Automatic detection of symmetry in dermoscopic images based on shape and texture

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Skin-lesion Symmetry

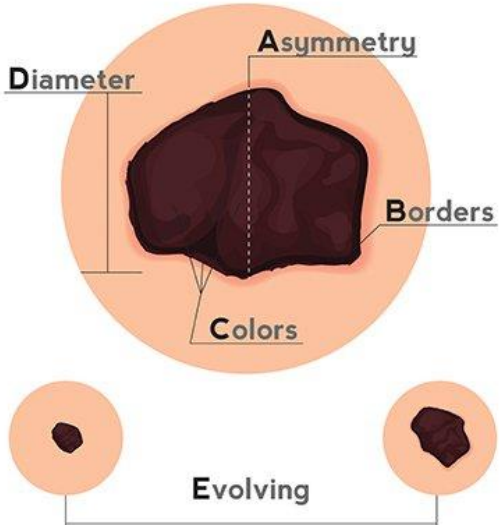
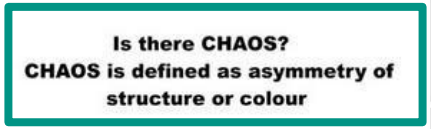
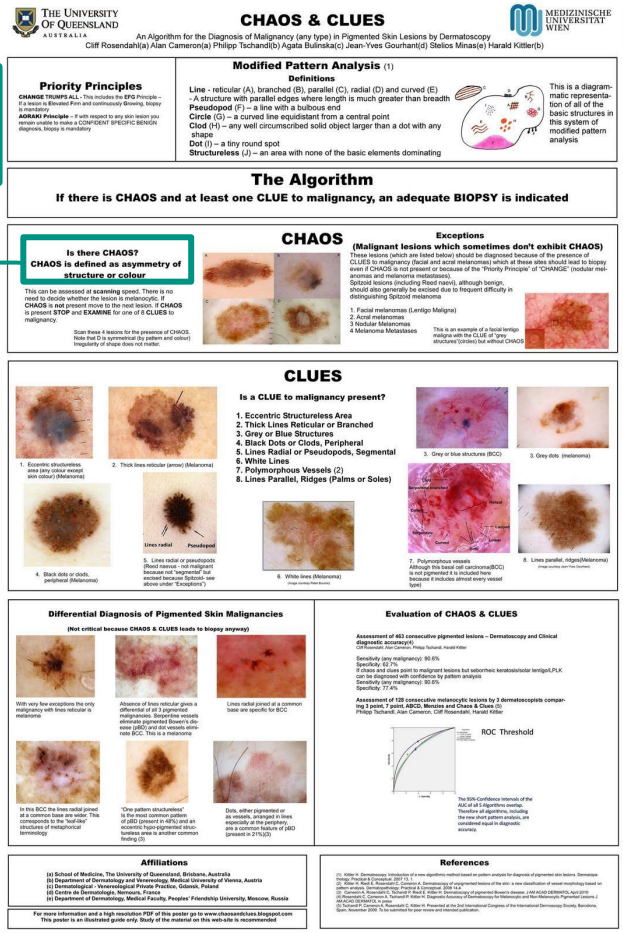


