EURASIP Journal on Applied Signal Processing 2004:4, 495–502

Ridge Distance Estimation in Fingerprint Images: Algorithm and Performance Evaluation

Yilong Yin
College of Computer Science & Technology, Shandong University, Shanda South Road 27, Jinan 250100, China
Email: ylyin@sdu.edu.cn

Jie Tian
Intelligent Bioinformatics Systems Division, Institute of Automation, The Chinese Academy of Sciences, Beijing 100080, China
Email: tian@doctor.com

Xiukun Yang
Identix Inc, One Exchange Place Suite 800, Jersey City, NJ 07302, USA
Email: susan.yang@identix.com

Received 17 October 2002; Revised 27 September 2003

It is important to estimate the ridge distance accurately, an intrinsic texture property of a fingerprint image. Up to now, only several articles have touched directly upon ridge distance estimation. Little has been published providing detailed evaluation of methods for ridge distance estimation, in particular, the traditional spectral analysis method applied in the frequency field. In this paper, a novel method on nonoverlap blocks, called the statistical method, is presented to estimate the ridge distance. Direct estimation ratio (DER) and estimation accuracy (EA) are defined and used as parameters along with time consumption (TC) to evaluate performance of these two methods for ridge distance estimation. Based on comparison of performances of these two methods, a third hybrid method is developed to combine the merits of both methods. Experimental results indicate that DER is 44.7%, 63.8%, and 80.6%; EA is 84%, 93%, and 91%; and TC is 0.42, 0.31, and 0.34 seconds, with the spectral analysis method, statistical method, and hybrid method, respectively.

Keywords and phrases: fingerprint, ridge distance, spectral analysis, statistical window, hybrid method.

1. INTRODUCTION

Fingerprint identification is the most popular biometric technology and has drawn a substantial attention recently [1]. An automated fingerprint identification system (AFIS) includes fingerprint acquisition, feature extraction, fingerprint matching, and/or fingerprint classification. Most AFISs are based on comparison of minutiae, the most prominent being ridge endings and ridge bifurcations [2].

A critical step in automatic fingerprint matching is to extract minutiae automatically and reliably from fingerprint images. Performance of a minutiae extraction algorithm relies heavily, however, on the quality of fingerprint images. In order to ensure a robust performance of an AFIS with respect to quality of fingerprint images, it is essential to incorporate an enhancement algorithm in the minutiae extraction module. Ridge distance is an intrinsic property of fingerprint images and it is used as a basic parameter in fingerprint enhancement in some enhancement methods, during which ridge distance is used to determine the period of enhancement mask. It is thus important to be able to estimate ridge distance in fingerprint images reliably in an AFIS.

Fingerprint ridge distance is defined as the distance from a given ridge to adjacent ridges. It can be measured as the distance from the center of one ridge to the center of another, as illustrated in Figure 1. Another notion related to ridge distance is ridge frequency. Ridge frequency is the reciprocal of ridge distance and indicates the number of ridges within a unit length.

Although fingerprint ridge distance is very important in AFIS, it is difficult to estimate due to the following factors:

(1) for the same finger, fingerprint images acquired with different image resolutions may have different ridge distance(s);
(2) even with the same image resolution, noises, such as low contrast, ridge breaks, ridge conglutination, and so forth, may distort estimations;
(3) occurrence of minutiae may disturb the estimation of the ridge distance;

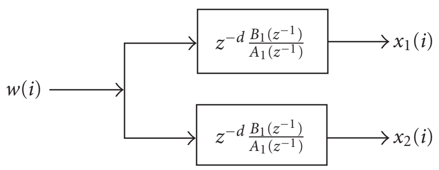

Figure 1: Definition of fingerprint ridge distance.

(4) the existence of high curvature, such as regions containing singularities, makes it difficult to estimate ridge distance in these regions with common methods;
(5) different fingers may have different ridge distances;
(6) within the same fingerprint image, different regions may have different ridge distances.

While problems (3), (4), and (5) are intrinsic properties of fingerprints, problems (1), (2), and (6) may be controlled or improved.

It has been noted above that the ridge distance is important for fingerprint identification. To the best of the authors' knowledge, however, the estimation of ridge distance was only addressed directly in several articles.

O'Gorman and Nickerson [3] used average ridge distance as key parameter in the design of filters. Lin and Dubes [4] attempted to count ridge number automatically. Douglas Hung [5] estimated ridge period over the whole image. Hong et al. [6] presented an oriented window method for estimating fingerprint ridge frequency. This method performs well when ridges in the oriented window have distinct contrast and consistent ridge directions. Kovacs-Vajna et al. [7] brought out geometric and spectral methods to estimate fingerprint ridge distance. One of the merits of the geometric method is that it calculates ridge direction directly, which means it does not depend on the result of ridge direction estimation as the prior procedure. Spectral method divides a fingerprint image into blocks, converts each block of fingerprint image from spatial field to frequency field using discrete Fourier transform (DFT), and estimates ridge distance of a block image according to the distribution of harmonic coefficients. Only less than half of the ridge distances of block images can be estimated directly according to their experimental results, however. Maio and Maltoni [8] did mathematical characterization of the local frequency of sinusoidal signals and developed a two-dimensional model in order to approximate the ridge-line patterns in his method for ridge-line density estimation in digital images.

This paper focuses on ridge distance estimation of fingerprint images. Traditional spectral analysis method is realized and a novel statistical method is presented. Also a hybrid method is brought out and performance evaluation of methods for ridge distance estimation is discussed.

This paper is organized as follows. Traditional spectral analysis method is introduced and applied in Section 2. The statistical method is described in detail in Section 3. Comparison between the spectral analysis method, the statistical method, and a hybrid method is described in Section 4. Performance evaluation and experimental results are shown in Section 5. Section 6 contains the conclusion and discussions.

2. SPECTRAL ANALYSIS METHOD

Spectral analysis method is a typical method of signal processing in the frequency field. It transforms the representation of fingerprint images from the spatial field to the frequency field and completes the ridge distance estimation in the frequency field. It is a traditional method for ridge distance estimation in fingerprint images.

If $g_{(x,y)}$ is the gray-scale value of the pixels with coordinates $x, y \in \{0, K, N-1\}$ in an $N \times N$ image, the DFT of $g_{(x,y)}$ is defined as follows:

$$\begin{aligned} G_{(u,v)} &= \frac{1}{N}\sum_{x=0}^{N-1}\sum_{y=0}^{N-1} g_{(x,y)} e^{-2\pi j/N\langle (x,y)(u,v)\rangle} \\ &= \frac{1}{N}\sum_{x=0}^{N-1}\sum_{y=0}^{N-1} g_{(x,y)}\left(\cos\left(-\frac{2\pi}{N}\langle (x,y)(u,v)\rangle\right)\right. \\ &\qquad\left. + j\sin\left(-\frac{2\pi}{N}\langle (x,y)(u,v)\rangle\right)\right), \end{aligned} \tag{1}$$

where j is an imaginary unit, $u, v \in \{0, \Lambda, N-1\}$, and $\langle (x,y)(u,v)\rangle = xu + yv$ is the vector dot product; $G_{(u,v)}$ is obviously complex. Let $|G_{(u,v)}|$ denote the magnitude of $G_{(u,v)}$, theoretically speaking,

$$\begin{aligned} &|G_{(u,v)}| \\ &= \frac{1}{N}\sum_{x=0}^{N-1}\sum_{y=0}^{N-1}\left(\left(g_{(x,y)}\cos\left(-\frac{2\pi}{N}\langle (x,y)(u,v)\rangle\right)\right)^2\right. \\ &\qquad\left. + \left(g_{(x,y)}\sin\left(-\frac{2\pi}{N}\langle (x,y)(u,v)\rangle\right)\right)^2\right)^{1/2}, \end{aligned} \tag{2}$$

$|G_{(u,v)}|$ is also called the coefficient. It represents the periodic characteristics of point u, v. The dominant period of signals in an area can be determined by analyzing the distribution of values of $|G_{(u,v)}|$.

A fingerprint image and its DFT at block level with window size of 32×32 are shown in Figure 2.

The whole procedure of ridge distance estimation with the spectral analysis method relies on a radial distribution function $Q(r)$ [7] defined as follows:

$$Q(r) = \frac{1}{\#C_r}\sum_{(u,v)\in C_r} |G_{(u,v)}|, \tag{3}$$

where $0 \le r \le \sqrt{2}(N-1)$, C_r represents the set of coordinates u, v that satisfy $\sqrt{u^2+v^2} \approx r$ (approximate equality $\approx$ is resolved by rounding to the nearest integer), and $\#C_r$ is the number of elements of C_r. Based on (3), $Q(r)$ denotes distribution intensity of the signal whose period is N/r in an $N\times N$ image, and the value of r corresponding to the maximum of $Q(r)$ is the incident times of dominant signal in this area.

