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Abstract Index

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Comparison of Wavelet Family Performances in ECG Signal Denoising

Perbandingan Unjuk Kerja Transformasi Wavelet dalam Denoising Sinyal ECG

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The heart is considered the most important organ of our body that controls the circulation of blood throughout the body. Measured heartbeat signals can be further analyzed in order to know the health condition of a person. The challenge of ECG signal measurement and analysis is how to remove the noises imposed on the signal that is interfered from many different sources, such as internal noise in sensor devices, power line interference, muscle activity, and body movements. This paper implemented wavelet transform to reduce the noise imposed on the ECG signal to get a closely actual heart signal. ECG data used in this research are three digitized recorded ECG data obtained from MIT-BIH Arrhythmia Database. The first step is generating the noisy ECG signal as the input system by adding 1W WGN signal into the original ECG signal. Then DWT is applied to extract the noisy ECG signal. Some DWT's parameters, threshold selection (rule, type, rescaling), decomposition level, and desired wavelet family are varied to get the best denoised output signal. All results are recorded to be compared. Based on the results, the best DWT parameter for ECG signal denoising is obtained by Symlet wavelet when the decomposition level is set to 3, with soft thresholding, in rigrsure

Keywords : denoising, ECG, signal, wavelet.

Organ jantung adalah bagian dari tubuh yang memiliki peran penting yang berfungsi untuk mengendalikan peredaran darah keseluruh tubuh. Pengamatan terhadap cara kerjanya adalah bidang studi yang sangat menarik untuk dipelajari sejak bertahun-tahun yang lalu. Seiring perkembangan

teknologi, pola sinyal detak jantung dapat diukur dan dianalisis lebih lanjut untuk mengetahui kondisi kesehatan seseorang. Adapun tantangan yang ditemui dalam pengukuran dan analisis sinyal EKG adalah bagaimana menghilangkan atau meminimalkan derau yang mengganggu sinyal EKG yang berasal dari berbagai sumber, seperti; derau internal perangkat sensor, interferensi pada jalur listrik, aktivitas otot, dan derau akibat gerakan tubuh/organ lainnya. Makalah ini menerapkan transformasi wavelet untuk mengurangi derau yang mengganggu sinyal EKG untuk mendapatkan sinyal detak jantung yang akurat sesuai dengan kondisi sebenarnya. Data EKG yang digunakan dalam penelitian ini sebanyak tiga data EKG yang telah direkam secara digital yang terdapat di database Aritmia MIT-BIH. Metodologi yang dilakukan pertama kali adalah menerapkan derau pada sinyal EKG sebagai input system dengan cara menambahkan sinyal derau WGN dengan power 1W ke sinyal EKG asli. Kemudian DWT diterapkan untuk mengekstrak sinyal EKG yang telah dikenai derau. Kemudian melakukan seting pada beberapa parameter DWT, seperti misalnya; pemilihan threshold (rule, type, rescaling), tingkat dekomposisi, dan jenis wavelet, untuk mendapatkan sinyal keluaran berupa sinyal denoised dari EKG yang paling akurat. Langkah terakhir adalah membandingkan semua hasil berdasarkan perubahan parameter-parameter DWT terhadap seluruh data input. Hasil terbaik dari proses denoising sinyal EKG menggunakan DWT diperoleh dari penggunaan wavelet Symlet, decomposition level sebesar 3, soft thresholding, pada rule thresholding rigrsure.

Kata kunci : denoising, EKG, sinyal, wavelet

Dwi Astharini , Ary Mayola, Octarina Nur Samijayani, Ary Syahriar (Fakultas Sains dan Teknologi, Universitas Al Azhar Indonesia)

Analisa Kinerja Teknik Modulasi Digital pada Kanal Optik Nirkabel

Performance Analysis of Digital Modulation Techniques on Wireless Optical Channel

