



Centre for Sensors, Instruments and
Systems Development

UNIVERSITAT POLITÈCNICA DE CATALUNYA

Shaping light to your needs

Study of Skin Cancer Lesions through Multispectral and 3D Techniques.

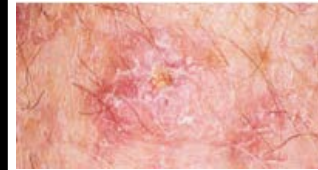
Laura Rey^{1}, Francisco J. Burgos-Fernández¹, Miguel Ares¹, Santiago Royo¹, Xana Delpueyo¹, Susana Puig², Josep Malvehy², Giovanni Pellacani³, Meritxell Vilaseca¹*

¹ Centre for Sensors, Instruments and Systems Development, Technical University of Catalonia; Terrassa, Spain

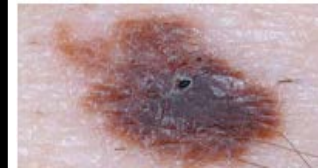
² Dermatology Department of the Hospital Clinic of Barcelona, IDIBAPS; Barcelona, Spain

³ Università di Modena e Reggio Emilia; Modena, Italy

Skin Cancer



Keratosis



Atypical nevus



Basal cell carcinoma

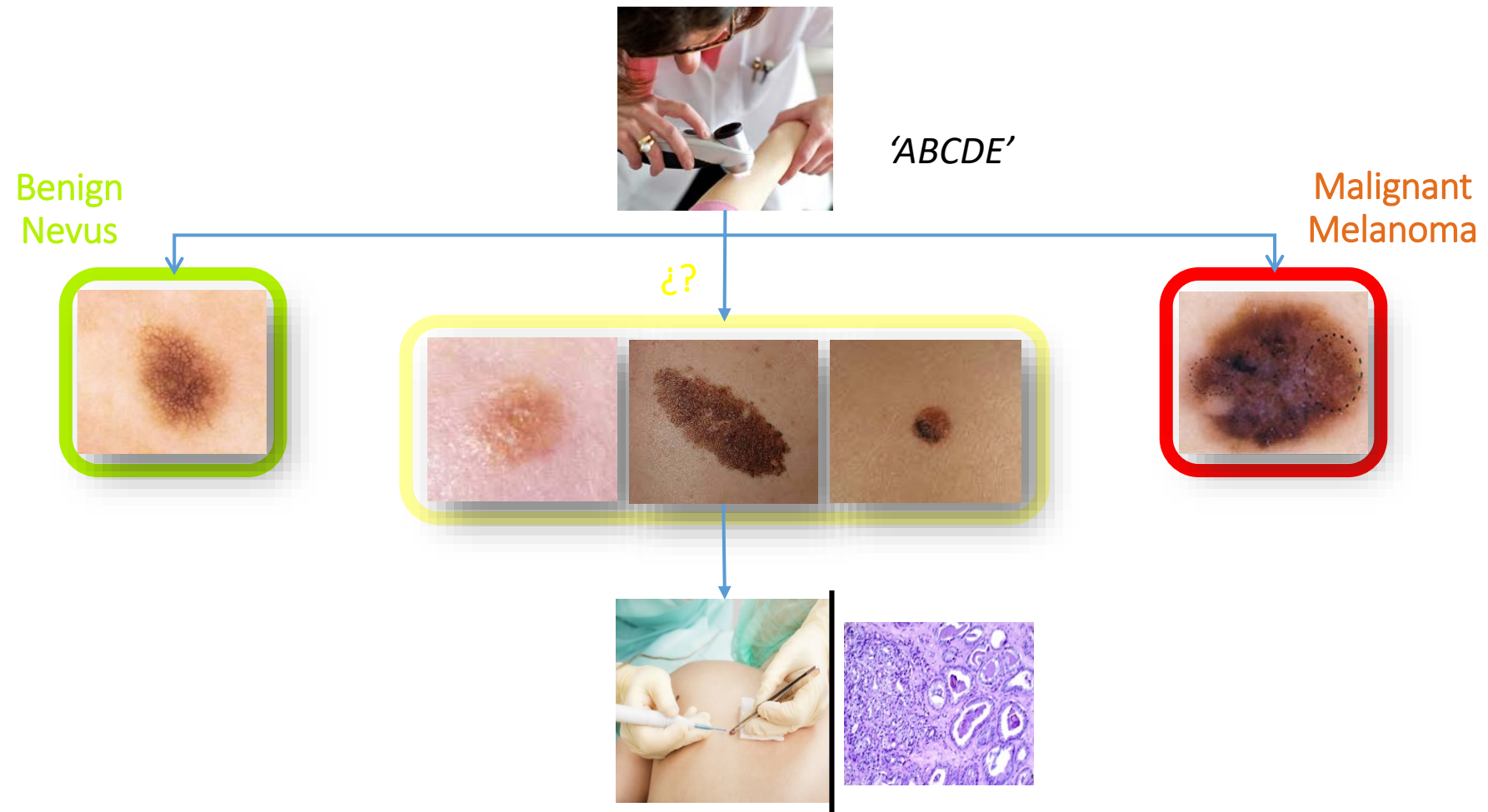


Melanoma



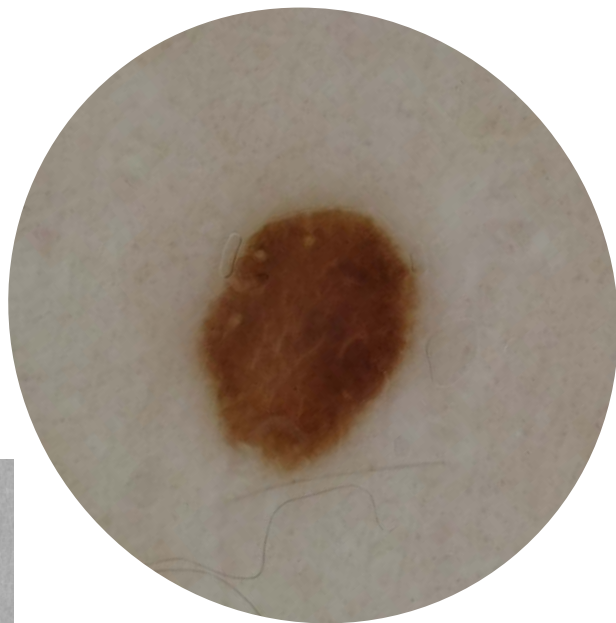
Squamous cell carcinoma

Skin Cancer

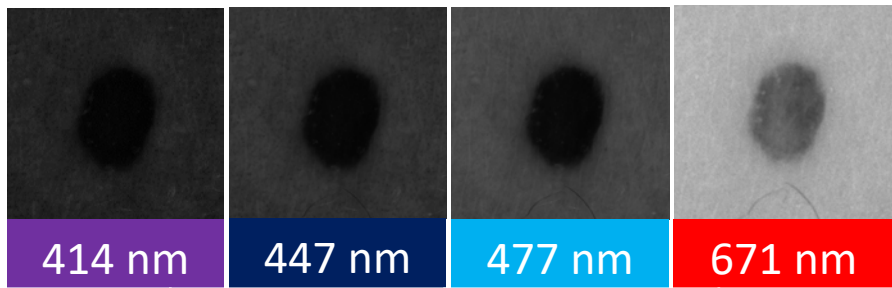


Skin Cancer