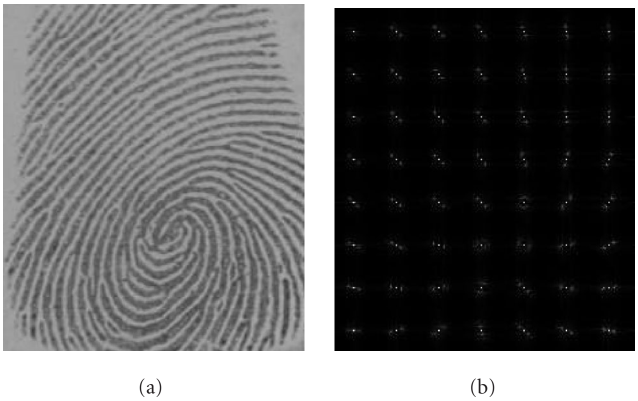

FIGURE 2: (a) A fingerprint image and (b) corresponding transform result at block level.

The following steps are taken for ridge distance estimation by the spectral analysis method in fingerprint images.

Step 1. Divide a fingerprint into nonoverlap block images of size $N \times N$ ($N = 32$). Each block image is considered as a unit in subsequent procedures.

Step 2. Calculate $|G_{(u,v)}|$ corresponding to all $g_{(x,y)}$, $x, y \in \{0, K, N-1\}$, in a block image using DFT.

A two-dimensional fast Fourier transform (FFT) algorithm is applied in this paper in order to reduce time consumption.

Step 3. Calculate $Q(r)$ for each block image, $0 \le r \le \sqrt{2}(N-1)$.

Step 4. Find r' such that $Q(r') > Q(r)$ for any $0 \le r_{\min} \le r \le r_{\max} \le \sqrt{2}(N-1)$, $r \ne r'$ (find the position of the largest peak), $r_{\min}$, $r_{\max}$ denote the possible minimum and maximum value of r, respectively. For a 500 dpi fingerprint image, the range of ridge distances is $\{3, 25\}$ [6]. Thus, $r_{\min} = \text{round}(32/25) = 1$, and $r_{\max} = \text{round}(32/3) = 11$. The sense of r' is shown in Figure 3.

Step 5. If there is not such a local maximum of $Q(r)$, the estimation is impossible.

Step 6. Find r'' such that $Q(r'') > Q(r)$ for any $0 \le r_{\min} \le r \le r_{\max} \le \sqrt{2}(N-1)$, $r \ne r'$ (find the position of the second largest peak).

Step 7. Estimate the ridge distance in the block image, N/r', with confidence level

$$\begin{aligned} \text{DL} = \frac{\alpha}{Q(r')} \min\{ & Q(r') - Q(r''), Q(r') - (r'-1), \\ & Q(r') - Q(r'+1)\}, \end{aligned} \tag{4}$$

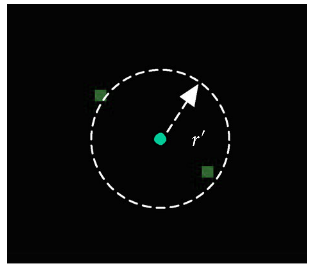

FIGURE 3: The sense of r' of a block image in the frequency field.

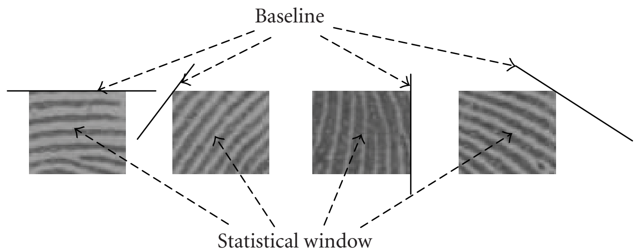

FIGURE 4: Definitions of statistical window and baseline.

where $\alpha = 2.43$ (experimental data). Only estimations whose $\text{DL} \ge 0.37$ (experimental data) are accepted.

3. STATISTICAL METHOD

A novel and efficient method, called the statistical method, is introduced to estimate ridge distance in fingerprint images in this paper. This method took the following steps.

Step 1. Calculate ridge directions at block level. Divide a fingerprint image into nonoverlap blocks of size $N \times N$ ($N = 32$) and calculate ridge direction for each block by an LMS method [6], which acquires the dominant direction of a block image and views it as the direction of the block. Smooth directions at block level; the initial values of ridge distances of all blocks are assigned to 0.

Step 2. Use a locally adaptive method [9] to binarize a fingerprint image at block level so that a value of 1 is assigned to pixels on ridges and 0 is assigned to pixels on furrows.

Step 3. Define the statistical window and baseline. Consider each block image of size $N \times N$ ($N = 32$) as a statistical window. The baseline is defined as a beeline parallel to the ridge direction of the block image. The baseline passes the left-top point of the statistical window when the ridge direction of the block image belongs to $[0, \pi/2)$ and passes the right-top point of the statistical window when the ridge direction of the block image belongs to $[\pi/2, \pi)$. The definitions of statistical window and baseline are illustrated in Figure 4.

Step 4. Determine the ridge distance distribution in each block image with the distance statistical method. For each statistical window, define an integral array SA[MD+1] as a

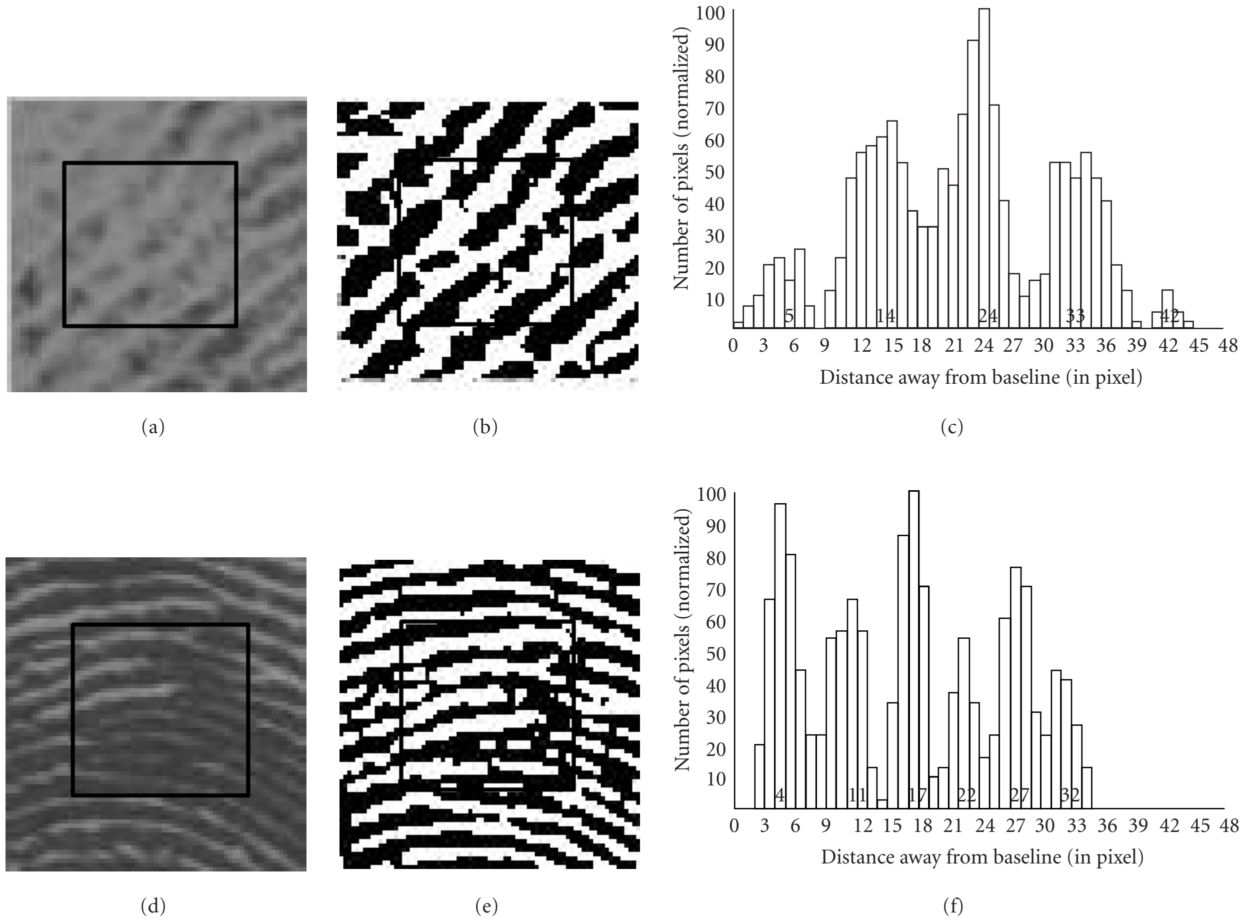

FIGURE 5: Binarized results: the distribution of ridge distances and peak positions detected in two typical block images: (a) and (d) two typical block images, the inner squares indicate statistical windows; (b) and (e) binarized results for (a) and (d), respectively; (c) and (f) the distribution of ridge distances of (b) and (e) and peaks detected, respectively.

statistical array in which MD denotes the maximum possible distance between pixels on ridges in a statistical window to the baseline. For example, $\text{SA}[4] = 20$ means there are 20 pixels on ridges in the statistical window 4 pixels away from the baselines. Using d as the X-coordinate and $\text{SA}[d]$ as the Y-coordinate, a histogram of ridge distance distribution in a block image is acquired.