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Transmisi optik nirkabel dengan kecepatan tinggi memiliki berbagai potensi untuk aplikasi jarak pendek terutama untuk komunikasi di dalam ruangan. Tulisan ini memaparkan perbandingan kinerja transmisi FSO menggunakan beberapa variasi skema modulasi. Pengamatan unjuk kinerja terutama dilakukan menggunakan bit error rate (BER). Gangguan turbulensi atmosferik menjadi bagian dari pemodelan kanal log normal yang digunakan dalam simulasi. Modulasi dasar spasial yang digunakan adalah on-off keying sebagai teknik klasik FSO, beserta pulse position modulation yang merupakan variasi spasialnya. Menelaah penggunaan modulasi baseband untuk sistem optik, disimulasikan PSK 2, 4, 8, 16, serta QAM 4 dan 16. Simulasi dengan data ukuran kecil menghasilkan bahwa BPSK dan 4 QAM menunjukkan unjuk kerja terbaik dengan BER rata-rata sekitar 10^{-3} pada kondisi gangguan sedang sampai tinggi. Sementara tingkat error pada OOK dan PPM masih di atas $10^{-0.5}$.

Kata kunci: FSO, OOK, PPM, PSK, QAM

Free space optical transmission with its data speed has many potential in close range especially indoor communication. This paper compared the performance of FSO transmission on a number of modulation schemes. The observations are mainly made by comparing the bit error rate result for each scheme. Atmospheric turbulence and noise are introduced to the transmission channel in the form of log normal model on simulation. The basic modulations simulated are on-off keying as the classical technique for FSO, and its spatial variation, the pulse position modulation. Exploring the baseband modulations for optic application, also implemented are the PSK of 2, 4, 8, 16, and QAM of 4 and 16. Simulation with short data-length resulted that BPSK dan 4-QAM gave best performance among all, with average BER of 10^{-3} in medium to high turbulence condition. While the error level of OOK and PPM are $10^{-0.5}$ at best.

Keywords: FSO, OOK, PPM, PSK, QAM

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Fabrication of Hybrid Polymer Solar Cells By Inverted Structure Based on P3HT:PCBM Active Layer

Pembuatan Sel Surya Polimer Hibrida dengan Susunan Terbalik Berbasis Lapisan Aktif P3HT:PCBM

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Hybrid polymer solar cell has privilege than its conventional structure. In humid environment, conventional polymer solar cell which usually has structure of (ITO/PEDOT:PSS/Active Layer/Al), the PEDOT:PSS will absorb water and hence can easily etch the ITO. Therefore it is necessary to use an alternative method to avoid this drawback to obtain more stable polymer solar cells, namely by using hybrid polymer solar cells structure with an inverted device architecture from the conventional, by reversing the nature of charge collection. In this paper we report the results of the fabrication of inverted bulk heterojunction polymer solar cells based on P3HT:PCBM as active layer, utilizing ZnO interlayer as buffer layer between the ITO and active layer with a stacked structure of ITO/ZnO/P3HT:PCBM/PEDOT:PSS/Ag. The ZnO interlayer is formed through short route, i.e. by dissolving ZnO nanoparticles powder in chloroform-methanol solvent blend rather than by sol-gel process. Based on the measurement results on electrical characteristics of inverted polymer solar cells under 500W/m² illumination and AM 1.5 direct filter at room temperature, cell with annealing process of active layer at 110 °C for 10 minutes results in higher cell performance than without annealing, with an open-circuit voltage of 0.21 volt, a short-circuit current density of 1.33 mA/cm², a fill factor of 43.1%, and a power conversion efficiency of 0.222%. The low cell's performance is caused by very rough surface of ZnO interlayer.

Keywords : inverted polymer solar cells; P3HT; PCBM; PEDOT:PSS; ZnO interlayer

Sel surya polimer hibrida mempunyai keistimewaan jika dibandingkan dengan sel surya polimer konvensional. Sel surya polimer konvensional biasanya mempunyai struktur ITO/PEDOT:PSS/Lapisan Aktif/Al. Pada lingkungan yang lembab, PEDOT: PSS akan menyerap air yang selanjutnya akan mengetsa lapisan ITO. Oleh karena itu diperlukan metode lain untuk mengatasi hal ini sehingga didapatkan sel surya polimer yang lebih stabil, yakni dengan menggunakan arsitektur divais terbalik dari sel surya polimer konvensional, yaitu dengan

