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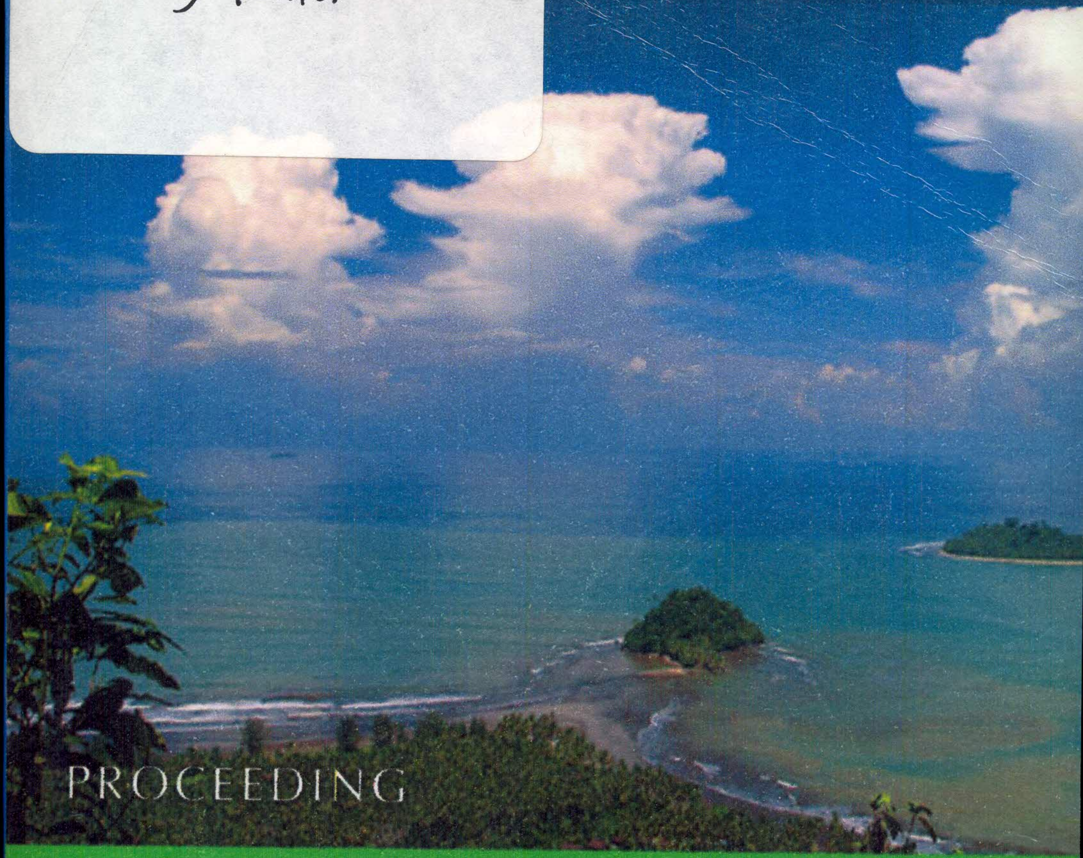

PROCEEDING

Padang, October 24 - 25, 2009

INTERNATIONAL SEMINAR ON SCIENCES AND TECHNOLOGY

The Role of Sciences and Technology to Improve the Quality of Life

ISST 2009

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ILMMIPA INDONESIA BEM KM FMIPA ANDALAS UNIVERSITY

Proceedings of The First International Seminar on Science and Technology (ISST 2009)

The Roles of Science and Tecnology to Improve The Quality of Life

October, 24th 2009

Bukittinggi, The Hills Hotel

Ikatan Mahasiswa MIPA Indonesia (ILM MIPA Indonesia)
Faculty of Mathematics and Nature Sciences
Andalas University
Padang Indonesia
2009

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The Roles of Science and Technology to Improve The Quality of Life
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Foreword by

Rector of Andalas University

It would a pleasure for me to deliver my best compliments to all participant of the International on Sciences and Technology (ISST) 2009. On behalf of Andalas University, let me welcome to the seminar in Bukittinggi, West Sumatera Province, the land of Minangkabau.