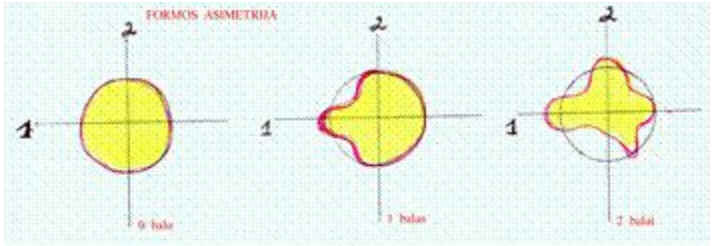
Image source: Cone Health

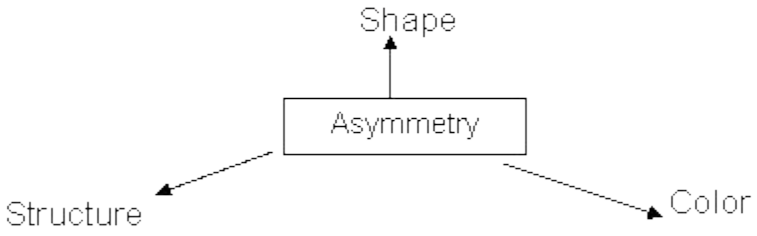


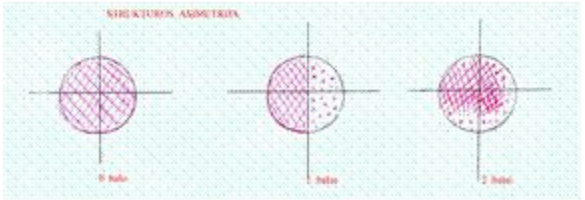


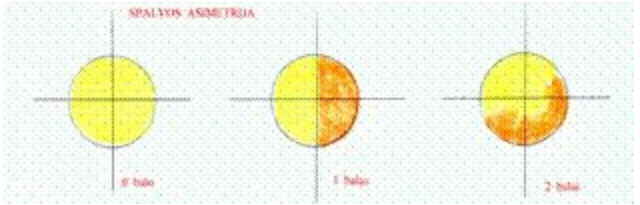
Rosendahl, Cliff, et al. "Dermatoscopy in routine practice: Chaos and clues." *Australian family physician* 41.7 (2012): 482.

Skin-lesion Symmetry





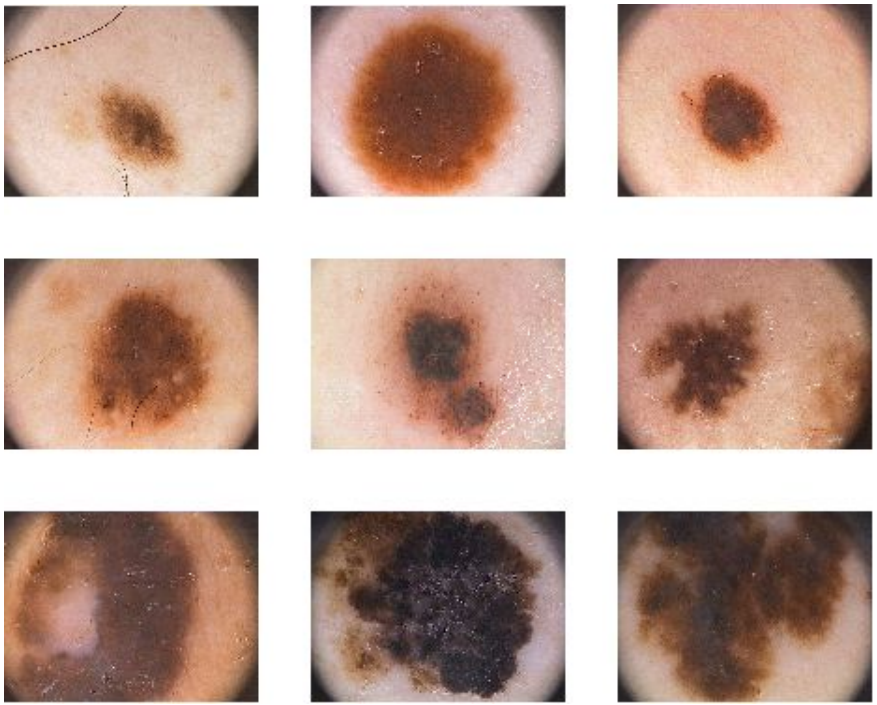




Source: Science Prog

Material

- PH^2 Dataset
- Jaccard Index
- Random Forests
- Patches Dataset



Mendonça, T. F., et al. "PH2: A public database for the analysis of dermoscopic images." *Dermoscopy image analysis* (2015).