Step 5. Detect positions of all peaks and calculate the peak intervals in the histogram. To each integer i which belongs to $[2, \text{MD} - 3]$, if

$$\begin{aligned}
&\text{SA}[i-1] + \text{SA}[i] + \text{SA}[i+1] \\
&\qquad > \text{SA}[i-2] + \text{SA}[i-1] + \text{SA}[i], \\
&\text{SA}[i-1] + \text{SA}[i] + \text{SA}[i+1] \\
&\qquad > \text{SA}[i] + \text{SA}[i+1] + \text{SA}[i+2]
\end{aligned} \tag{5}$$

are satisfied, then i is the position of a peak. Obviously, every peak position corresponds to a ridge and intervals of consecutive peaks denote ridge distances in a statistical window.

Binarized results, the distribution of ridge distances and peak positions detected, are shown for two typical block images in Figure 5.

Step 6. Estimate the ridge distance and calculate the confidence level. If a peak interval is beyond the range of $3 \sim 25$, then it is considered an invalid estimation result and should be discarded. After all invalid estimation results are discarded, if the number of the remainder peak intervals is less than 3, assert that the ridge distance of the block could not be estimated. Otherwise, M_0 and Var, the average and variance of valid peak intervals, are calculated:

$$\begin{aligned}
M_0 &= \frac{1}{\text{VPINum}} \sum_{i=0}^{\text{VPINum}-1} \text{VPI}[i], \\
\text{Var} &= \frac{1}{\text{VPINum} - 1} \sqrt{\sum_{i=0}^{\text{VPINum}-1} \left(\text{VPI}[i] - M_0\right)^2},
\end{aligned} \tag{6}$$

where VPINum is the number of valid peak intervals, and

VPI[i] is the ith valid peak interval. The confidence level of estimation result of a block image is defined as follows:

$$\alpha = 1 - \frac{\mathrm{Var}}{M_0}. \tag{7}$$

If α is greater than or equal to 0.80 (experimental threshold), the estimation result is accepted and recorded.

4. HYBRID METHOD

During the course of implementing the spectral analysis method and the statistical method, the following performance characteristics were observed.

Spectral analysis method

(1) Not sensitive to ridge directions. Even in regions whose ridge directions vary acutely, for example, regions containing singularities, this method still can estimate ridge distance reliably so long as the quality of the fingerprint image is good.
(2) Sensitive to image quality. When the quality of the fingerprint image is poor, its performance will deteriorate rapidly and the ridge distances of many block images could not be estimated.
(3) Complicated and time consuming.
(4) Estimation results are correspondingly coarse.

Statistical method

(1) Sensitive to ridge directions. The method performs poorly when ridge directions in the statistical window are very different, especially in regions containing singularities.
(2) Not sensitive to image quality, such as gray-level contrast, or appearance of ridge breaks. Ridge distances can be estimated reliably even if quality of the fingerprint image is poor, if only the dominant direction of a block image is existent and there is no serious ridge conglutination.
(3) Simple and efficient.
(4) Estimation results are correspondingly accurate.

Presentation of hybrid method

Based on the above analysis of performance of the two methods, a hybrid method that uses the two methods synthetically is defined. First, ridge distances are estimated with the statistical method. For block images that cannot be estimated, the spectral analysis method is then applied. For block images whose ridge distances still cannot be estimated, whose confidence level of estimation result is less than 0.8, ridge distance of the block is regarded as nonestimable.

5. PERFORMANCE EVALUATION AND EXPERIMENTAL RESULTS

It is important to use proper parameters to evaluate performance of methods of ridge distance estimation, which is called *performance evaluation*. Though the problem has been discussed in [6], further development is still necessary.

Definition of evaluation parameters

In this paper, we attempt to evaluate the performance of the above three methods by first defining the following parameters.

(1) Direct estimation ratio (DER):

$$\mathrm{DER} = \frac{A_d}{A_t} \times 100\%, \tag{8}$$

where A_d is the area of a fingerprint image for which ridge distance can be estimated in numbers of block images, and A_t is the total area of valid fingerprint region in numbers of block images.

DER clearly measures robustness of a method for ridge distance estimation in fingerprint images. A high DER value means that the method is flexible and insensitive to a variety of image quality and ridge directions.

(2) Estimation accuracy (EA): there is always deviation between the estimation result and the actual value of the ridge distance. A small deviation indicates that the estimation result is accurate. Suppose the number of valid blocks in a fingerprint image is S and let E_n and T_n denote the estimation result and the manually measured value of ridge distance of the nth valid block image, respectively; EA is defined as follows:

$$\mathrm{EA} = \left(1 - \frac{1}{S}\sum_{n=1}^{S}\frac{T_n - E_n}{T_n}\right) \times 100\%. \tag{9}$$

Only block images whose ridge distances can be estimated are considered in the calculation of EA. Here the manually measured value of the ridge distance is used as the actual value. The manually measured value is acquired by measuring the enlarged fingerprint image printed on a piece of paper.

(3) Time consumption (TC): TC is the average time needed for handling one fingerprint image.

Evaluation strategy and experimental conditions

Methods of ridge distance estimation may show different performance according to the variation in quality of fingerprint images. It is therefore necessary to implement performance evaluation on good, fair, and poor quality images. An average performance of methods on all test images should also be presented.

Until now, it has been difficult to find quantitative methods for strict measurement of the quality of fingerprint images. Considering mainly factors such as gray-level contrast, ridge break, ridge conglutination, and so forth, we selected 30 typical images (10 good-quality, 10 fair-quality, and 10 poor-quality) from the NJU fingerprint database (1200 live scan images, 10 per individual, with image resolutions = 450 dpi and image size = 320 × 320) according to experience to the estimate ridge distance with each of the