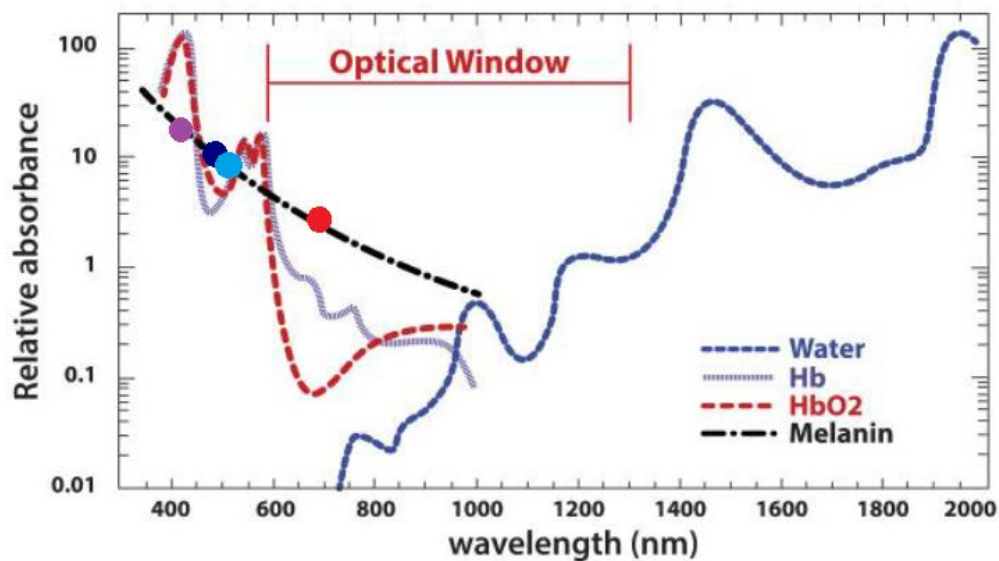
Dermoscope



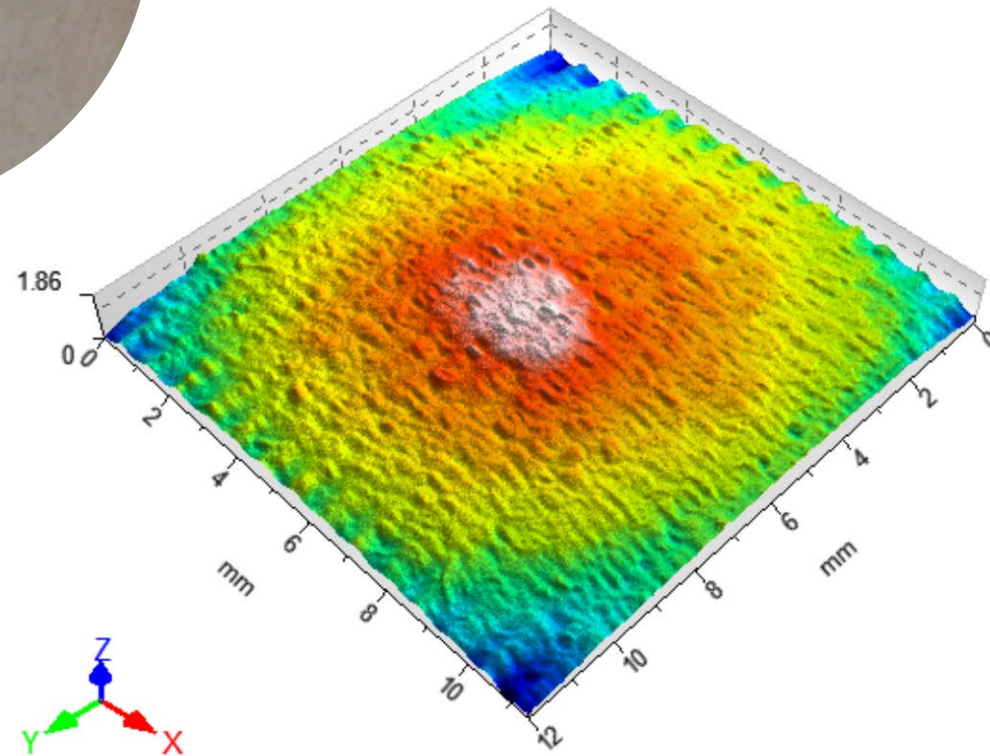
Multispectral Imaging



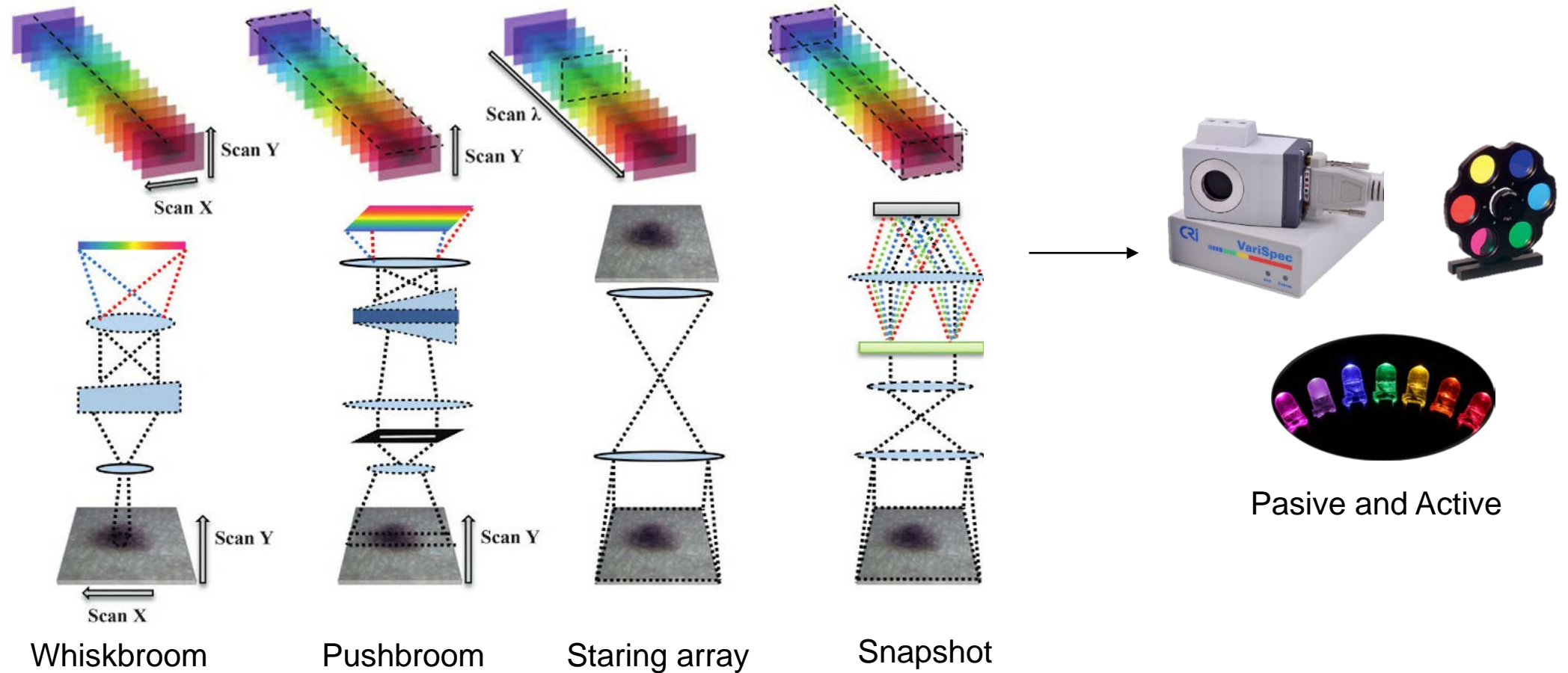
Melanin max. absorption. **Bilirubin** max. absorption. **Hb*** minimum absorption. **HbO₂*** minimum absorption.



3D Imaging

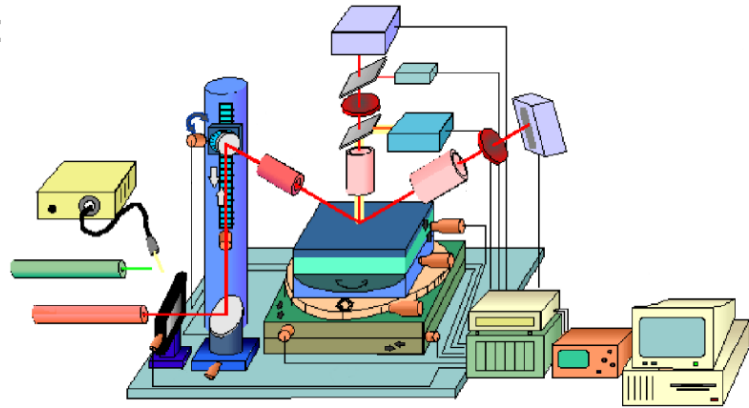


Multispectral Systems



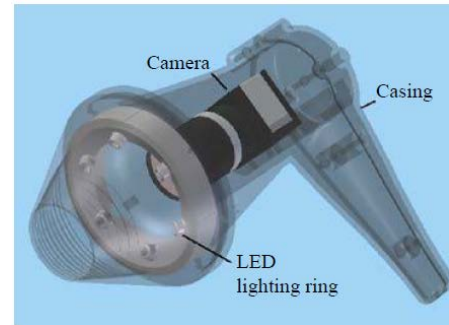
3D Imaging Techniques

Replica:



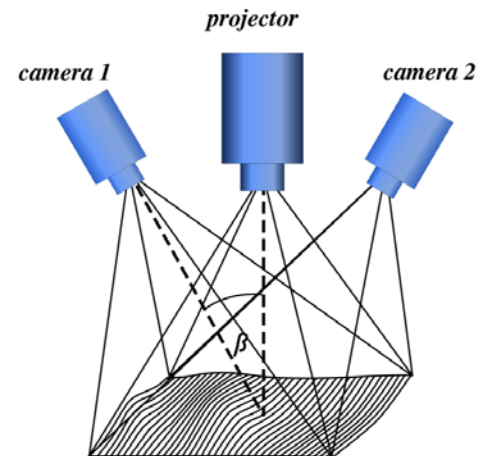
Ex-vivo!

