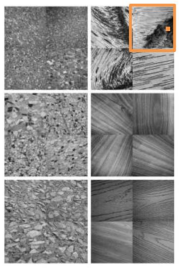
Statistical Texture Classification Using Variants of Local Binary Pattern

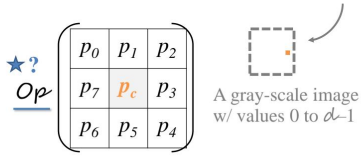
Shixuan Li
Department of Computer Science, University of Toronto

Overview

Texture image → **Feature extraction** → 1-NN Classifier

1. For each pixel (i, j) in I, apply an operator to its 3×3 patch p to get the value (i, j) in the feature map M





2. Take the histogram distribution of M as the d-dimensional feature vector

Attractive-Repulsive Strength-Based LBP (ARSBLBP)

A rotation-invariant and space-efficient method:

1.1. Measure strength in the neighbourhood → {0,...,7}

$$A_{S(i,j)} = \max\left(0,\ \sum_{k=0}^{7} \mathbb{1}[p_k \geq p_c] - 1\right)$$

$$R_{S(i,j)} = \max\left(0,\ \sum_{k=0}^{7} \mathbb{1}[p_k \leq p_c] - 1\right)$$

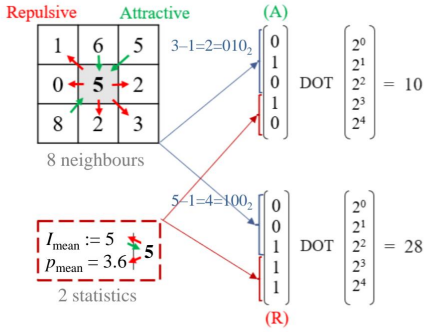
1.2. Add weighted comparisons to statistics → {0,...,31}

$$\text{ASBLBP}_{(i,j)} = A_{S(i,j)} + \begin{bmatrix}\mathbb{1}[I_{\text{mean}} \geq p_c] \\ \mathbb{1}[p_{\text{mean}} \geq p_c]\end{bmatrix} \cdot \begin{bmatrix}2^3 \\ 2^4\end{bmatrix}$$

$$\text{RSBLBP}_{(i,j)} = R_{S(i,j)} + \begin{bmatrix}\mathbb{1}[I_{\text{mean}} \leq p_c] \\ \mathbb{1}[p_{\text{mean}} \leq p_c]\end{bmatrix} \cdot \begin{bmatrix}2^3 \\ 2^4\end{bmatrix}$$

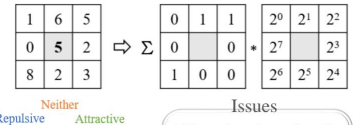
2. Concatenate the histograms of two M's → d = 64

$$\mathbf{hist}^{64}_{\text{ARSBLBP}} = [\mathbf{hist}^{32}_{\text{ASBLBP}}\ \mathbf{hist}^{32}_{\text{RSBLBP}}]$$

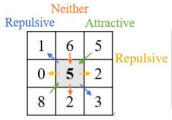


Related Work

- LBP[1]
  8 neighbours $\geq p_c$?



- ARCSLBP[2]
  4 pairs of I_{mean}, p_{mean}, p_{median} $\geq p_c$? (A) / $\leq p_c$? (R)



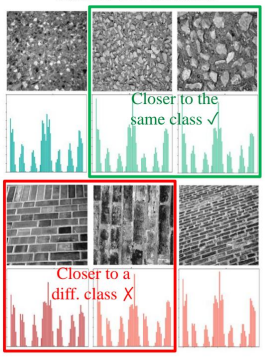
Issues
a. Rotation-invariant?
b. Dimensionality ↓?
c. Which neighbours are more important?

References

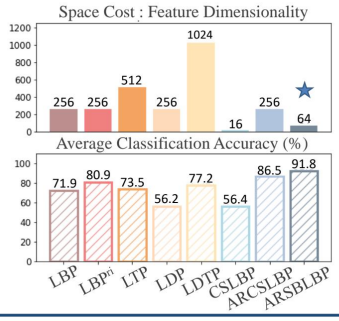
[1] Ojala et al., "A comparative study of texture measures with classification based on feature distribution," *Pattern Recognition*, 1996.
[2] El merabet et al., "Attractive-and-repulsive center-symmetric local binary patterns for texture classification," *Engineering Applications of Artificial Intelligence*, 2019.

Experimental Results

ARSBLBP features



The best among 8 variants



LBP vs. ARSBLBP