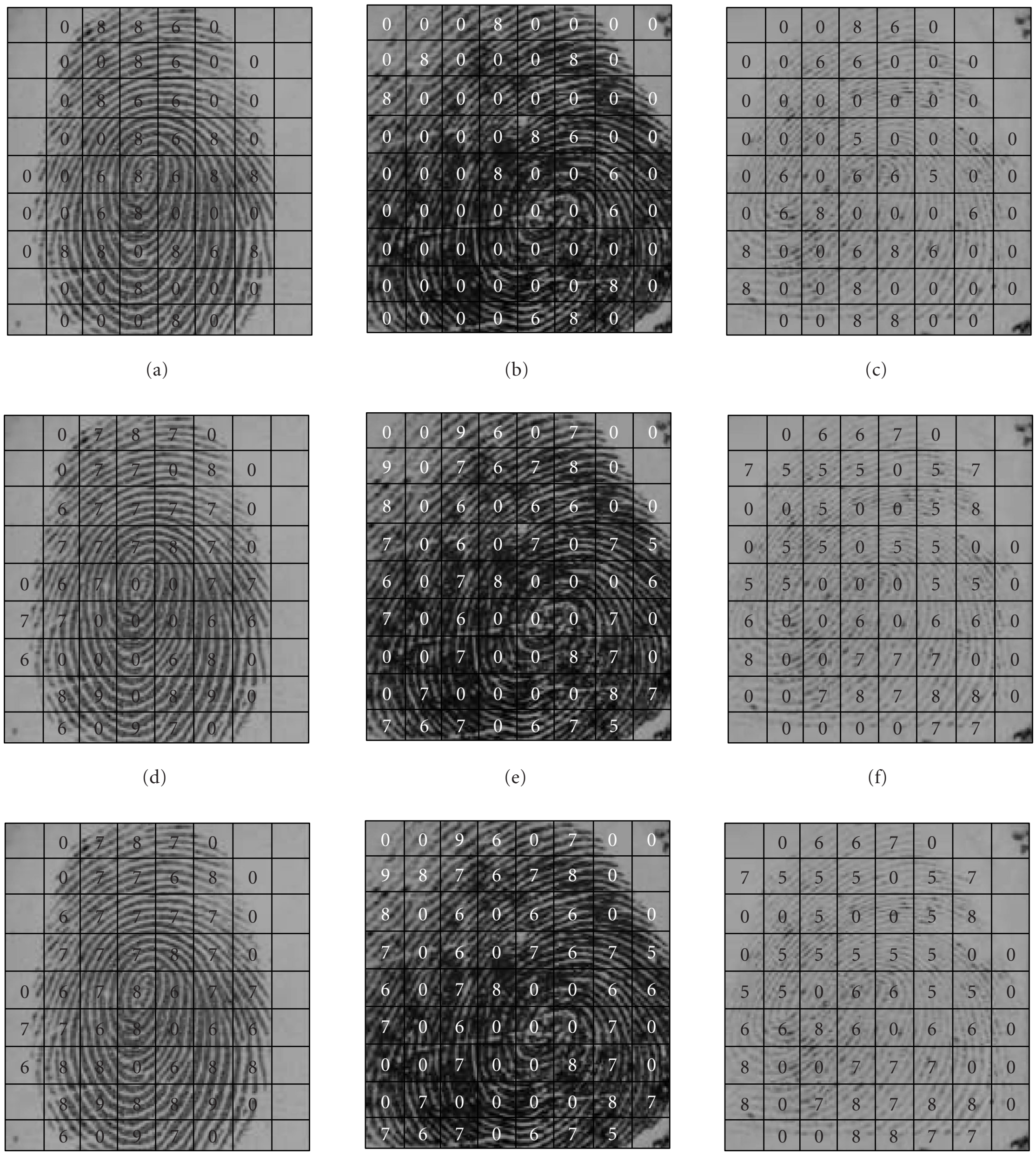

FIGURE 6: Results of ridge distance estimation with three methods: estimation values are overlapped on images based on (a), (b), and (c) spectral analysis method; (d), (e), and (f) statistical method; (g), (h), and (i) hybrid method.

traditional spectral analysis method, the statistical method, and the hybrid method. Sizes of block images are all 32×32 and values of the ridge distance in each block image were manually measured. The evaluation is performed with a computer Pentium 2.0 G, 256 M RAM.

Experimental results

DER, EA, and TC of the three methods on 10 good-quality images, 10 fair-quality images, 10 poor-quality images, and total 30 fingerprint images are listed in Tables 1, 2, 3, and 4, respectively. Estimation results on some typical fingerprint images with the three methods are shown in Figure 6.

6. CONCLUSION AND DISCUSSION

We have applied traditional spectral analysis method for the estimation of ridge distances in fingerprint images. A new method, the statistical method, is also evaluated in this paper. For good-quality fingerprint images, there is no dramatic difference in performance between the spectral analysis method

Table 1: Performance of the three methods on 10 good-quality images.

Methods	DER	EA	TC
Spectral analysis method	75.2%	92%	0.42 s
Statistical method	74.6%	97%	0.31 s
Hybrid method	95.5%	95%	0.32 s

Table 2: Performance of the three methods on 10 fair-quality images.

Methods	DER	EA	TC
Spectral analysis method	38.2%	83%	0.42 s
Statistical method	69.3%	94%	0.31 s
Hybrid method	88.1%	91%	0.33 s

Table 3: Performance of the three methods on 10 poor-quality images.

Methods	DER	EA	TC
Spectral analysis method	20.7%	77%	0.42 s
Statistical method	47.5%	88%	0.31 s
Hybrid method	58.2%	87%	0.37 s

Table 4: Performance of the three methods on total of 30 fingerprint images.

Methods	DER	EA	TC
Spectral analysis method	44.7%	84%	0.42 s
Statistical method	63.8%	93%	0.31 s
Hybrid method	80.6%	91%	0.34 s

and the statistical method (Table 1). For fair and poor-quality fingerprint images, however, performance of the statistical method is superior to that of the spectral analysis method (Tables 2 and 3). The statistical method is in addition more efficient. The statistical method shows better average performance on the total 30 images (Table 4). The obvious disadvantage of the statistical method is that it performs poorly in regions where there is acute variation of ridge directions.

Based on analysis and comparison of the performance of the two methods, a hybrid method is developed in this paper. In this method, the statistical method is used as the primary method for regions where ridge direction varies gently; the spectral analysis method is used as a supplement. The advantages of the statistical method and the spectral analysis method are thereby combined. Experimental results show that the hybrid method performs better than either single method, especially in achieving high overall DER (Table 4).

The key weakness of the spectral analysis method is how to determine r' accurately and reliably. If this problem can be solved, the performance of the spectral analysis method will be significantly improved. Statistical method depends heavily on reliable determination of ridge direction, especially when the fingerprint image quality is poor.

Window methods, which estimate ridge distance within block images, have intrinsic limitations. For example, the size of block images is a compromise between two factors: big windows may contain ridges with high curvature, causing difficulty in the estimation of distances; if small windows are used, there are too few ridges within a window to estimate the ridge distances. Our future research will focus on a region-based method that divides a fingerprint image into several regions in which ridge directions are approximately the same and ridge distances are estimated at the regional level.

REFERENCES

[1] Y. L. Yin, X. B. Ning, and X. M. Zhang, "Development and application of automatic fingerprint identification technology," *J. Nanjing Univ. Natur. Sci.*, vol. 38, no. 1, pp. 29–35, 2002.

[2] L. Hong, A. Jain, S. Pankanti, and R. Bolle, "Identity authentication using fingerprints," in *Proc. 1st International Conference on Audio- and Video-Based Biometric Person Authentication*, pp. 103–110, Switzerland, March 1997.

[3] L. O'Gorman and J. V. Nickerson, "An approach to fingerprint filter design," *Pattern Recognition*, vol. 22, no. 1, pp. 29–38, 1989.

[4] W.-C. Lin and R. C. Dubes, "A review of ridge counting in dermatoglyphics," *Pattern Recognition*, vol. 16, no. 1, pp. 1–8, 1983.

[5] D. C. Douglas Hung, "Enhancement and feature purification of fingerprint images," *Pattern Recognition*, vol. 26, no. 11, pp. 1661–1671, 1993.

[6] L. Hong, Y. Wan, and A. K. Jain, "Fingerprint image enhancement: algorithm and performance evaluation," *IEEE Trans. on Pattern Analysis and Machine Intelligence*, vol. 20, no. 8, pp. 777–789, 1998.

[7] Zs. M. Kovacs-Vajna, R. Rovatti, and M. Frazzoni, "Fingerprint ridge distance computation methodologies," *Pattern Recognition*, vol. 33, no. 1, pp. 69–80, 2000.

[8] D. Maio and D. Maltoni, "Ridge-line density estimation in digital images," in *Proc. 14th International Conference on Pattern Recognition*, vol. 1, pp. 534–538, Brisbane, Australia, August 1998.

[9] J. Bernsen, "Dynamic thresholding of grey-level images," in *Proc. 8th International Conference on Pattern Recognition*, pp. 1251–1255, Paris, France, 1986.

Yilong Yin was born in China in 1972. He received his Ph.D. degree from Jilin University, Changchun, China, in 2000. From September 2000 to August 2002, he worked as a Postdoctor in electronic science and engineering, Nanjing University, China. Since September 2002, he has been an Associate Professor in the Department of Computer Science and Technology, Shandong University, China. His research interests are in biometrics, image processing, pattern recognition, machine learning, and so forth, and now he mainly focuses on robust fingerprint identification algorithm. He has published more than 20 research papers in academic journals and international conferences and he is a member of Special Committee on Machine Learning of China.

Jie Tian received his Ph.D. degree (with honor) in artificial intelligence from the Institute of Automation, Chinese Academy of Sciences, in 1992. During the years from 1994 to 1996, he was a postdoctoral fellow at the medical image processing group, University of Pennsylvania. Since 1997, he has been a Professor in the Institute of Automation, Chinese Academy of Sciences. His research interests are in the bioinformatics, medical image process and analysis, pattern recognition, and so forth. He has published more than 50 research papers in academic journals and international conferences. Dr. Tian is the Reviewer of Mathematical Reviews, American Mathematical Society. Furthermore, he is the Director of a special social committee of pattern recognition and machine intelligence of Chinese Society of Automation and the Founding Member of a special interest group on nonlinear dynamics (SIG/NL) under International Nonlinear Networks System (INNS).

Xiukun Yang is currently a Research Scientist at Identix Incorporated (Nasdaq: IDNX), the world's leading multi-biometric security technology company located in New Jersey, USA, where she focuses on the development and optimization of fingerprint identification algorithms. After she got her Ph.D. degree from Jilin University, Changchun, China in 1997, Dr. Xiukun Yang came to the US as a Research Associate in Michigan State University, where she conducted research on computer vision and artificial intelligence application in automated defect identification of various products, with special emphasis on the development of generic algorithms and neural networks oriented classification and pattern recognition techniques. In April 2000, she started working for August Technology Corporation, headquartered in Bloomington, Minnesota, a leading manufacturer of automated visual inspection solutions for the vast microelectronics industry, where she was mainly involved in the design and implementation of advanced image processing algorithms used in semiconductor wafer macrodefect inspection software system.

