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Lying between radio frequency and infrared radiation, terahertz (THz) wave encounters lots of difficulties to produce, detect, transmit, and modulate. Great efforts have been made to construct THz devices, including sources, detectors, switches, modulators, lenses, and filters. However, only moderate progresses have been made in THz generation and detection. Furthermore, the devices and techniques to control and manipulate THz waves are still in its infancy. Therefore, it is still a challenge to date to develop sophisticated THz application systems such as communication, sensing, safety inspection, imaging and medical diagnose systems. This difficult position of THz wave is essential due to the deficiency of THz materials having a suitable THz electromagnetic response, as compared to its neighboring microwave and infrared regime. Practicable material will largely push the THz technology to real-world applications. The GaAs/Al$_x$Ga$_{1-x}$As material system, for example, is the heart of THz quantum cascade lasers. High quality NbN films, again, set the basis of THz hot electron bolometer.

In this special section, we show how materials are fabricated and designed for THz devices. These devices include a THz emitter based on nitrogen-doped n-type 6H-SiC, and a THz switch fabricated with high-speed phase-transition material.

In the first paper, a powerful THz emitter that operated above room temperature in pulsed mode was developed from nitrogen doped n-type 6H-SiC. J. Kolodzey, a professor from University of Delaware, fabricated this THz emitter by predominantly doping n-type 6H-SiC wafer with high density Nitrogen donors. Due to the radiative bound excitation transitions associated with the nitrogen donor impurities, the THz output power and operating temperature were significantly improved as compared to previous reported dopant based emitters. The devices emit THz pulse at temperatures up to 333 K, which is the highest emission temperature reported for any dopant based terahertz emitter of which we are aware.

In the second paper, devices and techniques to control and manipulate THz waves were demonstrated with an interesting electron material: vanadium dioxide (VO$_2$). VO$_2$ exhibits a reversible first-order phase transition from an insulating state to a metallic state under proper external stimulation. The ultrafast nature of the phase transition along with huge changes in the electrical/dielectric properties creates several possibilities for THz modulation devices such as modulators and switches. With VO$_2$ films, an ultrafast optical switching to THz transmission was realized with a switching ratio over 80% during a wide frequency range from 0.3 THz to 2.5 THz.

As the guest editor of this issue, I would like to express my sincere thanks to the authors for their contributions to this special section. I also appreciate the assistance of the editorial staffs for their great efforts on making this special section to be pressed in time.

Qi-Ye Wen, Guest Editor
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Qi-Ye Wen received his B.S. degree from Wuhan University of Technology, Wuhan in 1998, the M.S. degree from Guangxi University, Nanning in 2001, and the Ph.D. degree from University of Electronic Science and Technology of China (UESTC), Chengdu in 2005. He is now a professor with the School of Microelectronic and Solid-state Electronics, UESTC. He has published more than 100 journal papers with an H-index of 16. One of his papers on THz absorber was selected as the ESI High Cited Paper. His research interests include electronic materials and devices for THz wave manipulation, and THz communication and imaging. He was the recipient of Sichuan Outstanding Younger Research Foundation from Sichuan Province, and the New Century Excellent Talents Program Award from the Ministry of Education of China.
High Power, Room Temperature Terahertz Emitters Based on Dopant Transitions in 6H-Silicon Carbide

James Kolodzey, Guang-Chi Xuan, Peng-Cheng Lv, Nathan Sustersic, and Xin Ma

Abstract—Electrically pumped high power terahertz (THz) emitters that operated above room temperature in a pulse mode were fabricated from nitrogen-doped n-type 6H-SiC. The emission spectra had peaks centered on 5 THz and 12 THz (20 meV and 50 meV) that were attributed to radiative transitions of excitons bound to nitrogen donor impurities. Due to the relatively deep binding energies of the nitrogen donors, above 100 meV, and the high thermal conductivity of the SiC substrates, the THz output power and operating temperature were significantly higher than previous dopant based emitters. With peak applied currents of a few amperes, and a top surface area of 1 mm², the device emitted up to 0.5 mW at liquid nitrogen temperature (77 K), and tens of microwatts up to 333 K. This result is the highest temperature of THz emission reported from impurity-based emitters.

Index Terms—Intracenter radiative transitions, semiconductor devices, silicon carbide, terahertz emitting devices, wide band gap semiconductors.