Skin:



In-vivo but out of ISO!

Fringe projection



Skin Cancer Diagnosis

Confocal Microscopy



Self-Mixing Interferometry

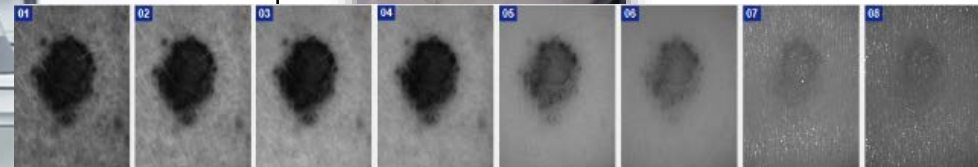


Multispectral Imaging



Delgado et al., Biomedical Optics Express.

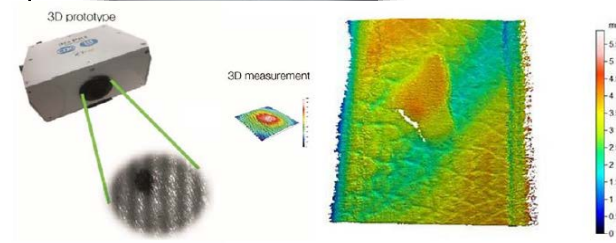
414 nm, 447 nm, 477 nm, 524 nm, 671 nm, 735 nm, 890 nm + 995 nm



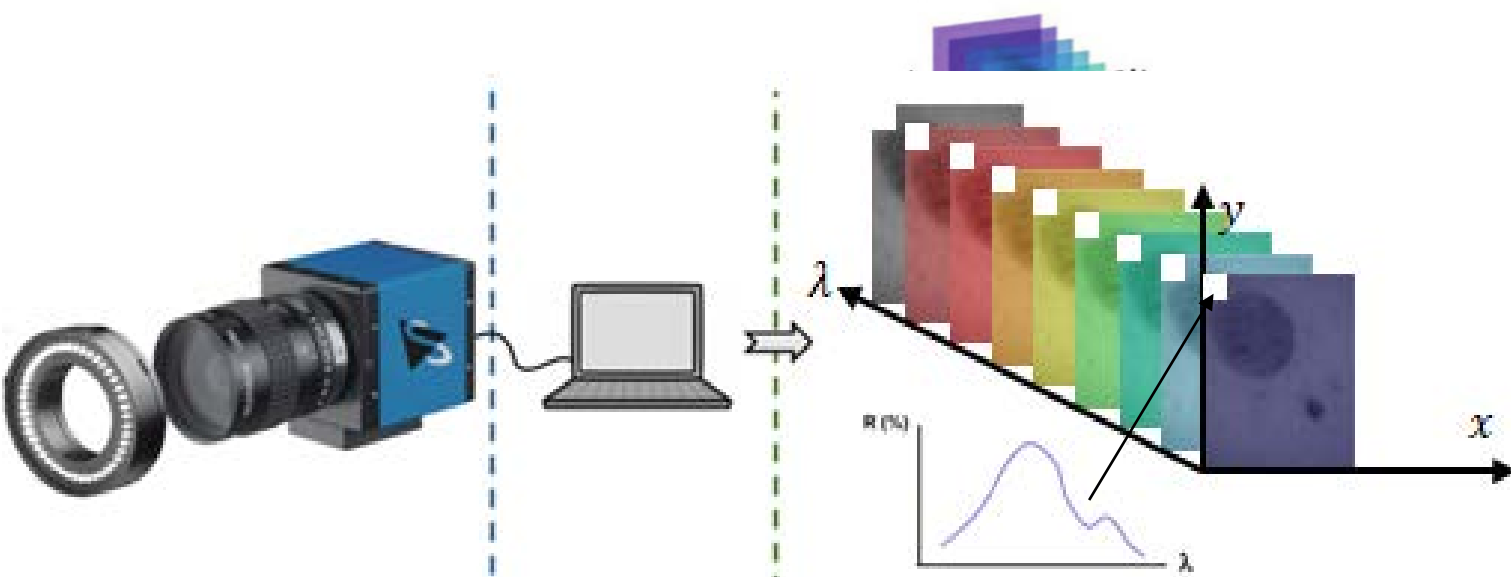
3D Topography



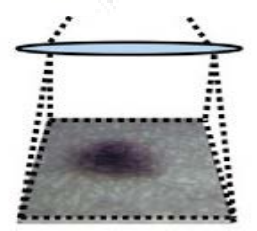
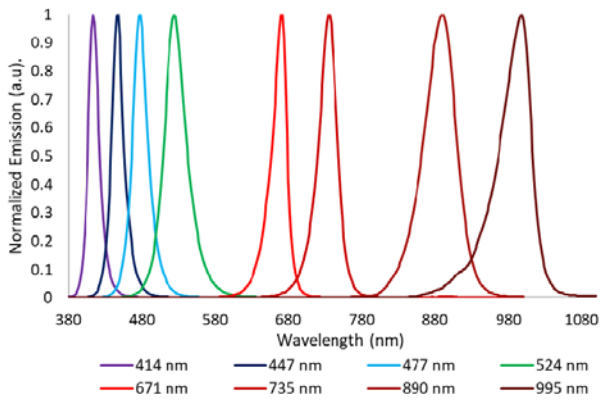
Ares et al.