EURASIP JOURNAL ON APPLIED SIGNAL PROCESSING

Special Issue on Spatial Sound and Virtual Acoustics

Call for Papers

Spatial sound reproduction has become widespread in the form of multichannel audio, particularly through home theater systems. Reproduction systems from binaural (by headphones) to hundreds of loudspeaker channels (such as wave field synthesis) are entering practical use. The application potential of spatial sound is much wider than multichannel sound, however, and research in the field is active. Spatial sound covers for example the capturing, analysis, coding, synthesis, reproduction, and perception of spatial aspects in audio and acoustics.

In addition to the topics mentioned above, research in virtual acoustics broadens the field. Virtual acoustics includes techniques and methods to create realistic percepts of sound sources and acoustic environments that do not exist naturally but are rendered by advanced reproduction systems using loudspeakers or headphones. Augmented acoustic and audio environments contain both real and virtual acoustic components.

Spatial sound and virtual acoustics are among the major research and application areas in audio signal processing. Topics of active study range from new basic research ideas to improvement of existing applications. Understanding of spatial sound perception by humans is also an important area, in fact a prerequisite to advanced forms of spatial sound and virtual acoustics technology.

This special issue will focus on recent developments in this key research area. Topics of interest include (but are not limited to):

- Multichannel reproduction
- Wave field synthesis
- Binaural reproduction
- Format conversion and enhancement of spatial sound
- Spatial sound recording
- Analysis, synthesis, and coding of spatial sound
- Spatial sound perception and auditory modeling
- Simulation and modeling of room acoustics
- Auralization techniques
- Beamforming and sound source localization
- Acoustic and auditory scene analysis
- Augmented reality audio
- Virtual acoustics (sound environments and sources)
- Intelligent audio environments
- Loudspeaker-room interaction and equalization
- Applications

Authors should follow the EURASIP JASP manuscript format described at http://www.hindawi.com/journals/asp/. Prospective authors should submit an electronic copy of their complete manuscript through the EURASIP JASP manuscript tracking system at http://www.mstracking.com/asp/, according to the following timetable:

Manuscript Due	May 1, 2006
Acceptance Notification	September 1, 2006
Final Manuscript Due	December 1, 2006
Publication Date	1st Quarter, 2007

GUEST EDITORS:

Ville Pulkki, Helsinki University of Technology, Espoo, Finland; ville@acoustics.hut.fi

Christof Faller, EPFL, Lausanne, Switzerland; christof.faller@epfl.ch

Aki Harma, Philips Research Labs, Eindhoven, The Netherlands; aki.harma@philips.com

Tapio Lokki, Helsinki University of Technology, Espoo, Finland; ktlokki@cc.hut.fi

Werner de Bruijn, Philips Research Labs, Eindhoven, The Netherlands; werner.de.bruijn@philips.com

EURASIP JOURNAL ON APPLIED SIGNAL PROCESSING

Special Issue on

Advances in Electrocardiogram Signal Processing and Analysis

Call for Papers

Since its invention in the 19th century when it was little more than a scientific curiosity, the electrocardiogram (ECG) has developed into one of the most important and widely used quantitative diagnostic tools in medicine. It is essential for the identification of disorders of the cardiac rhythm, extremely useful for the diagnosis and management of heart abnormalities such as myocardial infarction (heart attack), and offers helpful clues to the presence of generalised disorders that affect the rest of the body, such as electrolyte disturbances and drug intoxication.

Recording and analysis of the ECG now involves a considerable amount of signal processing for S/N enhancement, beat detection, automated classification, and compression. These involve a whole variety of innovative signal processing methods, including adaptive techniques, time-frequency and time-scale procedures, artificial neural networks and fuzzy logic, higher-order statistics and nonlinear schemes, fractals, hierarchical trees, Bayesian approaches, and parametric models, amongst others.

This special issue will review the current status of ECG signal processing and analysis, with particular regard to recent innovations. It will report major achievements of academic and commercial research institutions and individuals, and provide an insight into future developments within this exciting and challenging area.

This special issue will focus on recent developments in this key research area. Topics of interest include (but are not limited to):

- Beat (QRS complex) detection
- ECG compression
- Denoising of ECG signals
- Morphological studies and classification
- ECG modeling techniques
- Expert systems and automated diagnosis
- QT interval measurement and heart-rate variability
- Arrhythmia and ischemia detection and analysis
- Interaction between cardiovascular signals (ECG, blood pressure, respiration, etc.)
- Intracardiac ECG analysis (implantable cardiovascular devices, and pacemakers)
- ECGs and sleep apnoea
- Real-time processing and instrumentation
- ECG telemedicine and e-medicine
- Fetal ECG detection and analysis
- Computational tools and databases for ECG education and research

Authors should follow the EURASIP JASP manuscript format described at http://www.hindawi.com/journals/asp/. Prospective authors should submit an electronic copy of their complete manuscripts through the EURASIP JASP manuscript tracking system at http://www.mstracking.com/asp/, according to the following timetable:

Manuscript Due	May 1, 2006
Acceptance Notification	September 1, 2006
Final Manuscript Due	December 1, 2006
Publication Date	1st Quarter, 2007

GUEST EDITORS:

William Sandham, Scotsig, Glasgow G12 9pf, UK; w.sandham@scotsig.co.uk

David Hamilton, Department of Electronic and Electrical Engineering, University of Strathclyde, Glasgow G1 1XW, UK; d.hamilton@eee.strath.ac.uk

Pablo Laguna Lasaosa, Departmento de Ingeniería Electrónica y Communicaciones, Universidad de Zaragoza, 50015 Zaragoza, Spain; laguna@unizar.es

Maurice Cohen, University of California, San Francisco, USA; mcohen@fresno.ucsf.edu

Special Issue on

Emerging Signal Processing Techniques for Power Quality Applications

Call for Papers

Recently, end users and utility companies are increasingly concerned with perturbations originated from electrical power quality variations. Investigations are being carried out to completely characterize not only the old traditional type of problems, but also new ones that have arisen as a result of massive use of nonlinear loads and electronics-based equipment in residences, commercial centers, and industrial plants. These nonlinear load effects are aggravated by massive power system interconnections, increasing number of different power sources, and climatic changes.

In order to improve the capability of equipments applied to monitoring the power quality of transmission and distribution power lines, power systems have been facing new analysis and synthesis paradigms, mostly supported by signal processing techniques. The analysis and synthesis of emerging power quality and power system problems led to new research frontiers for the signal processing community, focused on the development and combination of computational intelligence, source coding, pattern recognition, multirate systems, statistical estimation, adaptive signal processing, and other digital processing techniques, implemented in either DSP-based, PC-based, or FPGA-based solutions.

The goal of this proposal is to introduce powerful and efficient real-time or almost-real-time signal processing tools for dealing with the emerging power quality problems. These techniques take into account power-line signals and complementary information, such as climatic changes.

This special issue will focus on recent developments in this key research area. Topics of interest include (but are not limited to):

- Detection of transients
- Classification of multiple events
- Identification of isolated and multiple disturbance sources
- Compression of voltage and current data signals
- Location of disturbance sources
- Prediction of transmission and distribution systems failures
- Demand forecasting
- Parameters estimation for fundamental, harmonics, and interharmonics

Digital signal processing techniques applied to power quality applications are a very attractive and stimulating area of research. Its results will provide, in the near future, new standards for the decentralized and real-time monitoring of transmission and distribution systems, allowing to closely follow and predict power system performance. As a result, the power systems will be more easily planned, expanded, controlled, managed, and supervised.