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Manipulation of Terahertz Radiation Using Vanadium Dioxide

Qi-Ye Wen

Abstract—Vanadium dioxide (VO₂) is a phase transition material which undergoes a reversible metal-insulator transition (MIT) when triggered by thermal, photo, electrical, and even stress. The huge conduction change of VO₂ renders it a promising material for terahertz (THz) manipulation. In this paper, some interesting works concerning the growth and characteristics of the VO₂ film are selectively reviewed. A switching of THz radiation by photo-driven VO₂ film is demonstrated. Experiments indicate an ultrafast optical switching to THz transmission within 8 picoseconds, and a switching ratio reaches to over 80% during a wide frequency range from 0.3 THz to 2.5 THz.

Index Terms—Active device, phase transition; terahertz (THz), vanadium dioxide.

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Guest Editorial

Special Section on Energy-Efficient Technologies

EET Editorial Committee

As global energy demands continue increasing, the constant improvement of energy efficiency has been a consensus in the world wide and received more and more attention from not only the technical but also the sociological, economic, and political sectors. Energy efficient technologies have been not only transforming the way that energy is produced, delivered, and consumed, but also changing every aspect of our life and even the future.

To encourage researchers to become even more interested and participate in this hopeful and significant area and bring together the state-of-the-art research results and industrial applications of energy-efficient technologies, we launched the Special Section on Energy-Efficient Technologies (EET) on JEST. So far, we have published three EET special sections which are focused on Energy-Efficient Design of Integrated Circuits and Systems, Energy Management for Different Power Systems, and Emerging Energy-Efficient Devices and Integration Paradigms, respectively.

In this section, by a very careful review of many highly qualified submissions, we accepted 3 papers which cover the areas of the novel energy concept for energy turnaround and control technologies for renewable energy systems.

This section begins with a review: The Crowd Energy Concept written by Prof. S. Teufel, University of Fribourg, Switzerland and Prof. B. Teufel, Dr. Teufel Consultancy Services, Switzerland, which presents the crowd energy concept for energy generation, storage, and consumption and the necessary research fields are identified. In this review, the Fukushima disaster in Japan in 2011 is mentioned. After the disaster, European politicians began to reassess the energy strategy for their countries. Currently, with the new developments of energy turnaround, the way back from the centralized architecture of our energy system to a more decentralized one is predetermined. Decentralization implies the change in the role of today’s consumers. They become energy prosumers. This is the basis for the crowd energy concept. This paper points that only with the helps from different dimensions, the crowd energy concept can be a successful and sustainable implementation.

With the increasing applications of renewable energy sources, conventional controllers may no longer be able to damp the frequency deviation brought by the renewable energy sources output and load fluctuations. The second paper, Coefficient Diagram Method Based Load Frequency Control for a Modern Power System, proposes a frequency control method for the power system with controllable or dispatchable loads. This paper shows the ability of plug-in hybrid electric vehicles, heat pumps, and batteries to contribute in the frequency control of an isolated power system. And this paper proposes a new online intelligent approach by using a coefficient diagram method (CDM) to enhance the system performance and robustness against uncertainties. The performance of the proposed intelligent CDM control has been compared with the proportional-integral controller and the superiority of the proposed scheme has been verified in Matlab/Simulink programs.

The third paper, Solar Energy System with Digital Controller for Grid Connected Systems, presents the implementation of an automatic digital controller of a DC-DC boost converter without batteries for a solar cell module by using a PIC microcontroller. The proposed scheme can track the maximum power operating point to adjust the photovoltaic operating voltage close to the maximum under changing atmospheric conditions. The proposed controller is verified by the simulated results by using Proteus 8 and hardware implemented results.

As the editorial committee of EET, we would like to express our sincere gratitude to all authors and reviewers for their great contribution to this Special Section. We also would like to thank the editorial staffs for their efforts throughout the process.

We hope the EET special section continues at a high standard and involves increasing researchers in this promising and important research area for our future green consumption life.

EET Editorial Committee

September, 2014
The Crowd Energy Concept
Stephanie Teufel and Bernd Teufel

Abstract—After the Fukushima disaster, European politicians began to reassess the energy strategy for their countries. The focus is now on renewable energy sources and as a result on decentralization. The decentralized generation, storage, and of course the consumption of energy is the central point. Now with the new developments under the roof of energy turnaround the way back from the centralized architecture of our energy system to a more decentralized one is predetermined. Decentralization implies the change in the role of today’s consumers. They become energy prosumers. This is the basis for the crowd energy concept. In this position paper the crowd energy concept is introduced and necessary research fields are identified.