Material

- PH^2 Dataset
- Jaccard Index
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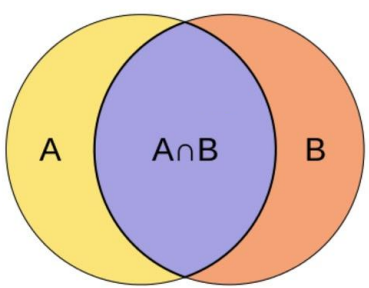
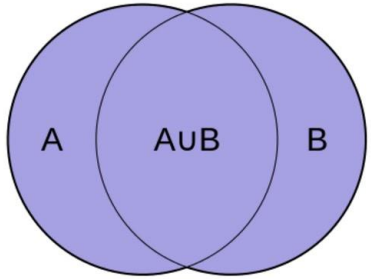
- Patches Dataset





$$J(A,B) = \frac{|A \cap B|}{|A \cup B|}$$

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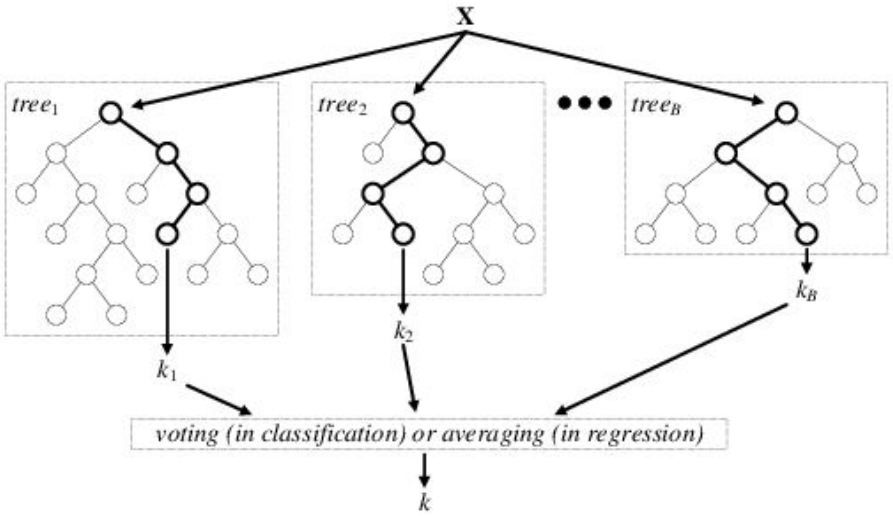


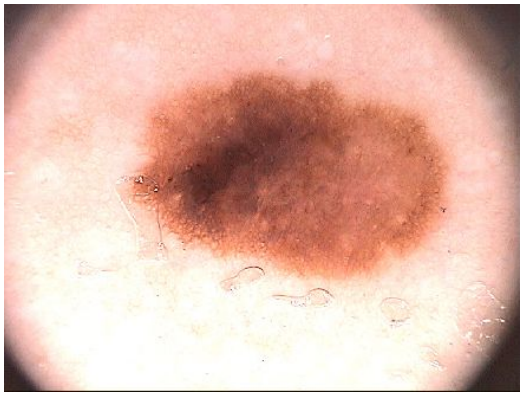
Image source: Antanas Verikas et al.