membalik sifat pengumpulan muatannya. Tulisan ini melaporkan hasil penelitian mengenai pembuatan sel surya polimer bulk heterojunction inversi berbasis P3HT: PCBM sebagai lapisan aktif, menggunakan interlayer ZnO sebagai lapisan penyangga antara ITO dan lapisan aktif dengan susunan bertumpuk ITO/ZnO/P3HT: PCBM/PEDOT: PSS/Ag. Interlayer ZnO dibuat melalui rute yang singkat, yakni dengan melarutkan serbuk partikel nano ZnO ke dalam campuran pelarut metanol-kloroform, selain dengan cara proses sol-gel. Berdasarkan hasil pengukuran karakteristik listrik dari sel surya polimer inversi di bawah penyinaran 500 W/m² dan filter AM 1.5 direct pada suhu ruangan, sel dengan proses anil lapisan aktif pada 110 °C selama 10 menit menghasilkan kinerja sel yang lebih tinggi daripada sel yang tidak dianil, dengan tegangan sirkuit terbuka sebesar 0,21 volt, densitas arus hubung singkat sebesar 1,33 mA/cm², fill factor sebesar 43,1%, dan efisiensi konversi daya sebesar 0,22%. Rendahnya kinerja sel ini disebabkan oleh permukaan interlayer ZnO yang sangat kasar.

Kata kunci: sel surya polimer susunan terbalik, P3HT, PCBM, PEDOT:PSS, antar lapis ZnO.

Budiman P.A. Rohman * and Dayat Kurniawan
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Classification of Radar Environment using Ensemble Neural Network with Variation of Hidden Neuron Number

Klasifikasi Lingkungan Radar Menggunakan Jaringan Syaraf Tiruan Ensemble dengan Variasi Jumlah Neuron Tersembunyi

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The radar system performance is mainly determined by its detection rate which is why target detection is an essential task in this system. Constant False Alarm Rate (CFAR) is a detection algorithm commonly used in radar systems. This method is divided into several approaches which have different performance in the different environments. Therefore, this paper proposes an ensemble neural network based classifier with a variation of hidden neuron number for classifying the radar environments. The result of this research will support the improvement of the performance of the target detection on the radar systems by developing such an adaptive CFAR. Multi-layer perceptron network (MLPN) with a single hidden layer is employed as the structure of base classifiers. The first step of this research is the

evaluation of the hidden neuron number giving the highest accuracy of classification and the simplicity of computation. According to the result of this step, the three best structures are selected to build an ensemble classifier. On the ensemble structure, all of those three MLPN outputs then be collected and voted for getting the majority result in order to decide the final classification. The three possible radar environments investigated are homogeneous, multiple-targets and clutter boundary. According to the simulation results, the ensemble MLPN provides a higher detection rate than the conventional single MLPNs. Moreover, in the multiple-target and clutter boundary environments, the proposed method is able to show its highest performance.

Keywords: radar environment, homogeneity, ensemble neural network, hidden neuron number, CFAR.

Deteksi target merupakan fungsi utama dari sistem radar sehingga unjuk kerja dari sebuah sistem ini ditentukan oleh tingkat akurasi deteksi targetnya. Constant False Alarm Rate (CFAR) merupakan algoritma deteksi yang umum digunakan pada sistem radar. Algoritma ini terbagi menjadi beberapa pendekatan metode komputasi yang memiliki performansi berbeda untuk lingkungan radar yang berbeda. Oleh karena itu, pada makalah ini akan diajukan sebuah struktur jaringan syaraf tiruan (JST) ensemble dengan variasi jumlah neuron tersembunyi untuk klasifikasi lingkungan radar. Hasil penelitian ini akan dapat mendukung peningkatan akurasi deteksi target radar pada semacam CFAR adaptif. Struktur dari JST basis yang digunakan adalah multi-layer perceptron network (MLPN) dengan satu lapisan tersembunyi. Tahap pertama dari metode yang diusulkan adalah melakukan evaluasi terhadap jumlah neuron tersembunyi yang paling efektif dalam tingkat akurasi dan kompleksitas komputasi. Berdasarkan tahap evaluasi ini, tiga struktur basis terbaik dipilih untuk selanjutnya membentuk struktur ensemble. Pada struktur ensemble, ketiga keluaran struktur basis dikumpulkan dan dilakukan voting untuk mendapatkan hasil mayoritas yang menentukan hasil klasifikasi final. Tiga lingkungan radar yang dikaji pada makalah ini adalah homogen, target jamak, dan perbatasan clutter. Berdasarkan hasil simulasi, hasil klasifikasi lingkungan radar dari JST ensemble lebih baik dari struktur konvensional MLPN tunggal. Selain itu, pada lingkungan target jamak dan perbatasan clutter, metode yang diajukan dapat mengklasifikasi homogenitas lingkungan radar secara hampir sempurna.