We believe that form this scientific meeting, all participant will have time to discuss and exchange ideas, findings, creating new networking as well as strengthen the existing collaboration in the respective fields of expertise. In the century in which the information is spreading in a tremendous speed and globalization is a trend, Andalas University must prepare for the tough competition that lays ahead. One ways to succeed is by initiating and developing collaboration work with many partners from all over the world. I strongly believe that this seminar is and extraordinary testimony to our capacity building at international, regional and local level.

I would like to express my deep gratitude to committee board of who has put into effort to host this prestigious seminar. I would also like to extend my gratitude to keynote speakers, participant and organizer of this conference for their contribution to this event.

Finally I wish all participants a fruitful deliberation at this conference. I also wish all participants and accompanying spouses a pleasant and enjoyable stay in Bukittinggi City, West Sumatera.

Prof. Dr.Ir.Musliar Kasim,MS
Rector

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Foreword by

Dean of Faculty of Mathematics and Nature Sciences Andalas University

I would like to thank all of you who participate in the first International Seminar of Sciences and Technology which is held in Bukittinggi on October 24,2009. On behalf the Faculty of Mathematics and Nature Sciences, we are pleased to welcome you to Andalas University. We are proud that so many experts in the field of this seminar decide to participate in the event that has been co-organized by our staff members and student.

I am confident that the seminar will provide a marvelous opportunity for an international gathering for scientist from various interest of research and background. The seminar participants will have opportunity of visiting many of the most interesting and nice sites in West Sumatera, especially Bukittinggi.

I would like to thank the organizing committee for all effort they have made to success the ISST 2009 and to manage every aspect of the seminar.

Let me finish this address by wishing your conference real success and you all to enjoy the beauty of Bukittinggi. Welcome to our city and get in touch with the nice views you can feel here.

Prof.Dr.Emriadi,MS

Dean

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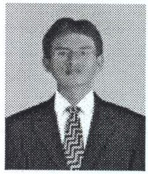

Foreword by

Chairperson of Organizing Committe

I would like to welcome all participant to the first International Seminar on Sciences and Technology 2009 at Bukittinggi and Andalas University. I really proud of your enthusiasm to contribute the program despite of arising issues about the current nature phenomenon. I am sure that we agree, as scientist that nature and its phenomenon are our basic motivation to learn and improve related researches.

ISST 2009 is the first international program organized by ILMMIPA Indonesia in partnership with the Faculty of Mathematics and Nature Sciences Andalas University. This program is strongly supported by DIKTI Indonesia as it will be able to lead Indonesian Science students to contribute and strife together for the academics education. From the Seminar we are looking forward to development of our scientific insight knowledge and skill of organizing, quality and challenging work. We are also expecting that the conducted research my result exact solution for today scientific problem especially in Indonesia. This is way we choose "The of Sciences and Technology to Improve The Quality of Life" to become the main theme for the seminar.

At this last of address I would like to deliver my gratitude to all Keynotes and contributed speaker the university, attendants, and all partner for their immeasurable contribution and support.

Thank you very much.

Hendri
Chairperson

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Content

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Parquet Texture Analysis

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Abstract

Texture features play a very important role in computer vision and pattern recognition. Texture Applications include industrial inspection, estimation of object range and orientation, shape analysis. Texture mages of real objects often do not exhibit regions of uniform intensities. For example, the image of a parquet surface is not uniform but contains variations of intensities.

In former research, parquet surface texture is obtained only from the sole angle, obviously which is not sufficient. Therefore, we take extract texture parameters of parquet analysis methods in the space and frequency field. With Gabor filter, parquet surface texture characters are measured from many angles.

1. Introduction

The need of manufacturing companies to maintain high quality product requires an exhaustive production control during and at the end the process. When control is human visual inspection product control is not completely reliable and it is not guaranty of a total quality control.

However, the development of new technologies, and specially image analysis systems, has ostensibly improved the quality control process. Since it is a noninvasive technology and is capable to inspect the 100 % of the production, image analysis system offers an advantage when compared with the manufactured product quality control techniques like human inspection [6].

The wood industry and especially in parquet industry has produced efforts to improve each and every one of the production stages. Decorative parquet is the reason why parquet surface texture must be controlled, only parquets slabs which have similar texture should be placed together. Since the objective of these products is satisfy the requirement of having good aesthetic qualities[1][6].