Index Terms—Crowd energy, decentralization, energy turnaround, energy prosumer, smart grid.

doi: 10.3969/j.issn.1674-862X.2014.03.005


Coefficient Diagram Method Based Load Frequency Control for a Modern Power System
Princess Garasi, Yaser Qudaih, Raheel Ali, Masayuki Watanabe, and Yasunori Mitani

Abstract—With the increasing penetration of renewable energy sources with a wide range of operating conditions causing power system uncertainties, conventional controllers are incapable of providing proper performance to keep the system stable. However, controllable or dispatchable loads such as electric vehicles (EVs) and heat pumps (HPs) can be utilized for supplementary frequency control. This paper shows the ability of plug-in hybrid EVs, HPs, and batteries (BTs) to contribute in the frequency control of an isolated power system. Moreover, we propose a new online intelligent approach by using a coefficient diagram method (CDM) to enhance the system performance and robustness against uncertainties. The performance of the proposed intelligent CDM control has been compared with the proportional-integral (PI) controller and the superiority of the proposed scheme has been verified in Matlab/Simulink programs.

Index Terms—Battery, coefficient diagram method, electric vehicles, heat pump, load frequency control, renewable energy sources.

doi: 10.3969/j.issn.1674-862X.2014.03.006


Solar Energy System with Digital Controller for Grid Connected Systems
Abhijit V. Padgavhankar and Sharad W. Mohod

Abstract—The solar photovoltaic (PV) module output voltage changes according to the variation of light intensity and temperature. This paper presents the implementation of an automatic digital controller of a DC-DC boost converter without batteries for a solar cell module by using a peripheral interface controller, which forms a closed loop, to control the ON-OFF period of the switching pulse. The output of DC-DC converter is maintained by automatically increasing or decreasing the pulse width. To produce the pulse width modulation (PWM), the microcontroller is programmed according to the required duty cycle for the power switch. The PWM ON period is increased with the decrease in the PV voltage and vice-versa. The input voltage to the inverter is maintained constantly and is converted into an AC signal by using the metal-oxide-semiconductor field effect transistor (MOSFET) H-bridge operated in the sinusoidal pulse width modulation mode by using a PIC (peripheral interface...
controller) microcontroller. The generated AC signal can be connected to the AC grid or to the AC load. The simulated results by using Proteus 8 and hardware implemented results verify the effectiveness of the proposed controller.

**Index Terms**— Boost converter, digital controller, inverter, renewable energy, solar energy.

doi: 10.3969/j.issn.1674-862X.2014.03.007


**Grid-Based Localization Mechanism with Mobile Reference Node in Wireless Sensor Networks**

Kuo-Feng Huang, Po-Ju Chen, and Emery Jou

**Abstract**— Wireless sensor networks (WSNs) are based on monitoring or managing the sensing area by using the location information with sensor nodes. Most sensor nodes require hardware support or receive packets with location information to estimate their locations, which needs lots of time or costs. In this paper we proposed a localization mechanism using a mobile reference node (MRN) and trilateration in WSNs to reduce the energy consumption and location error. The simulation results demonstrate that the proposed mechanism can obtain more unknown nodes locations by the mobile reference node moving scheme and will decreases the energy consumption and average location error.

**Index Terms**— Localization, mobile sensor node, received signal strength indicator, wireless sensor networks.

doi: 10.3969/j.issn.1674-862X.2014.03.008


**Blind Decorrelating Detection Based on Particle Swarm Optimization under Spreading Code Mismatch**

Jhih-Chung Chang and Chih-Chang Shen

**Abstract**— A way of resolving spreading code mismatches in blind multiuser detection with a particle swarm optimization (PSO) approach is proposed. It has been shown that the PSO algorithm incorporating the linear system of the decorrelating detector, which is termed as decorrelating PSO (DPSO), can significantly improve the bit error rate (BER) and the system capacity. As the code mismatch occurs, the output BER performance is vulnerable to degradation for DPSO. With a blind decorrelating scheme, the proposed blind DPSO (BDPSO) offers more robust capabilities over existing DPSO under code mismatch scenarios.

**Index Terms**— Code division multiple access, code mismatch, decorrelating detector, multiuser detection, particle swarm optimization.

doi: 10.3969/j.issn.1674-862X.2014.03.009

Refinement of Enhanced Speech Using Hybrid-Median Filter and Harmonic Regeneration Approach
Ching-Ta Lu, Jun-Hong Shen, Kun-Fu Tseng, and Chih-Tsung Chen

Abstract—This study proposes a post-processor to improve the harmonic structure of a vowel in an enhanced speech, enabling the speech quality to be improved. Initially, a speech enhancement algorithm is employed to reduce the background noise for a noisy speech. Hence the enhanced speech is post-processed by a hybrid-median filter to reduce the musical effect of residual noise. Since the harmonic spectra are impacted by background noise and a speech enhancement process, the quality of a vowel is deteriorated. A harmonic regenerated method is developed to improve the quality of post-processed speech. Experimental results show that the proposed method can improve the quality of post-processed speech by adequately regenerating harmonic spectra.