Multispectral System



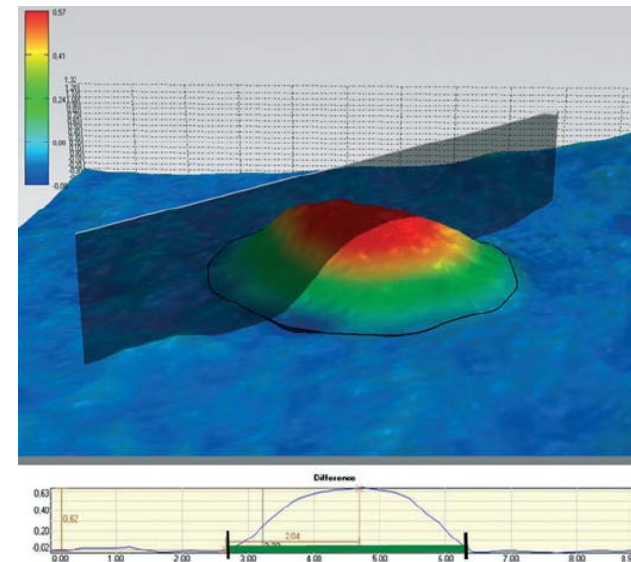
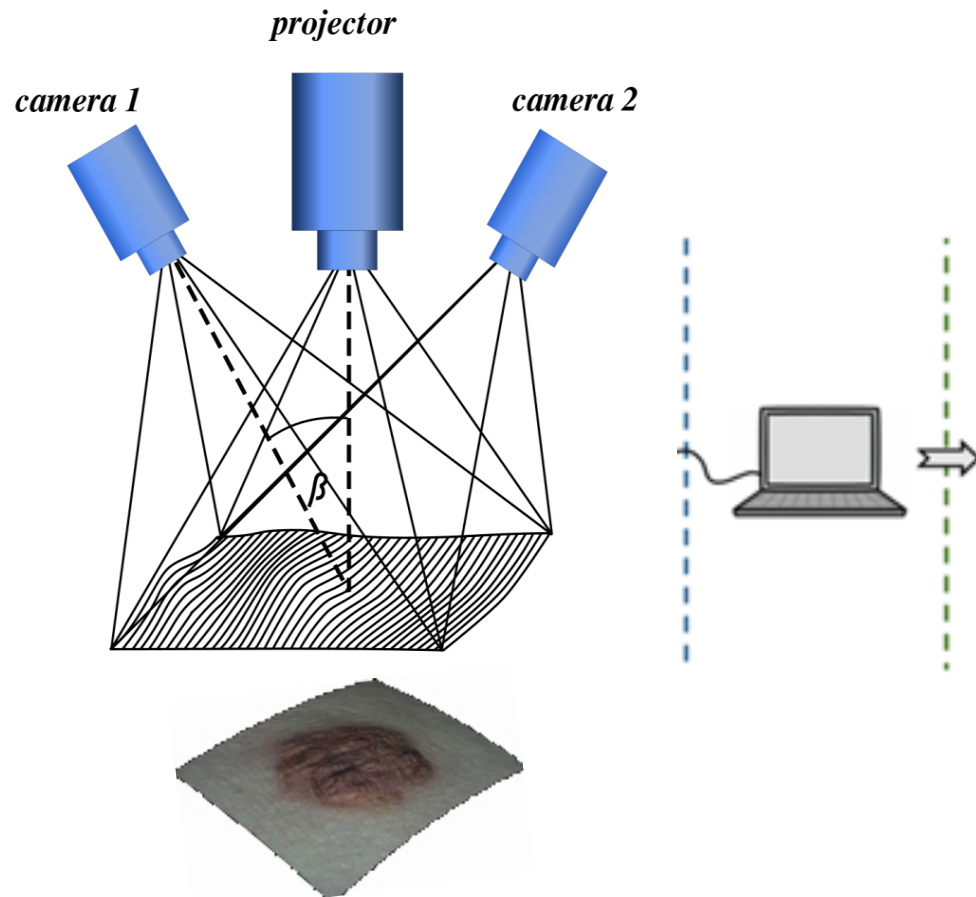
$$\rightarrow \mathit{Refl}(i,j) = R_{Gi} \cdot \frac{DL(i,j) - DL_0(i,j)}{DL_p(i,j) - DL_0(i,j)}$$