For the reason, texture is one important natural attribute of parquet slabs, the important basis of recognizing and analysis parquet slabs. Texture parquet has complicated structure, it is difficult to describe with exact math parse formula. It has both scientific and practical value to research parquet surface texture.

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Texture can be seen in many images from multispectral remote sensed data to microscopic photography. Despite its importance, there is no unique and precise definition of *texture*. Each texture analysis method characterizes image texture in terms of the features it extracts from the image. Therefore, it depends not only on studying the images but also on the goal for which the image texture is used and the features that are extracted from the image. Some standard definitions of texture are follows [5]:

- Faugeras and Pratt

The basic pattern and repetition frequency of a texture sample could be perceptually invisible, although quantitatively present. In the deterministic formulation texture is considered as a basic local pattern that is periodically or quasi-periodically repeated over some area.

- Bovik, Clarke and Geisler

An image texture may be defined as a local arrangement of image irradiances projected from a surface patch of perceptually homogeneous irradiances.

- Jain and Karu

Texture is characterized not only by the grey value at a given pixel, but also by the grey value `pattern' in a neighborhood surrounding the pixel. The unit of texture is texels, and the repetitiveness of the texels determines the type of the texture and decides the texture analysis approach.

The approaches for analyzing texture are very diverse, and differ from each other mainly by the method used for extracting textural features. Four categories can be defined: (1) statistical methods, (2) structural methods, (3) modelbased methods, and (4) transform-based methods.

Statistical texture analysis techniques primarily describe texture of regions in an image through higher-order moments of their grayscale histograms. Probably, the most frequently cited method for texture analysis is based on extracting various textural features from a gray level cooccurrence matrix (GLCM). The GLCM approach is based on the use of second-order statistics of the grayscale image histograms. Alternatively, the run length matrix (RLM) encompasses higher-order statistics of the gray level histogram. The RLM texture analysis approach characterizes coarse textures as having many pixels in a constant gray level run and fine textures as having few pixels in such a run. Besides traditional statistical texture analysis, multivariate statistical methods have also been proposed for textural feature extraction. Considering an image as a matrix, the Singular Value Decomposition (SVD) spectrum is a summary vector of image texture represented by its singular values. The SVD spectrum has been used as a textural feature vector for image classification.

Structural texture analysis techniques describe a texture as the composition of well-defined texture lements such as regularly spaced parallel lines. The properties and placement rules of the texture elements define the image texture. Various structural texture analysis approaches have been proposed, ranging from using different shapes of structuring elements to conceiving real textures as distorted versions of ideal textures. However, these methods appear to be limited in practicality since they can only describe very regular textures.

Model-based texture analysis techniques generate an empirical model of each pixel in the image based on a weighted average of the pixel intensities in its neighborhood. The estimated parameters of the image models are used as textural feature descriptors. Examples of such model-based texture

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descriptors are autoregressive (AR) models, Markov random fields (MRF) and fractal models. Finally, transform-based texture analysis techniques convert the image into a new form using the spatial frequency properties of the pixel intensity variations. The success of these latter techniques lies in the type of transform used to extract textural characteristics from the image. The use of spectra from 2-D Fast Fourier Transform (FFT) magnitude images for textural feature extraction. Image classification using Multi-way Principal Component Analysis (MPCA) on 2-D FFT magnitude images to extract features from various images. The Gabor or Wavelet transforms have been preferred recently in image texture analysis due to their space-frequency decomposition abilities. Features derived from a set of Gabor filters have been widely used in texture analysis for image segmentation [3].

2. Gabor Filter

Gabor filters provide means for better spatial localization however their usefulness is limited in practice because there is usually no single filter resolution at which one can localize a spatial structure in natural texture. Evaluation of Gabor Filters can be done by analyzing Human Vision System (HVS) and Gabor's theory.

The phenomenon of perceptual organization enables humans to detect such relationships among image elements as collinearity, parallelism, connectivity, and repetitively. In computer vision, perceptual grouping is the study of how features are clustered for object recognition. Inspired by biological studies, its purpose is to group feature elements prior to recognition. Perceptual organization has been studied by investigators in psychology in an attempt to classify the behavior of grouping phenomena in the human visual system, with laws of symmetry, proximity, simplicity, closure etc. proposed as the mechanism for grouping features such as edges, corners, regions. The coding of Gabor filter is based on the imitation of HVS. It has been tried to incorporate the same property as HVS for the localized analysis.

