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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

Description

Classification

Benign

Melanoma

Methods

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.

Definition:
- 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.

\[
V^2_D(x) = C_{(D+1)}(x) \cup (D(x) \cup N(x))
\]

where:
- \( D \): Spatial support (\( D \subseteq \mathbb{R}^2 \))
- \( A \): Criterion mapping (\( A : \mathbb{R} \to \mathbb{R} \))
- \( m \): Tolerance homogeneity
- \( C_1(x) \): Path connected component of \( X \) containing \( x \)

GAN-based Minkowski Map (Local Characterization)

Definition
\[
\mu^m_D(x) = \mu(V^m_D(x))
\]

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

Image Description (Skin Lesion Features)
The final image descriptor is built in two steps:
- The GAN-based Minkowski map (with \( m = 20 \)) of the color components R, G and B of the original image is computed.
- The Local Binary Pattern (LBP\( _{P,R} \)) operator of each of these maps is computed, and the three histograms are concatenated.

\[
\sum\frac{R}{P} = A \quad \mu = 0 \quad \text{Area under ROC curve}
\]

Descriptor parameters
- GAN-based Minkowski maps
  - \( m = 20 \)
  - \( \mu = A \) (area)
  - \( \text{Sigmoid transfer function} \)
- LBP\( _{P,R} \)
  - \( P \) fixed to 8
  - \( R \) varying from 1 to 6

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

Classification
- Feed-forward neural network
- One hidden layer
- 10-fold cross validation

Results

Conclusion and Perspectives

Conclusion
- 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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