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

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.

**GAN of a point \( x \):**
\[
V^A(x) = \frac{1}{|P(x)|} \sum c_{(x)}(x) \sum c_{(x)}(x) \sum c_{(x)}(x)
\]

where:
- \( P(x) \): Spatial support (\( D \leq B \))
- \( A \)Criticism mapping, (\( h = B \))
- \( m \) Tolerance homogeneity
- \( c_{(x)}(x) \): Path connected component of \( X \) containing \( x \)

GAN-based Minkowski Map (Local Characterization)

**Definition**
\[
\mu_{\rho}^A(x) = \mu(V^A(x))
\]

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

Image Description (Skin Lesion Features)

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

**Results**

- **Area under ROC curve.**
- **Different neurons in hidden layer and training cycles.**
- **Comparison with classical LBP.**

**Perspectives**

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

**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: 0.792 (Dermatologists); 0.8948 (Classical LBP); 0.9115 (Proposed method).**

**Dataset**

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

**Experiments**

**Descriptor parameters**

- **GAN-based Minkowski maps**
  - \( m = 20 \)
  - \( \rho = A \) (area)
  - LBP_{PH}
  - \( P \) fixed to 8
  - \( R \) varying from 1 to 6

**Classification**

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