

# External Awards

## Achievement Award

**Winners:** Atsushi Fukuda<sup>†1</sup>, Hiroshi Okazaki<sup>†2</sup>, and Shoichi Narahashi<sup>†2</sup>

†1 Radio Access Network Development Department, NTT DOCOMO, INC.

†2 Research Laboratories, NTT DOCOMO, INC.

**Date:** May 26, 2012

**Organization:** IEICE

For “A leading study on the multi-band operation of power amplifiers for mobile terminals”.

[http://www.ieice.org/eng/awards/gyouseki\\_01e.html](http://www.ieice.org/eng/awards/gyouseki_01e.html)

## Achievement Award

**Winners:** Seizo Onoe<sup>†1</sup>, Toshio Miki<sup>†2</sup>, and Hiroshi Nakamura<sup>†3</sup>

†1 R&D Strategy Department, NTT DOCOMO, INC.

†2 Product Department, NTT DOCOMO, INC.

†3 Core Network Development Department, NTT DOCOMO, INC.

**Date:** May 26, 2012

**Organization:** IEICE

For “Implementation of LTE”.

[http://www.ieice.org/eng/awards/gyouseki\\_04e.html](http://www.ieice.org/eng/awards/gyouseki_04e.html)

## Best Paper Award

**Winners:** Yasushi Ikei<sup>†1</sup>, Koji Abe<sup>†1</sup>, Koichi Hirota<sup>†2</sup>, and Tomohiro Amemiya<sup>†3</sup>

†1 Tokyo Metropolitan University

†2 The University of Tokyo

†3 NTT Communication Science Laboratories

**Date:** Sept. 16, 2012

**Organization:** 18th International Conference on Virtual Systems and Multimedia (VSMM 2012)

For “A Multisensory VR System Exploring the Ultra-Reality”.

**Published as:** Y. Ikei, K. Abe, K. Hirota, and T. Amemiya, “A Multisensory VR System Exploring the Ultra-Reality,” Proc. of the 18th International Conference on Virtual Systems and Multimedia (VSMM 2012), Milan, Italy, 2012.

# Papers Published in Technical Journals and Conference Proceedings

## Conductive Polymer Combined Silk Fiber Bundle for Bioelectrical Signal Recording

S. Tsukada, H. Nakashima, and K. Torimitsu

PLoS ONE, Public Library of Science, Vol. 7, No. 4, p. e33689, 2012.

Electrode materials for recording biomedical signals, such as electrocardiography (ECG), electroencephalography (EEG) and evoked potentials data, are expected to be soft, hydrophilic and electroconductive to minimize the stress imposed on living tissue, especially during long-term monitoring. We have developed and characterized string-shaped electrodes made from conductive polymer with silk fiber bundles (thread), which offer a new biocompatible stress-free interface with living tissue in both wet and dry conditions.

An electroconductive polyelectrolyte, poly(3,4-ethylenedioxythiophene)-poly(styrenesulfonate) (PEDOT-PSS) was electrochemically combined with silk thread made from natural *Bombyx mori*. The polymer composite 280  $\mu\text{m}$  thread exhibited a conductivity of 0.00117 S/cm (which corresponds to a DC resistance of 2.62 M $\Omega$ /cm). The addition of glycerol to the PEDOT-PSS silk thread improved the conductivity to 0.102 S/cm (20.6 k $\Omega$ /cm). The wettability of PEDOT-PSS was controlled with glycerol, which improved its durability in water and washing cycles. The glycerol-treated PEDOT-PSS silk thread showed a tensile strength of 1000 cN in both wet and dry states. Without using any electrolytes, pastes or solutions, the thread

directly collects electrical signals from living tissue and transmits them through metal cables. ECG, EEG, and sensory evoked potential (SEP) signals were recorded from experimental animals by using this thread placed on the skin. PEDOT-PSS silk glycerol composite thread offers a new class of biocompatible electrodes in the field of biomedical and health promotion that does not induce stress in the subjects.

## Vapor Phase Polymerization of EDOT from Submicrometer Scale Oxidant Patterned by Dip-pen Nanolithography

C. D. O’Connell, M. J. Higgins, H. Nakashima, S. E. Moulton, and G. G. Wallace

Langmuir, American Chemical Society, Vol. 28, No. 1, pp. 9953–9960, 2012.