Staring array

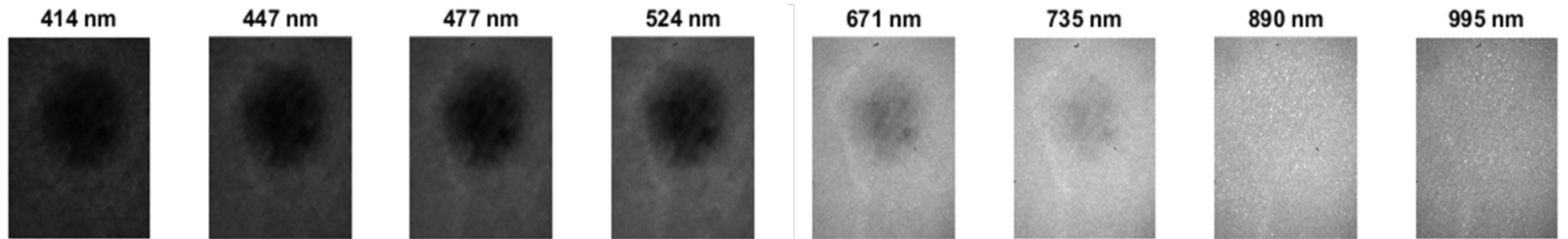
3D Scanner

Fringe projection

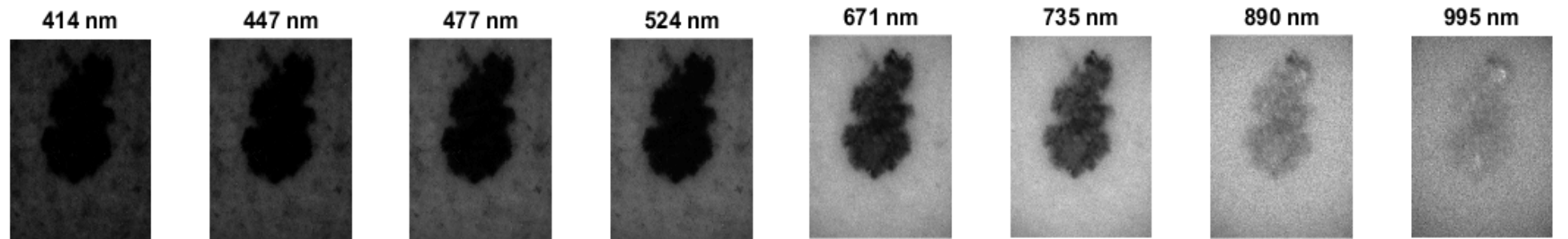


Results

- **Nevus**

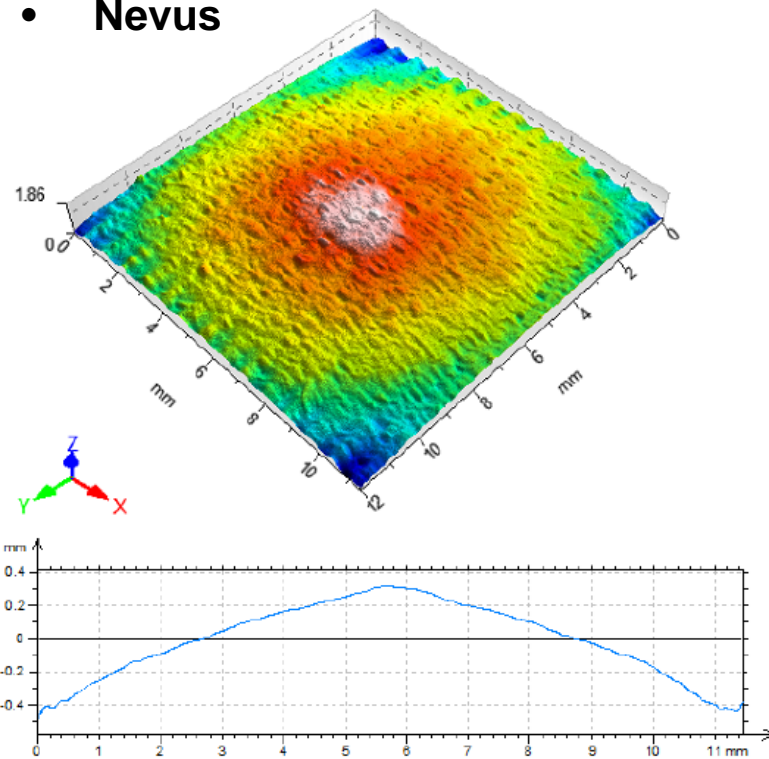


- **Melanoma**

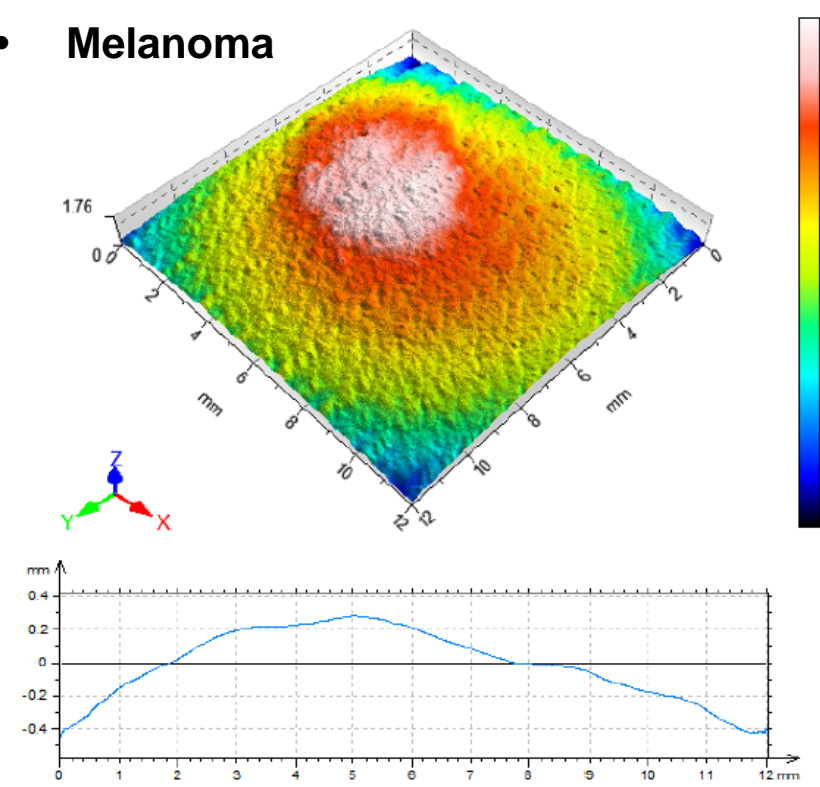


Results

- **Nevus**



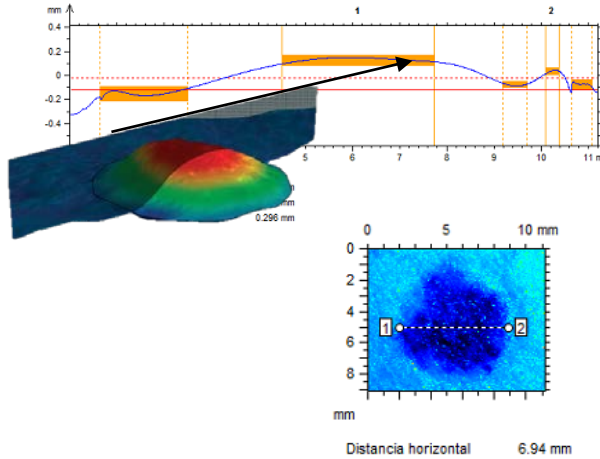
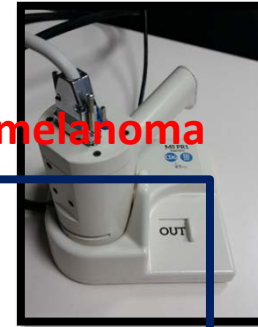
- **Melanoma**



