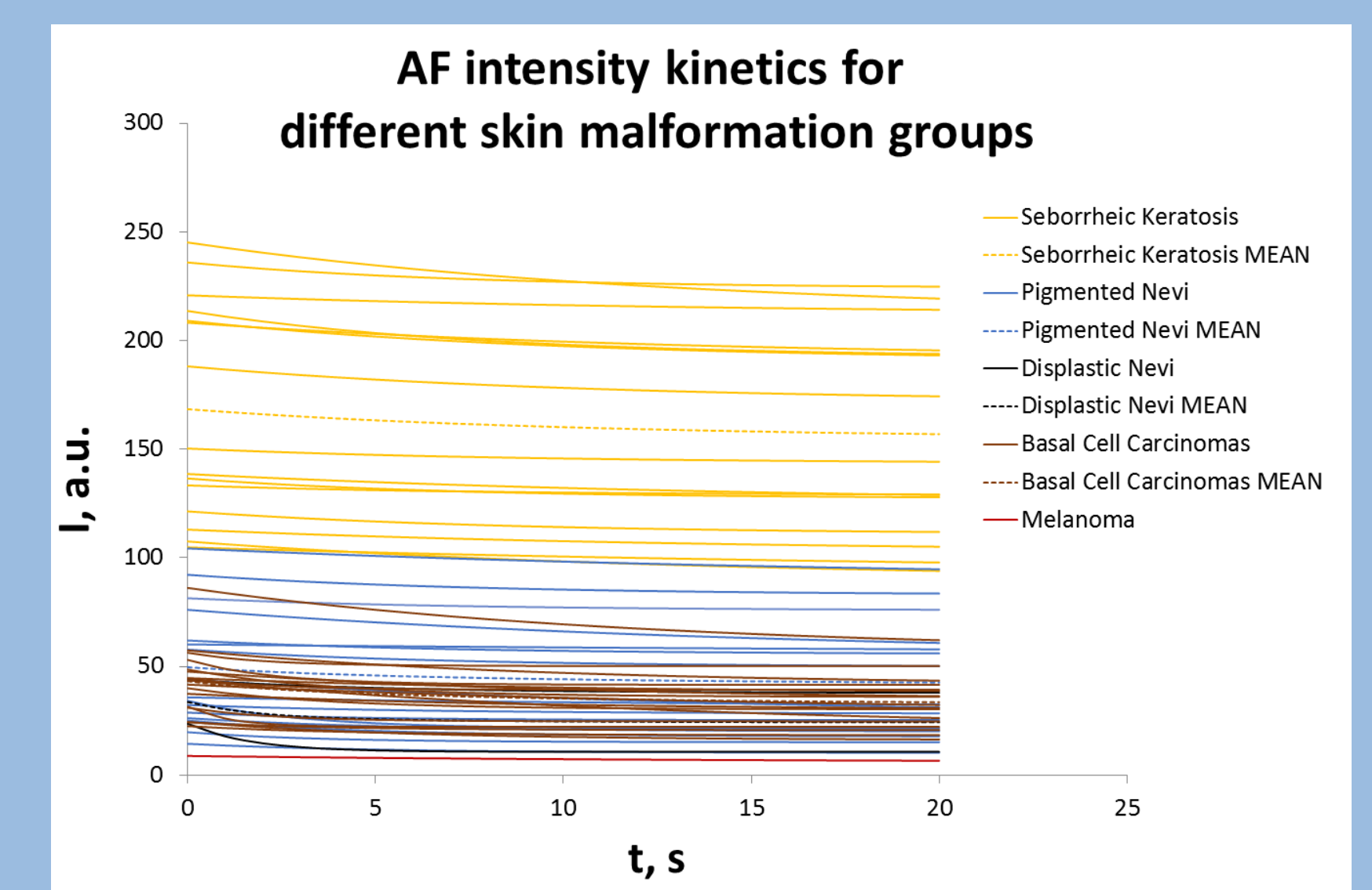
Separation of pigmented basal cell carcinomas from melanomas and nevi:

Sensitivity 100%; Specificity 95%.

## Skin autofluorescence measurements Equipment and Method



Smartphone camera equipped with 405 nm LEDs, 515 nm low pass filter in front of objective and 650 nm high pass filter built in smartphone sensitivity matrix. 20 images (~1 image/s) was recorded under LED excitation for further data analysis.