Simple cells of visual cortex of human have receptive fields (RFs) which are restricted to small regions of space and are highly structured. They are having three important characteristics: Band pass, orientation Selectivity, and direction selectivity. They respond differently to the stimuli with different spatial frequencies, orientation, and directions. These cells can be said to be localized spatial filters that response only to certain spatial frequency band, orientations, and directions.

It has been observed that most of the cells can be combined in pairs, one cell of each pair has even symmetry and the other has odd symmetry. This observation can be modeled by a cosine function and sine function as wave is the chosen function.

R.F's of both (pair) of cells can be combined in a complex notation (RF is a pattern of photoreceptors that determines the behavior of a cell in visual cortex) as given below

$$exp(ikx)=cos(kx) + i*sin(kx)$$

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The real part corresponds to cell with even symmetry and the imaginary part to the cells with odd symmetry. Thus a biologically motivated filter can be formulated having the characteristics of the visual cortex cell pairs to simulate human vision system for localized filtering operation. Recent studies on Mathematical modeling of visual cortical cells suggest a tuned band pass filter bank structure. These filters are found to have Gaussian transfer functions in the spatial frequency domain. Thus, taking the Inverse Fourier Transform of this transfer function we get the filter characteristics in the spatial domain that closely resembles the Gabor filters. The Gabor filter is basically a Gaussian Band pass filter having spreads of σ_x and σ_y along x and y-axes respectively.

Gabor filters have various properties that make them particularly suitable for texture segmentation. It has been shown that the Gabor function is a band-pass filter that can be tuned to a narrow set of frequency anywhere in the frequency domain. Gabor filters achieve an optimal joint resolution in the frequency and spatial domain. It is also show that a limited set of Gabor filters can be used to approximate the coefficients of the Gabor expansion of a band-limited image. The output of properly parameterized Gabor channels can thus be used to reconstruct the most important features of a textured image.

A Gabor filter tuned to that frequency range exhibits a strong response in the presence of the texture but a significantly weaker response in the presence of a different texture. The first step is thus to select appropriate filters for use in the different channels. the power spectrum of the image to determine the frequency characteristics of the dominant components of the textures. Some intuition must then be used to select the appropriate peaks. For strongly oriented textures the largest peak in the appropriate orientation should be chosen. For periodic texture the lower fundamental frequency should be chosen instead. By selecting a Gabor filter that is most sensitive to this narrow band of frequencies and orientations it is possible to obtain an indicator for the presence of a given texture. Each channel filters the image by computing the convolution of the image with a Gabor function tuned to one of the image's textures. The magnitude of the channel output is much larger over regions of the appropriate frequencies.

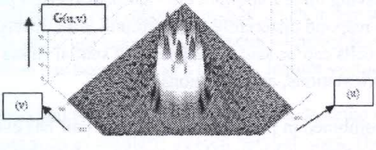

Figure 1. Family of 8 Gabor filter bank plotted in freq. domain, with 4 orientations of 0, 90, 135, 45.

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3. Parameter of Gabor Filter

The set of 2-D Gabor filters have been proved to be appropriate for texture segmentation in several senses.

They have

1. Tunable orientation and radial frequency bandwidths
2. Tunable center frequencies and orientations.
3. They optimally achieve joint resolution in space and spatial frequency domains.

Gabor filters can be configured to have various shapes, bandwidths, center frequencies and orientations by the adjustment of suitable parameters. By varying these parameters a filter can be made to pass any elliptical region of spatial frequencies.

$$h(x,y) = \frac{1}{2\pi\sigma_x\sigma_y} \exp\left\{-\frac{1}{2}\left[\frac{(x\cos\theta + y\sin\theta)^2}{\sigma_x^2} + \frac{(-x\sin\theta + y\sin\theta)^2}{\sigma_y^2}\right]\right\} \exp(j2\pi Fx)$$

$\in [0, \pi]$) specifies the orientation of the Gabor filters. W is the radial frequency of the sinusoid. A filter will respond stronger to a bar or an edge with a normal parallel to the orientation θ of the sinusoid.