Spectral + color parameters

Results

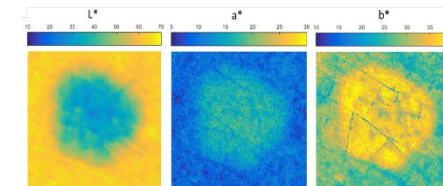
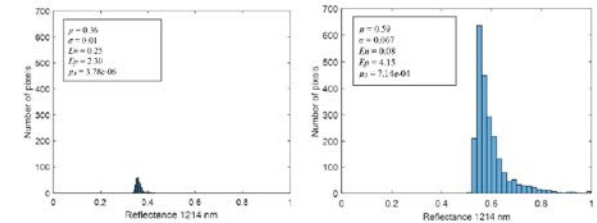
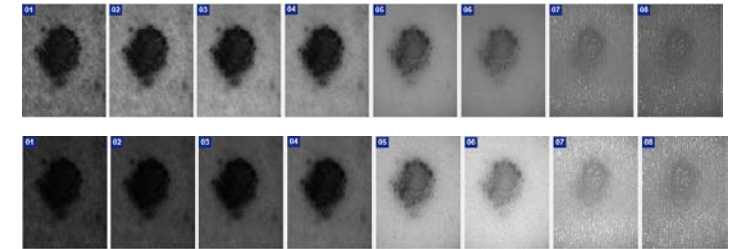
137 lesions: 81 nevi 56 melanoma



- Area
- Volume
- Perimeter
- Maximum height
- Average height
- 1st order statistics
- 2nd order statistics: height map histogram

- Reflectance and absorbance values
- 1st order statistics: Maximum, minimum, standard deviation
- 2nd order statistics: gray values histogram

Morfology + Texture & color
1325 parameters



Color:

Pseudo-CIELAB (L*, a*, b*, Cab, hab*)

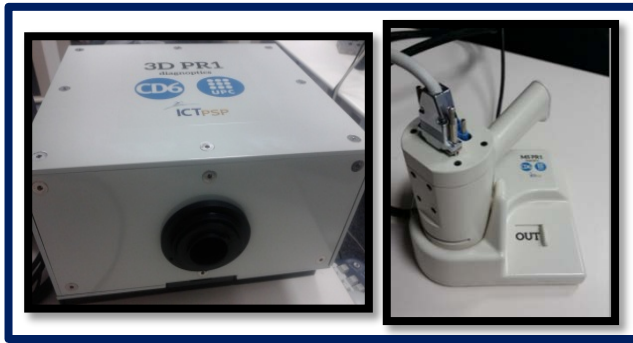
ΔE between the lesion & a ROI averaged surrounding healthy skin