Kata kunci: lingkungan radar, homogenitas, jaringan syaraf tiruan *ensemble*, jumlah neuron tersembunyi, CFAR.

Reyhani Lian Putri , Mona Renasari, Gelar Budiman (Teknik Telekomunikasi, Fakultas Teknik Elektro, Universitas Telkom)

Removable Watermarking Sebagai Pengendalian Terhadap Cyber Crime Pada Audio Digital

Removable Watermarking As Cyber Crime Control In Digital Audio

Jurnal Elektronika dan Telekomunikasi, Agustus 2017, e-ISSN : 2527-9955, p-ISSN : 1411-8289, Vol. 17, No. 1, Hal. 25 - 29.

Perkembangan teknologi informasi yang pesat menuntut penggunaannya untuk lebih berhati-hati seiring semakin meningkatnya *cyber crime*. Banyak pihak telah mengembangkan berbagai teknik perlindungan data digital, salah satunya adalah *watermarking*. Teknologi *watermarking* berfungsi untuk memberikan identitas, melindungi, atau menandai data digital, baik audio, citra, ataupun video, yang mereka miliki. Akan tetapi, teknik tersebut masih dapat diretas oleh oknum-oknum yang tidak bertanggung jawab. Pada penelitian ini, proses *watermarking* diterapkan pada audio digital dengan menyisipkan *watermark* yang terdengar jelas oleh indera pendengaran manusia (*perceptible*) pada audio *host*. Hal ini bertujuan agar data audio dapat terlindungi dan apabila ada pihak lain yang ingin mendapatkan data audio tersebut harus memiliki “kunci” untuk menghilangkan *watermark*. Proses *removable watermarking* ini dilakukan pada data *watermark* yang sudah diketahui metode penyisipannya, agar *watermark* dapat dihilangkan sehingga kualitas audio menjadi

lebih baik. Dengan menggunakan metode ini diperoleh kinerja *audio watermarking* pada nilai distorsi tertinggi dengan rata-rata nilai SNR sebesar 7,834 dB dan rata-rata nilai ODG sebesar -3,77. Kualitas audio meningkat setelah *watermark* dihilangkan, di mana rata-rata SNR menjadi sebesar 24,986 dB dan rata-rata ODG menjadi sebesar -1,064 serta nilai MOS sebesar 4,40.

Kata kunci : *removable watermarking*, audio, *audio watermarking*, perlindungan hak cipta, *perceptible*

The rapid growth of information technology requires its users to be more careful due to the increase of cyber crime. Various techniques for digital data protection have been developed, one of which is watermarking. Watermarking technology serves to provide an identity, protect by marking of digital data including image, audio, and videos. However, this technique can still be hacked by irresponsible users. In this study, watermarking process is applied to digital audio by inserting watermark audio that can be sensed by human (perceptible) to the audio host. This process is aimed to protect the audio data, so that if there are other parties who wish to get the original audio, it required a “key” to remove the watermark. Removable watermarking process which performed on the data is already known so that the watermark can be removed and the resulting audio quality will be better. The obtained audio watermarking performance at the highest distortion value with an average value of 7.834 dB SNR and the average value of -3.77 ODG. The audio quality is increased after the watermark is removed, which on average amounted to 24.986 dB SNR and an average ODG amounted to -1.064, so that MOS value is 4.40.

Keywords : *removable watermarking*, audio, *audio watermarking*, copyright protection, *perceptible*

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