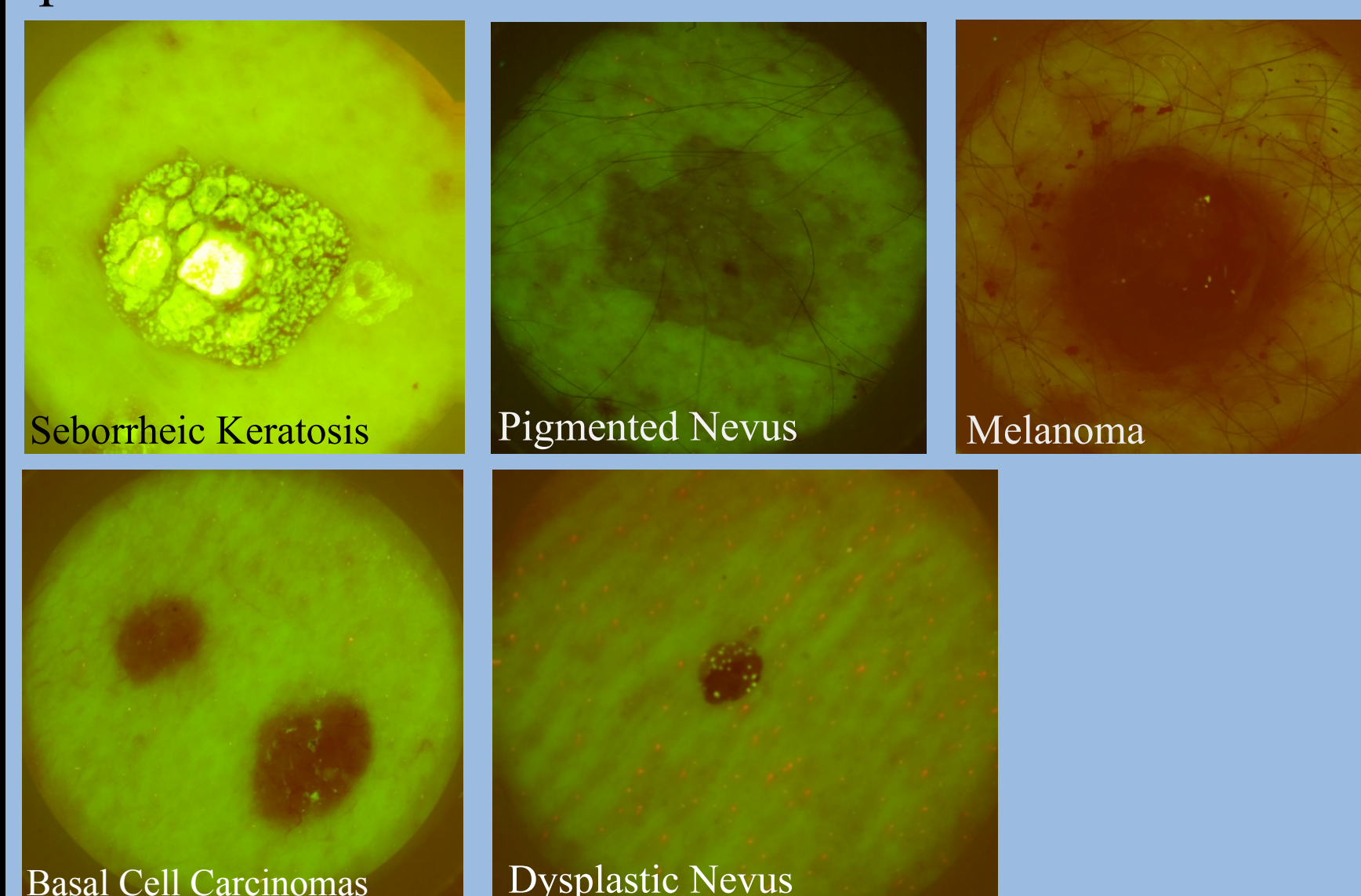


Mean autofluorescence intensity kinetics from selected area for different skin formation groups: Seborrheic keratosis, pigmented nevi, dysplastic nevi, basal cell carcinoma and melanoma.