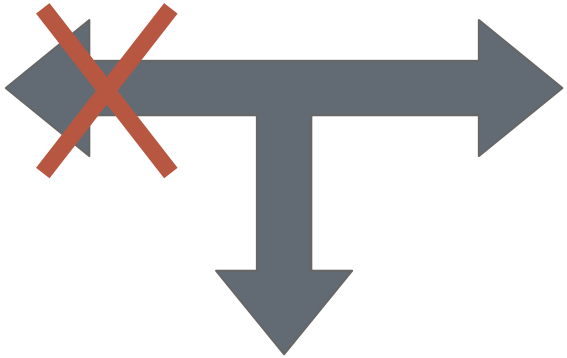
Material

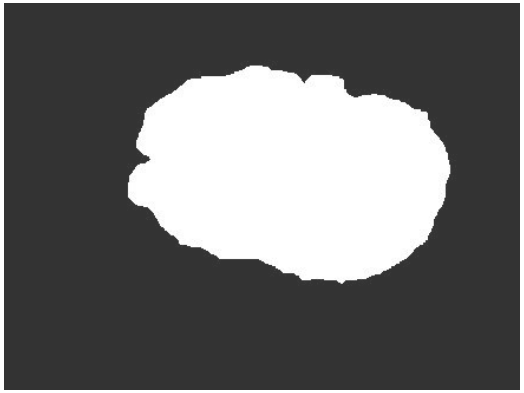
- PH^2 Dataset
- Jaccard Index
- Random Forests
- Patches Dataset

Symmetry Method:
Based on Shape

Shape-Based Method

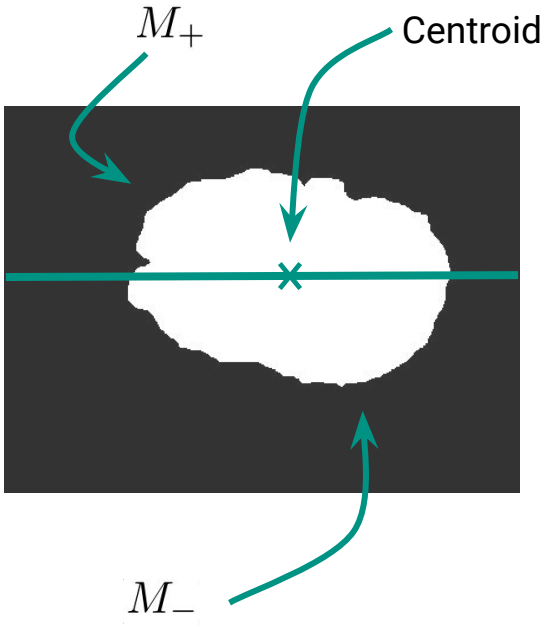






Symmetry
Based on Shape

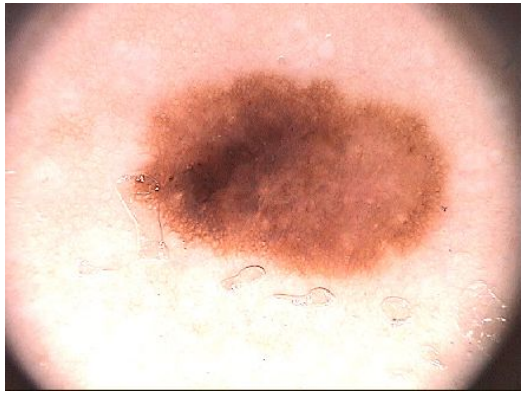
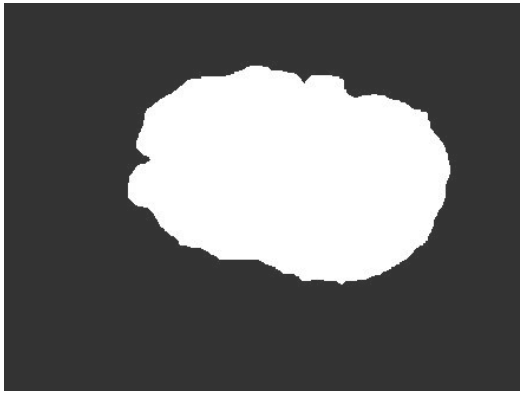
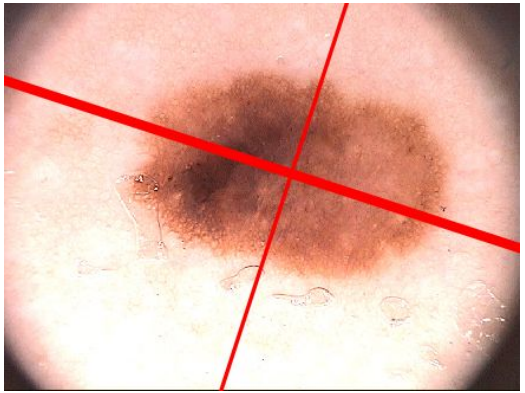
Shape-Based Method