Index Terms—Harmonic regeneration, hybrid-median filter, noise reduction, post-processing, speech enhancement.

doi: 10.3969/j.issn.1674-862X.2014.03.010

Weighted Learning for Feedforward Neural Networks
Rong-Fang Xu, Thao-Tsen Chen, and Shie-Jue Lee

Abstract—In this paper, we propose two weighted learning methods for the construction of single hidden layer feedforward neural networks. Both methods incorporate weighted least squares. Our idea is to allow the training instances nearer to the query to offer bigger contributions to the estimated output. By minimizing the weighted mean square error function, optimal networks can be obtained. The results of a number of experiments demonstrate the effectiveness of our proposed methods.

Index Terms—Extreme learning machine, hybrid learning, instance-based learning, weighted least squares.

doi: 10.3969/j.issn.1674-862X.2014.03.011

Performance Evaluation of Mobility Anchor Point with Guard Load Reservation in Hierarchical Mobile IPv6
Yung-Chung Wang, Li-Hsin Chiang, and Hung-Pin Lin

Abstract—Hierarchical mobile IPv6 (HMIPv6) introduces a mobility anchor point to reduce the signaling overhead and handoff latency. In this paper, we apply the matrix-analytical approach to explore the performance measures of the ongoing mobile nodes (MNs) drop and new MNs block probabilities of mobility anchor point with a guard bandwidth reservation scheme. We apply the Markovian arrival process (MAP) to model ongoing MNs and new MNs. Five related performance measures are derived, including the long-term new MN block and ongoing MN drop probabilities, and the three short-term measures of average length of a block period and a non-block period, as well as the conditional ongoing MN drop probability during a block period. These performance measures greatly assist the guard bandwidth reservation mechanism in determining a proper threshold guard bandwidth. The results presented in this paper can provide guidelines for designing adaptive algorithms to adjust the threshold in the guard bandwidth reservation scheme.

Index Terms—Hierarchical mobile IPv6, Markovian arrival process, matrix-analytic method, mobility anchor point.

doi: 10.3969/j.issn.1674-862X.2014.03.012
A Path-Based Approach for Data Aggregation in Grid-Based Wireless Sensor Networks

Neng-Chung Wang, Yung-Kuei Chiang, and Chih-Hung Hsieh

Abstract—Sensor nodes in a wireless sensor network (WSN) are typically powered by batteries, thus the energy is constrained. It is our design goal to efficiently utilize the energy of each sensor node to extend its lifetime, so as to prolong the lifetime of the whole WSN. In this paper, we propose a path-based data aggregation scheme (PBDAS) for grid-based wireless sensor networks. In order to extend the lifetime of a WSN, we construct a grid infrastructure by partitioning the whole sensor field into a grid of cells. Each cell has a head responsible for aggregating its own data with the data sensed by the others in the same cell and then transmitting out. In order to efficiently and rapidly transmit the data to the base station (BS), we link each cell head to form a chain. Each cell head on the chain takes turn becoming the chain leader responsible for transmitting data to the BS. Aggregated data moves from head to head along the chain, and finally the chain leader transmits to the BS. In PBDAS, only the cell heads need to transmit data toward the BS. Therefore, the data transmissions to the BS substantially decrease. Besides, the cell heads and chain leader are designated in turn according to the energy level so that the energy depletion of nodes is evenly distributed. Simulation results show that the proposed PBDAS extends the lifetime of sensor nodes, so as to make the lifetime of the whole network longer.

Index Terms—Base station, cell head, data aggregation, grid-based, wireless sensor networks.

doi: 10.3969/j.issn.1674-862X.2014.03.013


Detecting Circles Using a Two-Stage Approach

Wen-Yen Wu

Abstract—We propose a two-stage method for detecting circular objects in this paper. In the first stage, curves are divided as linear segments or nonlinear segments. A least square estimator is used to find the estimated centers and radii of the nonlinear segments in the second stage. The found centers and radii are then evaluated to see if there exist circles in the nonlinear segments. Both of the broken and occluded circular objects are evaluated for the proposed method. From the experimental results, it is seen that the proposed method is efficient.