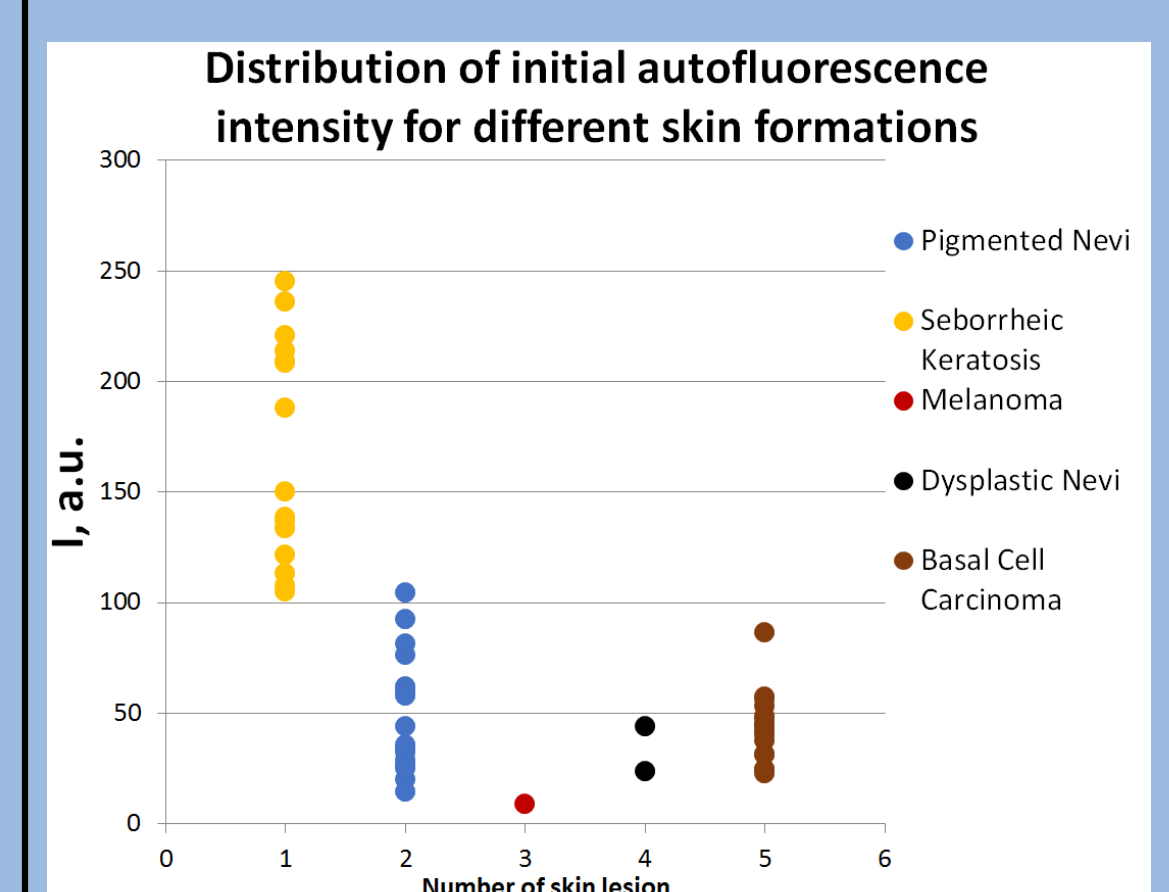
## Results

Overall 16 dermatologically confirmed pigmented nevi, 15 dermatologically confirmed seborrheic keratosis, 2 dermatologically confirmed dysplastic nevi, 17 histologically basal cell carcinomas and 1 histologically confirmed melanoma were inspected.

Initial (t = 0s) AF image from green channel of RGB picture for different skin malformations:



Distribution of mean initial (t = 0s) AF intensity from selected area of skin malformation



Using the AF initial intensity, it is possible to separate seborrheic keratoses from other skin formation groups (pigmented nevi, melanomas, dysplastic nevi, basal cell carcinomas with sensitivity 100% and specificity 100%.

## Conclusions

Using combination of described multispectral imaging and skin autofluorescence methods, it is possible to separate four different skin malformation types: nevus, melanoma, pigmented basal cell carcinoma and seborrheic keratosis. We are looking forward to work on the establishment of such equipment that would be useful (easy to use, inexpensive) for primary care physicians in their daily practice.

## References

- [1] Brussen, A., et al. (2017). J. Am. Acad. Dermatol. 76(1): 129-139.  
[2] Diebele, I., et al. (2012). Biomed. Opt. Express 3(3): 467-472.

## Acknowledgment

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