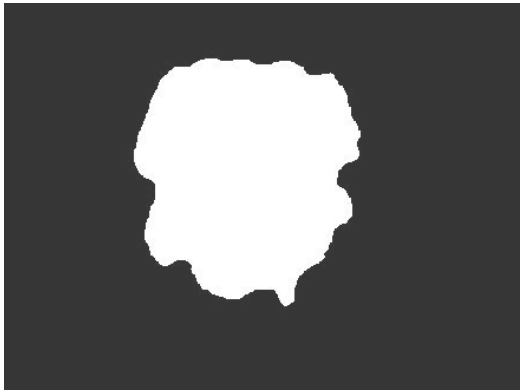
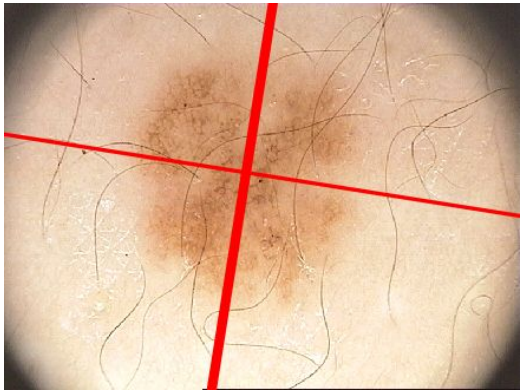