Index Terms—Circle detection, curve segmentation, error estimation, fitting.

doi: 10.3969/j.issn.1674-862X.2014.03.014


A High Efficiency Fully Integrated OOK Transmitter for WBAN

Mousa Yousefi, Ziaddin Daie Koozehkanani, Jafar Sobhi, and Hamid Jangi

Abstract—A 2.4 GHz high efficiency radio frequency (RF) transmitter for wireless body area network (WBAN) in medical applications is presented in this paper. The transmitter architecture with high energy efficiency is proposed to achieve a high data rate with low power consumption. In conventional transmitters, the oscillator and power amplifier are turned off when the transmitter sends 0. The required time for turning oscillator ON/OFF is longer than the other blocks of the transmitter. In the proposed transmitter, the low power oscillator is on all the time while the power amplifier and modulator are turned off when “0” data is sent. The transmitter consumes 3.2 mW at 0.5 dBm output by 285 Mbps data rate and the energy consumption per transmitted bit with 0.5 dBm output power is 10 pJ/(bit mW). The proposed transmitter was designed in 0.18 µm CMOS technology.

Index Terms—On-off keying, power amplifier, transmitter, wireless body area network.

doi: 10.3969/j.issn.1674-862X.2014.03.015

Role of Gate in Triode-Structure for Carbon Nanotube Cold Cathode

Yong-Qing Guo, Wei-Min Zheng, and Xiao-Juan Zhang

Abstract—Field emission properties of carbon nanotube cold cathode (CNT-CC) of triode- and diode-structure have been investigated by using the finite element method of numerical simulation. Specially, the effects of gate voltage and hole radius $R$ on the emission properties have been analyzed based on the finite element method. Results indicate that the gate can make the excitation electric field $E$ increase, turn-on voltage decrease, and the emission current density $J$ rise. The result shows that the $E$ reaches its maximum value at the top of carbon nanotube (CNT), and the optimum field emission performance can be obtained when $R$ is equal to 10 times the diameter of the carbon nanotube.

Index Terms—Carbon nanotube, field emission, triode-structure.

doi: 10.3969/j.issn.1674-862X.2014.03.016

Numerical Solution for Fractional Partial Differential Equation with Bernstein Polynomials

Jin-Sheng Wang, Li-Qing Liu, Yi-Ming Chen, and Xiao-Hong Ke

Abstract—A framework to obtain numerical solution of the fractional partial differential equation using Bernstein polynomials is presented. The main characteristic behind this approach is that a fractional order operational matrix of Bernstein polynomials is derived. With the operational matrix, the equation is transformed into the products of several dependent matrixes which can also be regarded as the system of linear equations after dispersing the variable. By solving the linear equations, the numerical solutions are acquired. Only a small number of Bernstein polynomials are needed to obtain a satisfactory result. Numerical examples are provided to show that the method is computationally efficient.

Index Terms—Absolute error, Bernstein polynomials, fractional partial differential equation, numerical solution, operational matrix.

doi: 10.3969/j.issn.1674-862X.2014.03.017

Object Tracking Using a Particle Filter with SURF Feature

Shinfeng D. Lin, Yu-Ting Jiang, and Jia-Jen Lin

Abstract—in this paper, a novel object tracking based on a particle filter and speeded up robust feature (SURF) is proposed, which uses both color and SURF features. The SURF feature makes the tracking result more robust. On the other hand, the particle selection can lead to save time. In addition, we also consider the matched particle applicable to calculating the SURF weight. Owing to the color, spatial, and SURF features being adopted, this method is more robust than the traditional color-based appearance model. Experimental results demonstrate the robustness and accurate tracking results with challenging sequences. Besides, the proposed method outperforms other methods during the intersection of similar color and object’s partial occlusion.

Index Terms—Object tracking, occlusion, particle filter, SURF feature.

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Journal of Electronic Science and Technology

JEST (International), Journal of Electronic Science and Technology, dedicates to publishing research articles and reviews relating the state-of-the-art achievements in electronic science and technology. The most highlight areas of the Journal include communication technology, computer science and information technology, information and network security, optoelectronic and photonic technologies, bioelectronics and biomedicine, neural networks and intelligent systems, etc. More information of the Journal is available at http://www.intl-jest.com. The JEST (International) devotes itself to providing the best possible publication opportunity. All original, high quality contributions that are not yet published or that are not currently under review by other journals or conferences are welcomed.

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