Some of the most exciting recent advances in conducting polymer synthesis have centered around the method of vapor phase polymerization (VPP) of thin films. However, it is not known whether the VPP process can proceed using significantly reduced volumes of oxidant and therefore be implemented as part of a nanolithography approach. Here, we present a strategy for submicrometer-scale patterning of the conducting polymer poly(3,4-ethylenedioxythiophene) (PEDOT) via in situ VPP. Attolitre ( $10^{-18}$  L) volumes of oxidant “ink”

are controllably deposited using dip-pen nanolithography (DPN). DPN patterning of the oxidant ink is facilitated by the incorporation of an amphiphilic block copolymer thickener, an additive that also assists with stabilization of the oxidant. When exposed to EDOT monomer in a VPP chamber, each deposited feature localizes the synthesis of conducting PEDOT structures of several micrometers down to 250 nm in width. PEDOT patterns are characterized by atomic force microscopy (AFM), conductive AFM, two-probe electrical measurement, and micro-Raman spectroscopy, evidencing in situ vapor phase synthesis of conducting polymer at a scale (picogram) which is much smaller than that previously reported. Although the process of VPP on this scale was achieved, we highlight some of the challenges that need to be overcome to make this approach feasible in an applied setting.

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### Security Enhancements by OR-Proof in Identity-Based Identification

A. Fujioka, T. Saito, and K. Xagawa

Applied Cryptography and Network Security, Lecture Notes in Computer Science, Vol. 7341, pp. 135–152, 2012.

We investigate three security enhancement transformations, based on the well-known OR-proof technique, in identity-based identification (IBI) protocols and show a required condition of the underlying IBI protocols. The transformations can convert an IBI protocol, which satisfies a property similar to the  $\Sigma$ -protocol and is secure against impersonation under passive attacks, into one secure against impersonation under concurrent attacks in both adaptive and weak selective identity attack models. In addition, we argue that enhancing the security in the static identity attack model with two of the transformations seems to be difficult; however, we prove that the third one can convert an IBI protocol, which satisfies another property, in the model.

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### Optimal entanglement manipulation via coherent-state transmission

K. Azuma and G. Kato

Phys. Rev. A, Vol. 85, No. 6, 060303(R), 2012.

We derive an optimal bound for arbitrary entanglement manipulation based on the transmission of a pulse in coherent states over a lossy channel followed by local operations and unlimited classical communication (LOCC). This stands on a theorem to reduce LOCC via a local unital qubit channel to local filtering. We also present an optimal protocol based on beam splitters and a quantum nondemolition (QND) measurement on photons. Even if we replace the QND measurement with photon detectors, the protocol can achieve near-optimal performance, outperforming known entanglement generation schemes.

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### Sufficient Condition for Ephemeral Key-Leakage Resilient Tripartite Key Exchange

A. Fujioka, M. Manulis, K. Suzuki, and B. Ustaoglu

Proc. of the 17th Australasian Conference, ACISP 2012, Wollongong, NSW, Australia, 2012.

Tripartite Key Exchange (3KE) represents today the only known class of group key exchange protocols in which computation of unauthenticated session keys requires only one round and proceeds with minimal computation and communication overhead. The first one-round authenticated 3KE version that preserved the unique efficiency

properties of the original protocol and strengthened its security towards resilience against leakage of ephemeral secrets was proposed recently by Manulis, Suzuki, and Ustaoglu.

In this work we explore sufficient conditions for building such protocols. We define a set of *admissible polynomials* and show how their construction generically implies 3KE protocols with the desired security and efficiency properties. Our result generalizes the previous 3KE protocol and gives rise to many new authenticated constructions, all of which enjoy forward secrecy and resilience to ephemeral key-leakage under the Gap Bilinear Diffie-Hellman assumption in the random oracle model.

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### Grammar Error Correction Using Pseudo-Error Sentences and Domain Adaptation

K. Imamura, K. Saito, K. Sadamitsu, and H. Nishikawa

Proc. of the 50th Annual Meeting of the Association for Computational Linguistics, pp. 388–392, Jeju, Korea, 2012.

This paper presents grammar error correction for Japanese particles that uses discriminative sequence conversion, which corrects erroneous particles by substitution, insertion, and deletion. The error correction task is hindered by the difficulty of collecting large error corpora. We tackle this problem by using pseudoerror sentences generated automatically. Furthermore, we apply domain adaptation, the pseudo-error sentences are from the source domain, and the real-error sentences are from the target domain. Experiments show that stable improvement is achieved by using domain adaptation.

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### Meta-envy-free Cake-cutting and Pie-cutting Protocols

Y. Manabe and T. Okamoto

Journal of Information Processing, Vol. 20, No. 3, pp. 686–693, 2012.