Morphological parameters

- Energy
- Entropy
- Skewness

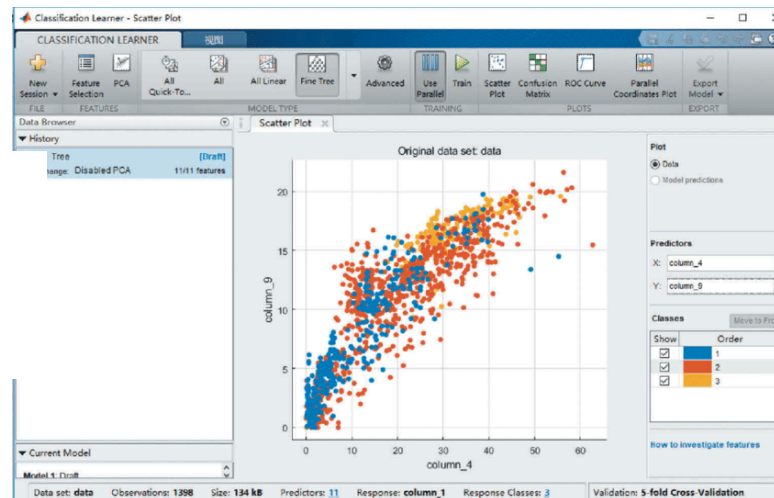
Results

1325 parameters

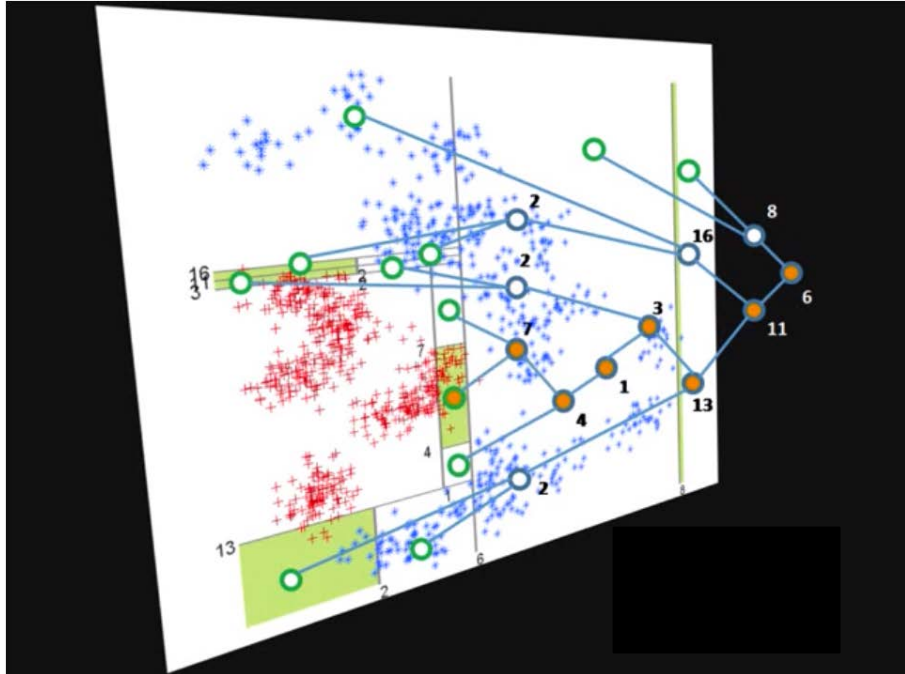
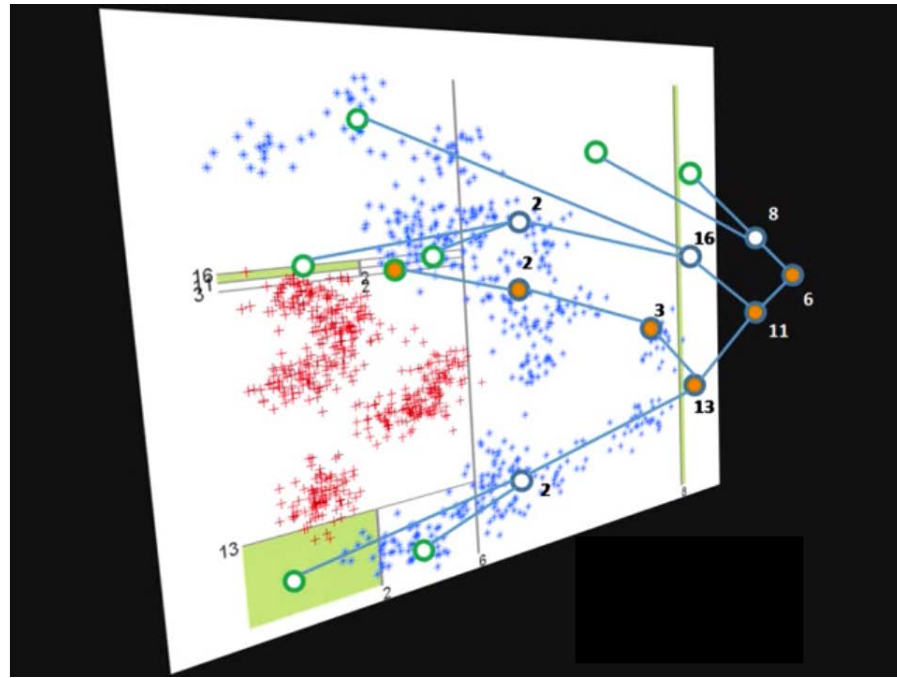
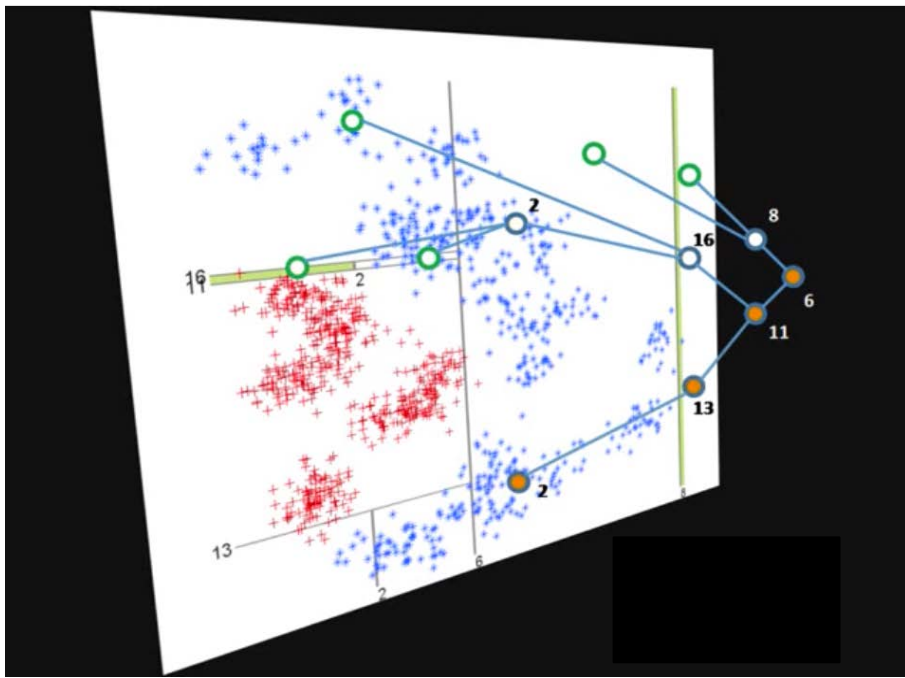


SPSS software: T-student (normal)
Mann Whitney (non-normal)

151 statistically significant parameters ($p < 0.005$)



Matlab Classification Learner, cross validation scheme



| Parameters | Validation Scheme | Classification Model | SN (%) | SP (%) |
|------------|------------------------|----------------------|--------|--------|
| MS | Cross Validation (k=2) | Boosted Trees | 73.2 | 75.0 |
| 3D | Cross Validation (k=2) | Cubic SVM | 71.4 | 69.9 |
| MS & 3D | Cross Validation (k=2) | Boosted Trees | 75.0 | 76.8 |

Conclusions

- Without any doubt: Spectral + color + morphology.
- Not as good as the gold standard (biopsy) yet, but improved specificity compared to other prototypes.
- Can help specialists to discern, useful tool for reducing false positives.



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THANK YOU!



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