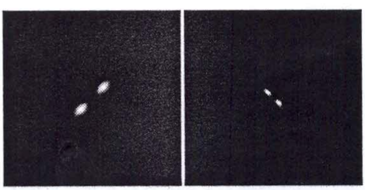

Figure 2. Power-spectra of two 2-dimensional Gabor functions.

Figure 2 shows the power spectra of two Gabor functions with different parameter settings. The light areas indicate spatial frequencies and wavevector orientations which will pass the corresponding filters. In this way Gabor filters act

as local bandpass filters.

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4. Result and Discussion

The goal of experiment is to evaluate the region and edge of the parquet image. For the region segmentation is conducted by using Gabor Filter and to detect the edge of the Gabor filter segmentation result is using Sobel. In the implementation is using Matlab 7.1.

Steps of experiment as follow:

1. Collect the parquet texture photo which acquired from wood industry. In this experiment, we have 9 parquet texture photos. The texture photo which used is the .gif form with 256x256 sizes.
2. Convert the wood texture photo data to gray scale image, then compose its histogram.
3. Filter the gray scale image to get the clearer region using the Gabor filter, by inputting the frequency data and teta value for each image. This experiment is using angle 30, 60, 90, 120, 150 with frequency ranging from 1 up to 5. All the experiment result data are saved in MS Excel format and histogram of each experiment are saved in the jpg form.
4. Detect the edge using Sobel operator.
5. Analysis the histogram result.
   Experiment result will be discussed in the next section.

Ten parquet texture photos which are utilized in this paper: (a) angus, (b) hevea, (c) kempas, (d)mahogany, (e) merbau, (f) mindi, (g) oceanbangkirai, (h) palisander, (i) teak, (j) yellowbangkirai.

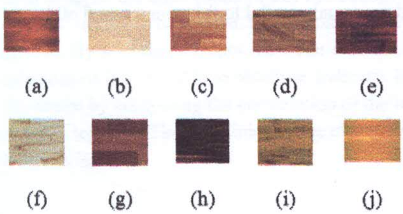
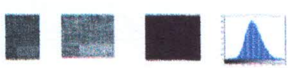


Figure 3.Ten of Parquet Textures

The experiment results from some image have been shown in the figure 4.



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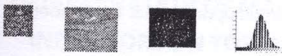
(c) Gray Scale	(c) Gabor Filter	(c) Sobel	(d) Histogram Hasil Gabor



(f) Gray Scale	(f) Gabor Filter	(f) Sobel	(f) Histogram Hasil Gabor

Figure 4. A few results of segmentation achieved by Gabor Filter and Sobel on Parquet Textures

The texture image is changed to the gray scale form. Every texture image is processed using Gabor filter to get the clearer region. From those 10 texture images, the experiment result produce spatial frequency domain range and space angular 30° with orientation domain ranging from 90° up to 150°. For more clear, it can be seen in the figure 5.

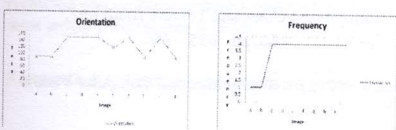


Figure 5. Orientations and Frequency

Graphic has shown in Figure 3 is constitute experiment result which is the most optimal through several time experiment. Each experiment is done by changing the spatial frequency and orientation. The experiment is conducted for each image includes its histogram until it finds close to normal form histogram.

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5. Conclusion

The filter is characterized by a preferred orientation and a preferred spatial frequency. Roughly speaking, a 2-D Gabor filters acts as a local band-pass filter with certain optimal joint localization properties in the spatial domain and in the spatial Frequency domain.

Gabor feature can be used directly as input to a classification or a segmentation operator or they can first be transformed into new feature vectors that are then used as such an input. We considered the problem of designing Gabor filters for textural segmentation. For parquet textures which have wide similarity, no elective systematic method existed previously for designing effective Gabor filters. Given a texture pair of interest the method gives the optimal Gabor filter for segmenting an image made up of these textures. The method is based on a decision theoretical formulation and requires representative samples of the texture of interest. The resulting filters minimize the probability of incorrectly assigning image pixels to regions based on the filter output. We use Sobel to measure 2-D spatial gradient performance from the resulting filter image. The purpose is to find the approximate absolute gradient magnitude at each point in an input grayscale image.

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