This paper discusses cake-cutting protocols when the cake is a heterogeneous good, represented by an interval on the real line. We propose a new desirable property, the meta-envy-freeness of cake-cutting, which has not been formally considered before. Meta-envy-free means there is no envy in role assignments; that is, no party wants to exchange his/her role in the protocol with that of any other party. If there is envy in role assignments, the protocol cannot actually be executed because there is no settlement of which party plays which role in the protocol. A similar definition, envy-freeness, is widely discussed. Envy-free means that no player wants to exchange his/her part of the cake with that of any other player. Though envy-freeness was considered to be one of the most important desirable properties, it does not prevent envy about role assignment in the protocols. We define meta-envy-freeness to formalize this kind of envy. We propose that simultaneously achieving meta-envy-freeness and envy-freeness is desirable in cake-cutting. We show that current envy-free cake-cutting protocols do not satisfy meta-envy-freeness. Formerly proposed properties such as strong envy-free, exact, and equitable do not directly consider this type of envy and these properties are very difficult to realize. This paper then shows cake-cutting protocols for two- and three-party cases that simultaneously achieve envy-freeness and meta-envy-freeness. Finally, we show meta-envy-free pie-cutting protocols.

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### Low-complexity PARCOR coder designed for entropy coding of prediction residuals

Y. Kamamoto, T. Moriya, and N. Harada

Acoust. Sci. & Tech. Vol. 33, No. 4, 2012.

The low-complexity PARCOR quantization method, which is used for ITU-T G.711.0 (lossless compression of G.711), is described.

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### **Laser Sharing between Transmitter and Receiver in Optical FDM-PON Access System Based on Optical Heterodyne Detection**

S. Narikawa and N. Sakurai

IEICE Trans. on Communications, Vol. J95-B, No. 7, pp. 800–808, 2012 (in Japanese).

A lot of recent research has been devoted to the wavelength division multiplexing passive optical network (WDM-PON). We studied and evaluated a coherent FDM-PON access system which uses optical heterodyne detection for the receivers. Optical heterodyne detection can increase the PON branch number and enhance the transmission distance; however, it requires multiple lasers in the optical network unit (ONU), so a cost-effective ONU architecture is needed. To resolve this issue, we propose sharing the directly modulated laser with upstream signals for transmitter and receiver. We experimentally evaluated its effect.

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### **Separability and Commonality of Auditory and Visual Bistable Perception**

H. M. Kondo, N. Kitagawa, M. S. Kitamura, A. Koizumi, M. Nomura, and M. Kashino

Cerebral Cortex, Oxford University Press, Vol. 22, No. 8, pp. 1915–1922, 2012.

It is unclear what neural processes induce individual differences in perceptual organization in different modalities. To examine this issue, the present study used different forms of bistable perception: auditory streaming, verbal transformations, visual plaids, and reversible figures. We performed factor analyses on the number of perceptual switches in the tasks. A 3-factor model provided a better fit to the data than the other possible models. These factors, namely the “auditory”, “shape”, and “motion” factors, were separable but correlated with each other. We compared the number of perceptual switches among genotype groups to identify the effects of neurotransmitter functions on the factors. We focused on polymorphisms of catechol-O-methyl-

transferase (COMT) Val(158)Met and serotonin 2A receptor (HTR2A)-1438G/A genes, which are involved in the modulation of dopamine and serotonin, respectively. The number of perceptual switches in auditory streaming and verbal transformations differed among COMT genotype groups, whereas that in reversible figures differed among HTR2A genotype groups. The results indicate that the auditory and shape factors reflect the functions of the dopamine and serotonin systems, respectively. Our findings suggest that the formation and selection of percepts involve neural processes in cortical and subcortical areas.

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### **Joint estimation of confidence and error causes in speech recognition**

A. Ogawa and A. Nakamura

Speech Commun., Elsevier, Vol. 54, No. 9, pp. 1014–1028, 2012.

Speech recognition errors are essentially unavoidable under the severe conditions of real fields, and so confidence estimation, which scores the reliability of a recognition result, plays a critical role in the development of speech-recognition-based real-field application systems. However, if we are to develop an application system that provides a high-quality service, in addition to achieving accurate confidence estimation, we also need to extract and exploit further supplementary information from a speech recognition engine. As a first step in this direction, in this paper, we propose a method for estimating the confidence of a recognition result while jointly detecting the causes of recognition errors based on estimating the confidence of a recognition result, while jointly detecting the causes of recognition errors, by using a discriminative model. The confidence of a recognition result and the nonexistence/existence of error causes are naturally correlated. By directly capturing these correlations between the confidence and error causes, the proposed method enhances its estimation performance for the confidence and each error cause complementarily. In the initial speech recognition experiments, the proposed method provided higher confidence estimation accuracy than a discriminative model based a state-of-the-art confidence estimation method. Moreover, the effective estimation mechanism of the proposed method was confirmed by detailed analyses.

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