Authors should follow the EURASIP JASP manuscript format described at http://www.hindawi.com/journals/asp/. Prospective authors should submit an electronic copy of their complete manuscripts through the EURASIP JASP manuscript tracking system at http://www.mstracking.com/asp/, according to the following timetable:

Manuscript Due	May 1, 2006
Acceptance Notification	September 1, 2006
Final Manuscript Due	December 1, 2006
Publication Date	2nd Quarter, 2007

GUEST EDITORS:

Moisés Vidal Ribeiro, Department of Electrical Circuit, Federal University of Juiz de Fora, CEP 36036-330, Juiz de Fora, Brazil; mribeiro@ieee.org

Jacques Szczupack, Department of Electrical Engineering, Pontifical Catholic University of Rio de Janeiro, CEP 22453-900, Rio de Janeiro, Brazil; jacques@ele.puc-rio.br

M. Reza Iravani, The Edward S. Rogers SR., Department of Electrical and Computer Engineering, University of Toronto, Toronto, ON, Canada M5S 3G4; iravani@ecf.utoronto.ca

Irene Yu-Hua Gu, Department of Signals and Systems, Chalmers University of Technology, SE-412 96, Gothenburg, Sweden; irenegu@s2.chalmers.se

Pradipta Kishore Dash, C. V. Raman, College of Engineering Bhubaneswar, Khurda-752054, Orissa, India; pkdash_india@yahoo.com

Alexander Mamishev, Department of Electrical Engineering, University of Washington, WA 98195-2500, Seattle, USA; mamishev@ee.washington.edu

Hindawi Publishing Corporation
http://www.hindawi.com

EURASIP JOURNAL ON APPLIED SIGNAL PROCESSING

Special Issue on Super-resolution Enhancement of Digital Video

Call for Papers

When designing a system for image acquisition, there is generally a desire for high spatial resolution and a wide field-of-view. To achieve this, a camera system must typically employ small f-number optics. This produces an image with very high spatial-frequency bandwidth at the focal plane. To avoid aliasing caused by undersampling, the corresponding focal plane array (FPA) must be sufficiently dense. However, cost and fabrication complexities may make this impractical. More fundamentally, smaller detectors capture fewer photons, which can lead to potentially severe noise levels in the acquired imagery. Considering these factors, one may choose to accept a certain level of undersampling or to sacrifice some optical resolution and/or field-of-view.

In image super-resolution (SR), postprocessing is used to obtain images with resolutions that go beyond the conventional limits of the uncompensated imaging system. In some systems, the primary limiting factor is the optical resolution of the image in the focal plane as defined by the cut-off frequency of the optics. We use the term "optical SR" to refer to SR methods that aim to create an image with valid spatial-frequency content that goes beyond the cut-off frequency of the optics. Such techniques typically must rely on extensive a priori information. In other image acquisition systems, the limiting factor may be the density of the FPA, subsequent postprocessing requirements, or transmission bitrate constraints that require data compression. We refer to the process of overcoming the limitations of the FPA in order to obtain the full resolution afforded by the selected optics as "detector SR." Note that some methods may seek to perform both optical and detector SR.

Detector SR algorithms generally process a set of low-resolution aliased frames from a video sequence to produce a high-resolution frame. When subpixel relative motion is present between the objects in the scene and the detector array, a unique set of scene samples are acquired for each frame. This provides the mechanism for effectively increasing the spatial sampling rate of the imaging system without reducing the physical size of the detectors.

With increasing interest in surveillance and the proliferation of digital imaging and video, SR has become a rapidly growing field. Recent advances in SR include innovative algorithms, generalized methods, real-time implementations, and novel applications. The purpose of this special issue is to present leading research and development in the area of super-resolution for digital video. Topics of interest for this special issue include but are not limited to:

- Detector and optical SR algorithms for video
- Real-time or near-real-time SR implementations
- Innovative color SR processing
- Novel SR applications such as improved object detection, recognition, and tracking
- Super-resolution from compressed video
- Subpixel image registration and optical flow

Authors should follow the EURASIP JASP manuscript format described at http://www.hindawi.com/journals/asp/. Prospective authors should submit an electronic copy of their complete manuscript through the EURASIP JASP manuscript tracking system at http://www.mstracking.com/asp/, according to the following timetable:

Manuscript Due	September 1, 2006
Acceptance Notification	February 1, 2007
Final Manuscript Due	April 15, 2007
Publication Date	3rd Quarter, 2007

GUEST EDITORS:

Russell C. Hardie, Department of Electrical and Computer Engineering, University of Dayton, 300 College Park, Dayton, OH 45469-0026, USA; rhardie@udayton.edu

Richard R. Schultz, Department of Electrical Engineering, University of North Dakota, Upson II Room 160, P.O. Box 7165, Grand Forks, ND 58202-7165, USA; RichardSchultz@mail.und.nodak.edu

Kenneth E. Barner, Department of Electrical and Computer Engineering, University of Delaware, 140 Evans Hall, Newark, DE 19716-3130, USA; barner@ee.udel.edu

EURASIP JOURNAL ON APPLIED SIGNAL PROCESSING

Special Issue on

Advanced Signal Processing and Computational Intelligence Techniques for Power Line Communications

Call for Papers

In recent years, increased demand for fast Internet access and new multimedia services, the development of new and feasible signal processing techniques associated with faster and low-cost digital signal processors, as well as the deregulation of the telecommunications market have placed major emphasis on the value of investigating hostile media, such as powerline (PL) channels for high-rate data transmissions.

Nowadays, some companies are offering powerline communications (PLC) modems with mean and peak bit-rates around 100 Mbps and 200 Mbps, respectively. However, advanced broadband powerline communications (BPLC) modems will surpass this performance. For accomplishing it, some special schemes or solutions for coping with the following issues should be addressed: (i) considerable differences between powerline network topologies; (ii) hostile properties of PL channels, such as attenuation proportional to high frequencies and long distances, high-power impulse noise occurrences, time-varying behavior, and strong inter-symbol interference (ISI) effects; (iv) electromagnetic compatibility with other well-established communication systems working in the same spectrum, (v) climatic conditions in different parts of the world; (vii) reliability and QoS guarantee for video and voice transmissions; and (vi) different demands and needs from developed, developing, and poor countries.

These issues can lead to exciting research frontiers with very promising results if signal processing, digital communication, and computational intelligence techniques are effectively and efficiently combined.

The goal of this special issue is to introduce signal processing, digital communication, and computational intelligence tools either individually or in combined form for advancing reliable and powerful future generations of powerline communication solutions that can be suited with for applications in developed, developing, and poor countries.

Topics of interest include (but are not limited to)

- Multicarrier, spread spectrum, and single carrier techniques
- Channel modeling
- Channel coding and equalization techniques
- Multiuser detection and multiple access techniques
- Synchronization techniques
- Impulse noise cancellation techniques
- FPGA, ASIC, and DSP implementation issues of PLC modems
- Error resilience, error concealment, and Joint source-channel design methods for video transmission through PL channels

Authors should follow the EURASIP JASP manuscript format described at the journal site http://asp.hindawi.com/. Prospective authors should submit an electronic copy of their complete manuscripts through the EURASIP JASP manuscript tracking system at http://www.mstracking.com/asp/, according to the following timetable:

Manuscript Due	October 1, 2006
Acceptance Notification	January 1, 2007
Final Manuscript Due	April 1, 2007
Publication Date	3rd Quarter, 2007

GUEST EDITORS:

Moisés Vidal Ribeiro, Federal University of Juiz de Fora, Brazil; mribeiro@ieee.org

Lutz Lampe, University of British Columbia, Canada; lampe@ece.ubc.ca

Sanjit K. Mitra, University of California, Santa Barbara, USA; mitra@ece.ucsb.edu

Klaus Dostert, University of Karlsruhe, Germany; klaus.dostert@etec.uni-karlsruhe.de

Halid Hrasnica, Dresden University of Technology, Germany hrasnica@ifn.et.tu-dresden.de

Special Issue on Video Adaptation for Heterogeneous Environments

Call for Papers

The explosive growth of compressed video streams and repositories accessible worldwide, the recent addition of new video-related standards such as H.264/AVC, MPEG-7, and MPEG-21, and the ever-increasing prevalence of heterogeneous, video-enabled terminals such as computer, TV, mobile phones, and personal digital assistants have escalated the need for efficient and effective techniques for adapting compressed videos to better suit the different capabilities, constraints, and requirements of various transmission networks, applications, and end users. For instance, Universal Multimedia Access (UMA) advocates the provision and adaptation of the same multimedia content for different networks, terminals, and user preferences.

Video adaptation is an emerging field that offers a rich body of knowledge and techniques for handling the huge variation of resource constraints (e.g., bandwidth, display capability, processing speed, and power consumption) and the large diversity of user tasks in pervasive media applications. Considerable amounts of research and development activities in industry and academia have been devoted to answering the many challenges in making better use of video content across systems and applications of various kinds.

Video adaptation may apply to individual or multiple video streams and may call for different means depending on the objectives and requirements of adaptation. Transcoding, transmoding (cross-modality transcoding), scalable content representation, content abstraction and summarization are popular means for video adaptation. In addition, video content analysis and understanding, including low-level feature analysis and high-level semantics understanding, play an important role in video adaptation as essential video content can be better preserved.

The aim of this special issue is to present state-of-the-art developments in this flourishing and important research field. Contributions in theoretical study, architecture design, performance analysis, complexity reduction, and real-world applications are all welcome.