$$S_1(\ell) = \frac{|M_+ \cap R_\ell(M_-)|}{|M_+ \cup R_\ell(M_-)|}.$$

	"Shape" Symmetry
0°	
15°	
30°	
...	
175°	

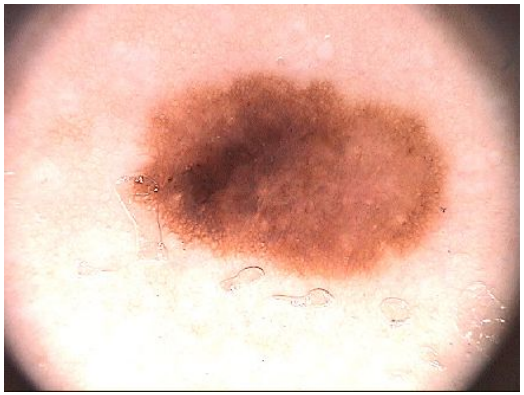
Shape-Based Method

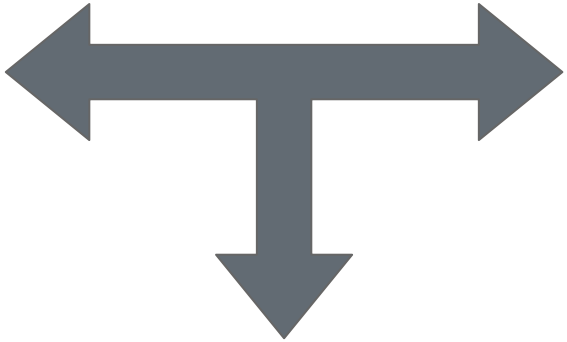




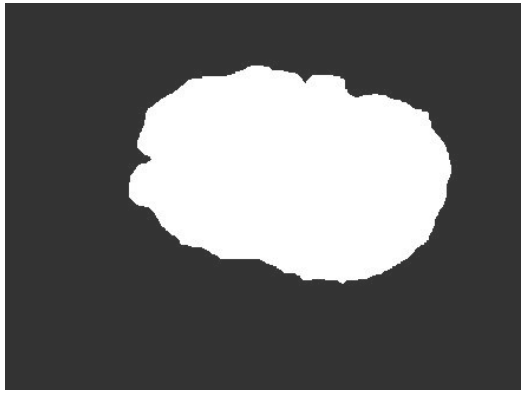



Symmetry Method:
Based on Texture

Texture-Based Method







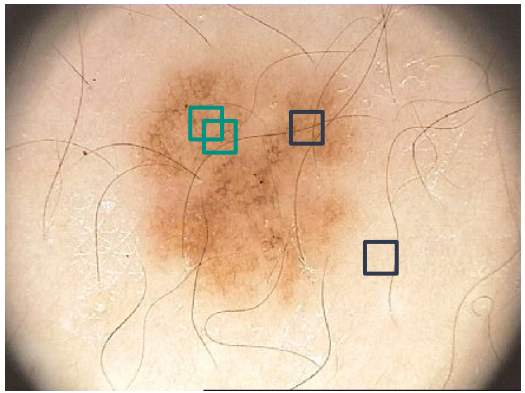
Symmetry
Based on Texture

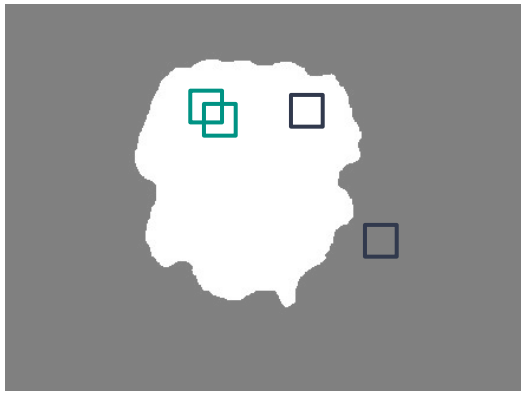
Material

- PH^2 Dataset
- Jaccard Index
- Random Forests
- Patches Dataset

Similar Pairs *vs* Non-Similar Pairs

Patches Dataset





Similar pairs:

- Close (partially overlapping)
- Both within or without the lesion

Non-similar pairs:

- One within the lesion, one without the lesion

10+10 pairs from each of the 200 samples.

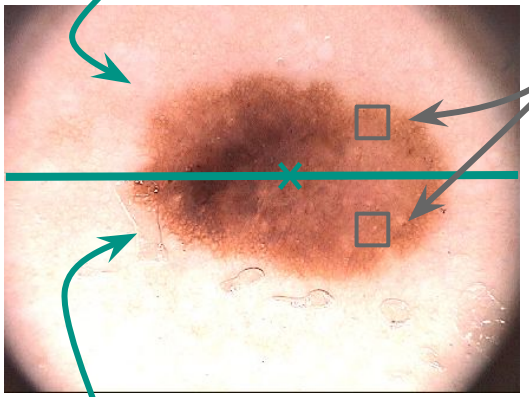
Patches Dataset

Random Forest Classifier

Two classes:
- Similar (2000 samples)
- Non-similar (2000 samples)

Textural features:
- GLCM features
- Per-channel histogram

Texture-Based Method

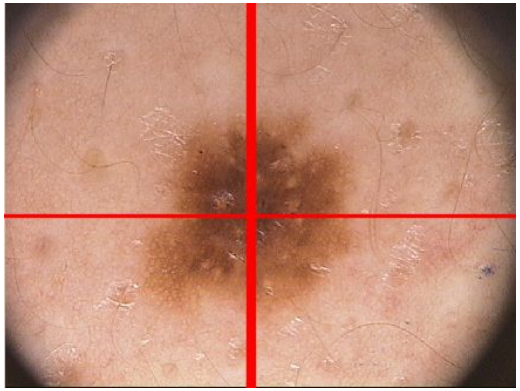


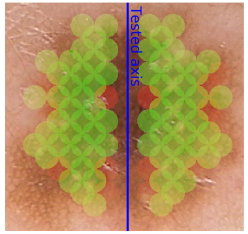
Patch similarity

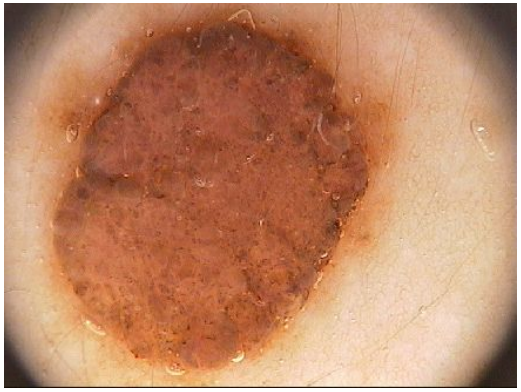
$$S_2(\ell) = \frac{1}{N}\sum_{i=1}^{N} T(p_+^{i)}, p_-^{i)})$$

