English Summary: Noisy Textures Classification Using Deep Neural Network and Completed Local Binary Pattern

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Abstract (published with the Farsi version on the time of publication.)
Local binary pattern is one of the most popular descriptors that widely used in feature extraction of texture images. Deep convolutional neural network is also one of the best classification methods that provides very high accuracy. In this research, by combining the features that produced by these two methods, a structure for noisy texture classification is proposed, which provides a very high classification rate. This method is based on two extracted features. The first part uses completed local binary pattern features and in the second part the features of texture images are extracted by using the DenseNet-121 convolution deep neural network. Another motivation of this research related to feature reduction, which significantly reduces the dimensions of extracted features. It employs a shallow convolution neural network to convert the extracted features into lower number of new features. The accuracy of the proposed method has been evaluated on noisy Outex, CUReT and UIUC datasets. The classification accuracy of the proposed method for different level of noise has increased significantly compared to many advanced methods and has improved between 3 and 25%.

Keywords (published with the Farsi version on the time of publication.)
Classification of texture images, Noisy texture images, Deep neural network, Local binary pattern

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Noisy Textures Classification Using Deep Neural Network and Completed Local Binary Pattern

Keywords: Texture classification, Noisy images, Deep learning, CLBP, DenseNet.

Objective

Propose a hybrid method for robust classification of noisy texture images by combining **Complete Local Binary Patterns (CLBP)** and **DenseNet-121**, achieving high accuracy under Gaussian, salt-and-pepper, and speckle noise.

Methodology

1. **Feature Extraction**:
   - **CLBP**: Extracts 3D histograms of local texture features (sign, magnitude, and center pixel information) with parameters P=16, R=2.
   - **DenseNet-121**: Uses pre-trained CNN (transfer learning) to extract 1024-dimensional deep features.
2. **Feature Reduction**:
   - A **shallow** CNN reduces CLBP histogram dimensions before fusion with DenseNet features.
3. **Classification**:
   - **Combined** features are classified using a fully connected neural network with dropout.

Key Innovations

- **Complementary Features**: CLBP (noise-resistant local patterns) + DenseNet (hierarchical deep features).
- **Dimensionality Reduction**: Shallow CNN compresses CLBP histograms without significant accuracy loss.

Results

Tested on **UIUC**, **CUReT**, and **Outex** datasets with varying noise levels:

- **Accuracy Improvements**: 3–15% over state-of-the-art methods (e.g., RMCLBP, SSLBP).
- **Noise Robustness**: Outperforms standalone CLBP/DenseNet, especially for low SNR (e.g., 96.57% accuracy on CUReT with Gaussian noise at SNR=3).

Significance

- **Applications**: Medical imaging, remote sensing, quality control.
- **GitHub Contribution**: Code repository includes pre-processing, hybrid feature extraction, and classification modules.

How to cite (cite the original paper)

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