Topics of interest include (but are not limited to):

- Heterogeneous video transcoding
- Scalable video coding
- Dynamic bitstream switching for video adaptation
- Signal, structural, and semantic-level video adaptation
- Content analysis and understanding for video adaptation
- Video summarization and abstraction
- Copyright protection for video adaptation
- Crossmedia techniques for video adaptation
- Testing, field trials, and applications of video adaptation services
- International standard activities for video adaptation

Authors should follow the EURASIP JASP manuscript format described at http://www.hindawi.com/journals/asp/. Prospective authors should submit an electronic copy of their complete manuscript through the EURASIP JASP manuscript tracking system at http://www.mstracking.com/asp/, according to the following timetable:

Manuscript Due	September 1, 2006
Acceptance Notification	January 1, 2007
Final Manuscript Due	April 1, 2007
Publication Date	3rd Quarter 2007

GUEST EDITORS:

Chia-Wen Lin, Department of Computer Science and Information Engineering, National Chung Cheng University, Chiayi 621, Taiwan; cwlin@cs.ccu.edu.tw

Yap-Peng Tan, School of Electrical and Electronic Engineering, Nanyang Technological University, Nanyang Avenue, Singapore 639798, Singapore; eyptan@ntu.edu.sg

Ming-Ting Sun, Department of Electrical Engineering, University of Washington, Seattle, WA 98195, USA ; sun@ee.washington.edu

Alex Kot, School of Electrical and Electronic Engineering, Nanyang Technological University, Nanyang Avenue, Singapore 639798, Singapore; eackot@ntu.edu.sg

Anthony Vetro, Mitsubishi Electric Research Laboratories,
201 Broadway, 8th Floor, Cambridge, MA 02138, USA;
avetro@merl.com

Special Issue on

Transforming Signal Processing Applications into Parallel Implementations

Call for Papers

There is an increasing need to develop efficient "system-level" models, methods, and tools to support designers to quickly transform signal processing application specification to heterogeneous hardware and software architectures such as arrays of DSPs, heterogeneous platforms involving microprocessors, DSPs and FPGAs, and other evolving multiprocessor SoC architectures. Typically, the design process involves aspects of application and architecture modeling as well as transformations to translate the application models to architecture models for subsequent performance analysis and design space exploration. Accurate predictions are indispensable because next generation signal processing applications, for example, audio, video, and array signal processing impose high throughput, real-time and energy constraints that can no longer be served by a single DSP.

There are a number of key issues in transforming application models into parallel implementations that are not addressed in current approaches. These are engineering the application specification, transforming application specification, or representation of the architecture specification as well as communication models such as data transfer and synchronization primitives in both models.

The purpose of this call for papers is to address approaches that include application transformations in the performance, analysis, and design space exploration efforts when taking signal processing applications to concurrent and parallel implementations. The Guest Editors are soliciting contributions in joint application and architecture space exploration that outperform the current architecture-only design space exploration methods and tools.

Topics of interest for this special issue include but are not limited to:

- modeling applications in terms of (abstract) control-dataflow graph, dataflow graph, and process network models of computation (MoC)
- transforming application models or algorithmic engineering
- transforming application MoCs to architecture MoCs
- joint application and architecture space exploration
- joint application and architecture performance analysis
- extending the concept of algorithmic engineering to architecture engineering
- design cases and applications mapped on multiprocessor, homogeneous, or heterogeneous SOCs, showing joint optimization of application and architecture

Authors should follow the EURASIP JASP manuscript format described at http://www.hindawi.com/journals/asp/. Prospective authors should submit an electronic copy of their complete manuscript through the EURASIP JASP manuscript tracking system at http://www.mstracking.com/asp/, according to the following timetable:

Manuscript Due	September 1, 2006
Acceptance Notification	January 1, 2007
Final Manuscript Due	April 1, 2007
Publication Date	3rd Quarter 2007

GUEST EDITORS:

F. Deprettre, Leiden Embedded Research Center, Leiden University, Niels Bohrweg 1, 2333 CA Leiden, The Netherlands; edd@liacs.nl

Roger Woods, School of Electrical and Electronic Engineering, Queens University of Belfast, Ashby Building, Stranmillis Road, Belfast, BT9 5AH, UK; r.woods@qub.ac.uk

Ingrid Verbauwhede, Katholieke Universiteit Leuven, ESAT-COSIC, Kasteelpark Arenberg 10, 3001 Leuven, Belgium; Ingrid.verbauwhede@esat.kuleuven.be

Erwin de Kock, Philips Research, High Tech Campus 31, 5656 AE Eindhoven, The Netherlands; erwin.de.kock@philips.com

INTERNATIONAL JOURNAL OF IMAGE AND VIDEO PROCESSING

Special Issue on Facial Image Processing

Call for Papers

Facial image processing is an area of research dedicated to the extraction and analysis of information about human faces; information which is known to play a central role in social interactions including recognition, emotion, and intention. Over the last decade, it has become a very active research field that deals with face detection and tracking, facial feature detection, face recognition, facial expression and emotion recognition, face coding, and virtual face synthesis.

With the introduction of new powerful machine learning techniques, statistical classification methods, and complex deformable models, recent progresses have made possible a large number of applications in areas such as model-based video coding, image retrieval, surveillance and biometrics, visual speech understanding, virtual characters for e-learning, online marketing or entertainment, intelligent human-computer interaction, and others.

However, lots of progress is yet to be made to provide more robust systems, especially when dealing with pose and illumination changes in complex natural scenes. If most approaches focus naturally on processing from still images, emerging techniques may also consider different inputs. For instance, video is becoming ubiquitous and very affordable, and there is growing demand for vision-based human-oriented applications, ranging from security to human-computer interaction and video annotation.

Taking into account temporal information and the dynamics of faces may also ease applications like, for instance, facial expression and face recognition which are still very challenging tasks.

Capturing 3D data may as well become very affordable and processing such data can lead to enhanced systems, more robust to illumination effects and where discriminant information may be more easily retrieved.

The goal of this special issue is to provide original contributions in the field of facial image processing.

Topics of interest include (but are not limited to):

- Face Detection and Tracking
- Facial Feature Detection and Face Normalization
- Face Verification and Recognition
- Facial Emotion Recognition and Synthesis
- 3D Reconstruction and Modelling
- Video-Driven Facial Animation
- Face Synthesis and Mimicking
- Affective Facial Animation
- 3D Analysis and Synthesis

Authors should follow the IJIVP manuscript format described at http://www.hindawi.com/journals/ijivp/. Prospective authors should submit an electronic copy of their complete manuscript through the IJIVP manuscript tracking system at http://www.mstracking.com/mts, according to the following timetable:

Manuscript Due	May 1, 2006
Acceptance Notification	August 1, 2006
Final Manuscript Due	October 1, 2006
Publication Date	4th Quarter, 2006

GUEST EDITORS:

Christophe Garcia, Image, Rich Media and Hyperlanguages Laboratory, France Telecom Division R&D, Rennes, France; christophe.garcia@francetelecom.com

Jörn Ostermann, Institut für Informationsverarbeitung, Universität Hannover, 30167 Hannover, Germany ostermann@tnt.uni-hannover.de;

Tim Cootes, Division of Imaging Science and Biomedical Engineering, University of Manchester, Manchester M13 9PL, UK Tim.Cootes@manchester.ac.uk;

Hindawi Publishing Corporation
http://www.hindawi.com

EURASIP JOURNAL ON BIOINFORMATICS AND SYSTEMS BIOLOGY

Special Issue on Genetic Regulatory Networks

Call for Papers

Genomic signal processing (GSP) has been defined as the analysis, processing, and use of genomic signals for gaining biological knowledge and the translation of that knowledge into systems-based applications. A major goal of GSP is to characterize genetic regulation and its effects on cellular behaviour and function, thereby leading to a functional understanding of diseases and the development of systems-based medical solutions. This involves the development of nonlinear dynamical network models for genomic regulation and of mathematically grounded diagnostic and therapeutic tools based on those models. This special issue is devoted to genetic regulatory networks. We desire high-quality papers on all network issues, including:

- Mathematical models
- Inference
- Steady-state analysis
- Optimal intervention
- Approximation and reduction
- Validation
- Computational complexity
- Applications

Authors should follow the EURASIP JBSB manuscript format described at http://www.hindawi.com/journals/bsb/. Prospective authors should submit an electronic copy of their complete manuscript through the EURASIP JBSB's manuscript tracking system at http://www.mstracking.com/mts, according to the following timetable.