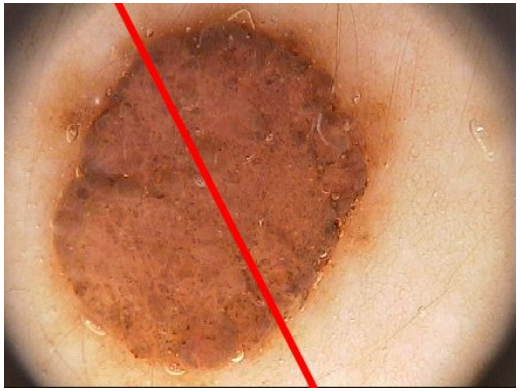
	"Texture" Symmetry
0º	
15º	
30º	
...	
175º	

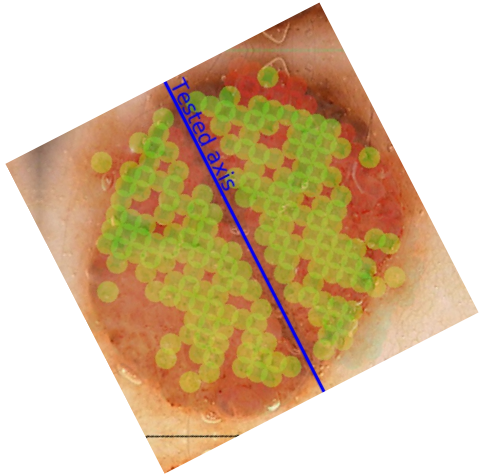
Texture-Based Method





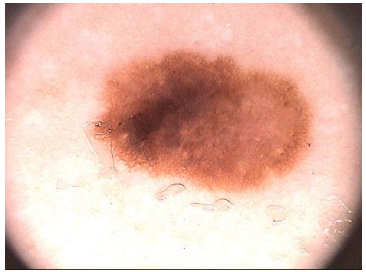


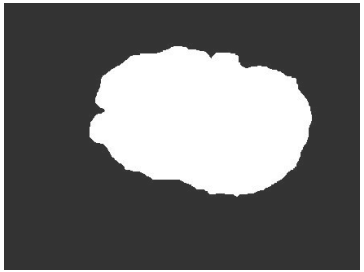




Symmetry Method:
Overall Symmetry

Overall Symmetry





Symmetry
Based on Texture

Symmetry
Based on Shape

Symmetry
Based on Shape
and Texture

Overall Symmetry

	"Shape" Symmetry	"Texture" Symmetry
0º		
15º		
30º		
...		
175º		

Random Forest Classifier

PH^2 dataset:

- Training (50 samples)
- Test (150 samples)

Three classes:

- No symmetry (26%)
- One-axis symmetry (15.5%)
- Two-axes symmetry (58.5%)

Patches dataset might have leaked some bits of information

Results

Classifier	Accuracy
Based on shape	86%
Based on texture	84%
Based on both	88%

Limitations

- Lack of comparison
- Patches dataset:
  - Biased
  - Limited amount of textures
- Study bias: light-skin patients

Contributions and software

- Patches dataset
- Symmetry detection
  - Only-shape and only-texture symmetry.
  - Overall symmetry.

`[Python package]` dermoscopic-symmetry
https://pypi.org/project/dermoscopic-symmetry/

`[Online demo]` DermaWeb
http://dermaweb.uib.es/d/algorithm/dermoscopy_shape_symmetry/
http://dermaweb.uib.es/d/algorithm/dermoscopy_texture_symmetry/

Thank you

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