5/24/2015

BINARY GENETIC PROGRAMMING BASED TEXTURE SEGMENTATION

Hussein Mohamed
Introduction

The texture is “A measure of the variation of the intensity of a surface, quantifying properties such as smoothness, coarseness, and regularity.”

Textures are homogenous visual patterns in a scene such as grass, cloud, wood, and sand. Although the stated definition is an acceptable one, Zucker and Kant described the textures as: "Texture is an apparently paradoxical notion. On the one hand, it is commonly used in the early processing of visual information, especially for practical classification purposes. On the other hand, no one has succeeded in producing a commonly accepted definition of texture". Textures have spatial continuity. Gabor wavelets optimize the theoretical limit of the joint resolution between space and frequency domain. They don’t have zero mean. It’s used to represent the time-varying signal in terms of functions that are localized in frequency and time.

The texture is essential for vision systems such as visual inspection, medical image analysis, and remote sensing. It’s not yet understood how a biological process of vision happens to mimic it. In texture analysis, we have a classification and segmentation. The process of texture classification is to assign an unknown texture to known texture class while texture segmentation is identifying the region in an image based on textural differences. The thesis statement is accuracy improvement of texture segmentation using genetic programming.

Motivation

The texture is essential to any vision system. Animals, for example, could detect the presence of a lion using its unique textures. Also, the Mars probe Pathfinder uses texture to detect sky, dust and other materials in the space. Textures are homogenous visual patterns such as grass, wood, and sand. The uniformity in patterns is essential for scene understanding.

Approach

This study aims at using the multi-classifier genetic programming algorithm for texture classification in binary form. Classification problems require searching through many partial candidate solutions to find a good solution. Genetic Programming allows finding a solution in a search space quickly and automatically. The choice of genetic programming was due to its ability to solve a diverse range of complex problems. It works by developing a population of “computer programs” have evolved over a number of generations. Genetic Programming was very successful in tasks like classification problems and image analysis. The process contains two steps, first texture feature extractions, and then using classification algorithms to classify textures.

Texture analysis provides an intuitive presentation of textures and produces texture features that are descriptive of texture. There are two approaches for texture analysis. A macro that views, textures as a composition of textural primitives, but to do that it needs to identify textual primitives and relations among these primitives and micro that measures textures without identifying textural primitives.

Texture segmentation is a complex texture analysis task that partitions an image into regions based on differences in texture appearance. It does not only identify the boundaries of each region, but also the textures inside each region.
The main aim of texture segmentation is separating objects from the background. It’s also worth noting that image segmentation methods such as edge detection and threshold-based are not applicable to texture segmentation.

Segmentation Methods like Boundary Image Segmentation identifies the usual non-continuous and unclosed boundaries between two textures. Region Based Segmentation concerned with identifying texture regions based on adjacent parts of regions that have different textures Split-and-merge works by splitting image into quarters and then analyze every two-quarters, if two-quarters are different, then it’s going to split again recursively otherwise the two-quarters will be merged again. Split-and-merge with sliding window slides a window over the whole image to sample small regions that might overlap. Segmentation is then done by classification voting strategy, in which regions are linked to specific classes. Due to overlapping between regions, a pixel might be classified into different classes, for each of those a voting scheme is used to choose a single class for each pixel. Split and merge is known for its low computational overhead, but it produces blocky boundaries that require further smoothing. It’s planned to use an ensemble of these methods.

**Literature review**

A proposed solution was using A Pulse Coupled Neural Network -FCM Time Series Classifier for Texture Segmentation First the Time series features are generated by PCNN and Filtered and then Clustered by Fuzzy C-Means algorithm and last a Posterior Morphologic process is applied to improve the segmentation this yielded out to an improvement in lost time information as final features are generated.

Random Walker Interactive Image Segmentation; this method relies on User input that can help in segmenting textures of an image. Algorithms such as graph cut algorithm, snake algorithm, live wire algorithm, random walk algorithm uses similar methods First the User Indicate main features and background information then Gabor energy establish a texture-based similarity weight function and then Laplacian matrix is applied to show adjacency relation between nodes in an undirected graph and finally some tweaking to Solve Dirichlet boundary conditions that result in a powerful extraction of the objects contour in a complex texture image

Using clustering method based on ensemble of criterias such as Clustering based on co-association matrix, Clustering based on voting, Clustering based on information theory, Clustering based on hypergraph partitioning, and Clustering based on Expectation Maximum (EM). Enable clustering is to combine results from different algorithms or same algorithm with different parameters which provide better results. The results were promising to combine different methods.

Using Global Minimization Active Contour Model. The model is not sensitive to initial condition because of having no existence of local minimum in the active contour energy. Combining the gray levels of pixels and texture information segmentation is possible then Local binary pattern is used to extract features, thus low computation complexity. The results proved the efficiency, accuracy, and robustness of proposed model.

Using Texture-topic Model. This method works by finding homogeneous regions in remote sensing images by using Latent Dirichlet Allocation (LDA). LDA is a text analysis method, so to apply LDA in image segmentation image
features are considered independent visual words. A topic model is used to take into consideration spatial relationship between adjacent features.

Using Image segmentation based on filters and a multi-level pixel-based classifier. The filters are trained using neural network to increase filters discrimination power. The obtained features are then processed by a classification scheme that utilises multiple evaluation window sizes, which iteratively refines the resulting segmentation.

Another supervised approach is used to achieve the target results, features for each pixel are computed by applying a set of feature extraction methods. Multichannel filtering is the leading filtering method for this object due to their versatility, and neuropsychological support. To choose filters back for multichannel filtering system filter responses in the spatial-frequency domain is localised in such a way that frequency plane is covered as much as possible. Adaptive filters allow the problem to be modelled as optimisation problem, thus well-known optimisation techniques such as Neural Network, and Support Vector Machines can easily be applied. The method shows in better segmentation in terms of accuracy and processing time.

**Conclusion**

There are various algorithms to solve the texture segmentation problems, with each taking a different approach in tackling the problem, but the one common thing is that none of them is able to achieve 100% accuracy.

**Future Work**

- Proposed approach refinement
- Construction and testing of the proposed methodology

**References**