Manuscript Due	July 1, 2006
Acceptance Notification	October 1, 2006
Final Manuscript Due	November 1, 2006
Publication Date	1st Quarter, 2007

GUEST EDITORS:

Edward R. Dougherty, Department of Electrical & Computer Engineering, College of Engineering, Texas A&M University, College Station, TX 77843-3128, USA; Translation Genomics Research Institute, Phoenix, AZ 85004, USA; edward@ece.tamu.edu

Tatsuya Akutsu, Bioinformatics Center, Institute for Chemical Research, Kyoto University, Gokasho, Uji, Kyoto 611-0011, Japan; takutsu@kuicr.kyoto-u.ac.jp

Paul Cristea, Digital Signal Processing Laboratory, Department of Electrical Engineering, "Politechnica" University Of Bucharest, 060032 Bucharest, Romania; pcristea@dsp.pub.ro

Ahmed Tewfik, Department of Electrical and Computer Engineering, Institute of Technology, University of Minnesota, Minneapolis, MN 55455, USA; tewfik@umn.edu

Hindawi Publishing Corporation
http://www.hindawi.com

Special Issue on

Adaptive Partial-Update and Sparse System Identification

Call for Papers

This special issue aims to draw together work on sparse system identification and partial-update adaptive filters. These research problems can be considered as exploiting sparseness in different "domains", namely, adaptive filter coefficient vector and update regressor vector. This special issue will further develop the positive outcomes of the EUSIPCO 2005 special session on sparse system identification and partial-update adaptive algorithms.

Identification of sparse and/or high-order FIR systems has always been a challenging research problem. In many applications, including acoustic/network echo cancellation and channel equalization, the system to be identified can be characterized as sparse and/or long. Partial-update adaptive filtering algorithms were proposed to address the large computational complexity associated with long adaptive filters. However, the initial partial-update algorithms had to incur performance losses, such as slow convergence, compared with full-update algorithms because of the absence of clever updating approaches. More recently, better partial-update techniques have been developed that are capable of minimizing the performance loss. In certain applications, these partial-update techniques have even been observed to produce improved convergence performance with respect to a full-update algorithm. The potential performance gain that can be achieved by partial-update algorithms is an important feature of these adaptive techniques that was not recognized earlier. The notion of partial-update adaptive filtering has been gaining momentum thanks to the recognition of its complexity and performance advantages.

Sparse system identification is a vital requirement for fast converging adaptive filters in, for example, certain specific deployments of echo cancellation. Recent advances, such as IPNLMS, have been used to good effect in network echo cancellation for VoIP gateways (to take account of unpredictable bulk delays in IP network propagation) and acoustic echo cancellation (to handle the unknown propagation delay of the direct acoustic path). It is known that several research labs are working on these problems with new solutions emerging.

This special issue will focus on recent developments in this key research area. Topics of interest include (but are not limited to):

- Adaptive filters employing partial-update methods,
- Time-domain and transform-domain implementations of partial-update adaptive filters,
- Convergence and complexity analysis of partial-update schemes,
- Single and multichannel algorithms employing partial updates,
- Adaptive algorithms for sparse system identification,
- Applications of partial-update adaptive filters and sparse system identification in echo/noise cancellation, acoustics, and telecommunications,
- Partial-update filters for sparse system identification.

Authors should follow the EURASIP JASP manuscript format described at http://www.hindawi.com/journals/asmp/. Prospective authors should submit an electronic copy of their complete manuscripts through the EURASIP JASP manuscript tracking system at http://www.mstracking.com/mts, according to the following timetable:

Manuscript Due	May 1, 2006
Acceptance Notification	September 1, 2006
Final Manuscript Due	December 1, 2006
Publication Date	1st Quarter, 2007

GUEST EDITORS:

Kutluyil Dogancay, School of Electrical and Information Engineering, University of South Australia, Mawson Lakes, South Australia 5095, Australia; kutluyil.dogancay@unisa.edu.au

Patrick A. Naylor, Department of Electrical & Electronic Engineering, Imperial College London, Exhibition Road, London SW7 2AZ, UK; p.naylor@imperial.ac.uk

INTERNATIONAL JOURNAL OF BIOMEDICAL IMAGING

Special Issue on Multimodality Imaging and Hybrid Scanners

Call for Papers

Over the past few decades, medical computed imaging has established its role as a major clinical tool. Technical advancements as well as advanced new algorithms have substantially improved spatial and temporal resolution and contrast. Nevertheless, despite these improvements single-modality scans cannot always provide the full clinical picture. Resolution and image quality are often compromised in order to obtain functional images. This is particularly true for NM imaging and has led to the development of hybrid scanners such as PET/CT and SPECT/CT. Also, the old problem of multimodality image fusion has and probably will continue to attract a lot of research. This has motivated us to edit a special issue which will provide a state-of-the-art picture of multimodality imaging.

The International Journal of Biomedical Imaging (IJBI) follows the Open Access model and publishes accepted papers on the web and in print. It targets rapid review, permanent archiving, high visibility, and lasting impact. In this special issue, the topics covered will include, but are not limited to, the following areas:

- New approaches and applications of PET/CT and SPECT/CT hybrid scanners
- Methods for image fusion of MRI and/or CT and/or Ultrasound
- Algorithms for data fusion and hybrid image reconstruction and display
- Methods for dual-modality scans alignment using fiducial markers, masks, and so forth
- Software-based multimodality image alignment
- Novel dual-modality scanning approaches
- Real-time navigation for image-guided intervention using multimodality systems

Authors should follow the IJBI manuscript format described at http://www.hindawi.com/journals/ijbi/. Prospective authors should submit an electronic copy of their complete manuscript through the IJBI manuscript tracking system at http://www.mstracking.com/mts, according to the following timetable:

Manuscript Due	May 1, 2006
Acceptance Notification	September 1, 2006
Final Manuscript Due	December 1, 2006
Publication Date	1st Quarter, 2007

GUEST EDITOR:

Haim Azhari, Department of Biomedical Engineering, Technion – Israel Institute of Technology, Haifa, 32000, Israel; haim@bm.technion.ac.il

Robert R. Edelman, Department of Radiology, Evanston Northwestern Healthcare, 2650 Ridge Ave., Evanston, IL 60201, USA; redelman@enh.org

David Townsend, Cancer Imaging and Tracer Development Program, University of Tennessee Medical Center, 1924, Alcoa Highway, Knoxville, TN 37920, USA; dtownsend@mc.utmck.edu

NEWS RELEASE

Nominations Invited for the Institute of Acoustics 2006 A B Wood Medal

The Institute of Acoustics, the UK's leading professional body for those working in acoustics, noise and vibration, is inviting nominations for its prestigious A B Wood Medal for the year 2006.

The A B Wood Medal and prize is presented to an individual, usually under the age of 35, for distinguished contributions to the application of underwater acoustics. The award is made annually, in even numbered years to a person from Europe and in odd numbered years to someone from the USA/Canada. The 2005 Medal was awarded to Dr A Thode from the USA for his innovative, interdisciplinary research in ocean and marine mammal acoustics.

Nominations should consist of the candidate's CV, clearly identifying peer reviewed publications, and a letter of endorsement from the nominator identifying the contribution the candidate has made to underwater acoustics. In addition, there should be a further reference from a person involved in underwater acoustics and not closely associated with the candidate. Nominees should be citizens of a European Union country for the 2006 Medal. Nominations should be marked confidential and addressed to the President of the Institute of Acoustics at 77A St Peter's Street, St. Albans, Herts, AL1 3BN. The deadline for receipt of nominations is **15 October 2005**.

Dr Tony Jones, President of the Institute of Acoustics, comments, "A B Wood was a modest man who took delight in helping his younger colleagues. It is therefore appropriate that this prestigious award should be designed to recognise the contributions of young acousticians."

Further information and an nomination form can be found on the Institute's website at www.ioa.org.uk.

A B Wood

Albert Beaumont Wood was born in Yorkshire in 1890 and graduated from Manchester University in 1912. He became one of the first two research scientists at the Admiralty to work on antisubmarine defence. He designed the first directional hydrophone and was well known for the many contributions he made to the science of underwater acoustics and for the help he gave to younger colleagues. The medal was instituted after his death by his many friends on both sides of the Atlantic and was administered by the Institute of Physics until the formation of the Institute of Acoustics in 1974.

PRESS CONTACT

Judy Edrich
Publicity & Information Manager, Institute of Acoustics
Tel: 01727 848195; E-mail: judy.edrich@ioa.org.uk

EDITORS NOTES

The Institute of Acoustics is the UK's professional body for those working in acoustics, noise and vibration. It was formed in 1974 from the amalgamation of the Acoustics Group of the Institute of Physics and the British Acoustical Society (a daughter society of the Institution of Mechanical Engineers). The Institute of Acoustics is a nominated body of the Engineering Council, offering registration at Chartered and Incorporated Engineer levels.

The Institute has some 2500 members from a rich diversity of backgrounds, with engineers, scientists, educators, lawyers, occupational hygienists, architects and environmental health officers among their number. This multidisciplinary culture provides a productive environment for cross-fertilisation of ideas and initiatives. The range of interests of members within the world of acoustics is equally wide, embracing such aspects as aerodynamics, architectural acoustics, building acoustics, electroacoustics, engineering dynamics, noise and vibration, hearing, speech, underwater acoustics, together with a variety of environmental aspects. The lively nature of the Institute is demonstrated by the breadth of its learned society programmes.

For more information please visit our site at www.ioa.org.uk.