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AUTOMATIC CLASSIFICATION OF SKIN LESIONS USING GEOMETRICAL MEASUREMENTS OF ADAPTIVE NEIGHBORHOODS AND LOCAL BINARY PATTERNS

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Context

Computer-Aided Diagnosis

Image Description (Skin Lesion Features)

The final image descriptor is built in two steps:
- The GAN-based Minkowski map with \( \mu = A \) of the color components R, G and B of the original image is computed.
- The Local Binary Pattern (LBP\(_A\)) operator of each of these maps is computed, and the three histograms are concatenated.

General Adaptive Neighborhoods (GANs)

The GAN of a point \( x \) is a spatial neighborhood whose size and shape is adapted to the local features of the image.

- The intensities of its points are close to that of the seed point according to a selected criterion (e.g., luminance, contrast...).
- The GAN is a path connected set.

\[
V_{\mu}(x) = C_{\text{path}}(x; A, \mu) \cdot s(x)
\]

where:
- \( \mu \): Spatial support, \( h \leq \mu \)
- \( A \): Criterion mapping, \( h \leq A \)
- \( s(x) \): Path connected component of \( x \) containing \( x \)

GAN-based Minkowski Map (Local Characterization)

\[
\mu_{\text{M}}(x) = \mu(V_{\mu}(x))
\]

where \( \mu \) is a Minkowski functional:
- Area (A)
- Perimeter (P)
- Euler Number (\( \mu \))

Skin lesion (dermoscopic imaging)

Description

Classification

Benign

Melanoma

Experiments

Dataset

1097 dermoscopic images of pigmented skin lesions: 88 of them histopathology confirmed melanomas.

Descriptor parameters

- GAN-based Minkowski maps
  - \( m = 20 \)
  - \( \mu = A \) (area)
  - LBP\(_A\)
  - \( R \) fixed to 8
  - \( R \) varying from 1 to 6

Classification

- Feed-forward neural network
- One hidden layer
- Sigmoid transfer function
- 10-fold cross validation

Results

<table>
<thead>
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<th>( R )</th>
<th>Num. neurons</th>
<th>Num. cycles</th>
<th>AUC</th>
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<tr>
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<tr>
<td>6</td>
<td>10</td>
<td>500</td>
<td>0.9115</td>
</tr>
</tbody>
</table>

Conclusion and Perspectives

- Classification of color images of naevi as benign lesions or melanoma.
- Descriptor built upon LBP and local geometrical features.
- Performance evaluated and compared with the classical LBP and the dermatologists’ predictions.
- AUC: 0.762 (Dermatologists); 0.8948 (Classical LBP); 0.9115 (Proposed method).

Perspectives

- Assess other GAN-based geometrical and/or morphometrical features.
- Automatic selection of relevant features.

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