

External Awards

MNC 2008 Young Authors Award

Winner: Kojiro Tamaru, NTT Basic Research Laboratories

Date: November 16, 2009

Organization: Class B, Microprocesses and Nanotechnology Conference (MNC)

For “Direct Actuation of GaAs Membrane using Microprobe of SPM”.

A method for evaluating the dynamic characteristics of micro/nanoresonators with high spatial resolution is proposed. The mechanical resonance of circular micromembrane resonators is directly induced by voltage applied from the microprobe of a scanning probe microscope (SPM). The vibration amplitude is simultaneously detected as SPM height information. The resonant properties of the fundamental and higher-order modes of 200-nm-thick GaAs micromembranes were measured experimentally. The highest mode had a frequency of 3.4 MHz with a resonant amplitude of about 1 nm. The resonant amplitude increased linearly with actuation voltage below

180 mV. A large actuation voltage induced nonlinear vibration with a spring softening effect originating from the strong attractive force induced by the electronic field between the probe and membrane. The higher tapping force, which was repulsive, induced another type of nonlinear vibration caused by a spring hardening effect. Simultaneous actuation and detection for mechanical resonators based on SPM revealed the characteristics of the mechanical interaction force between the micromembrane and microprobe.

Best Poster Award, 3rd International Symposium on Nanomedicine

Winner: Yoichi Shinozaki, NTT Basic Research Laboratories

Date: November 5, 2009

Organization: Class B, Japan Nanomedicine Society

For “Direct Visualization of Single Receptor Dynamics: The Relationship between Molecular Structure and Physiology/Pathology”.

Papers Published in Technical Journals and Conferences

DC to 50-GHz single-pole four-throw InP-HEMT switch IC with highly uniform performance

H. Kamitsuna, K. Onodera, S. Sugitani, K. Nishimura, K. Murata, and T. Enoki

IEE Electron. Lett., Vol. 45, No. 12, pp. 626–627, 2009.

A single-pole four-throw (SP4T) switch IC with a 3-dB bandwidth of over 50 GHz, which is believed to be the highest among cold-FET SP4T switches, is presented. A miniature and ideal divergence structure with an advanced four-level interconnect provides highly uniform performance in different paths.

Performance Analysis of a Two-hop Wireless Relay Network with CSMA/CA and Network Coding

C. H. Huang, D. Umehara, S. Denno, M. Morikura, and T. Sugiyama

ITC-CSCC 2009, The Institute of Electronics Engineers of Korea, Vol. 1, No. 1, pp. 1088–1091, Jeju Island, Korea, 2009.

In this paper, we provide an analytical model to compute the approximate throughput of a two-hop wireless relay network in which stations employ the carrier sense multiple access with collision avoidance (CSMA/CA) protocol and network coding on the MAC layer. In addition, this model can be applied to the conventional CSMA/CA wireless relay network without network coding. Network coding is a highly regarded technology that is able to enhance the system capacity of multiple unicast and multisource multicast net-

works. On the assumption of no hidden terminals, we show that the proposed analytical model works well with the parameters of IEEE 802.11a and the difference in throughput between theoretical analysis and computer simulation is at most 2%.

A Self-Assembled Protein Nanotube with High Aspect Ratio

F. F. Miranda, K. Iwasaki, S. Akashi, K. Sumitomo, M. Kobayashi, I. Yamashita, J. R. H. Tame, and J. G. Heddl

Small, Wiley-VCH Verlag, Vol. 5, No. 18, pp. 2077–2084, 2009.

Production of a self-assembled protein nanotube achieved through engineering of the 11mer ring protein trp RNA-binding attenuation protein is described. The produced mutant protein is able to stack in solution to produce an extremely narrow, uniform nanotube apparently stabilized by a mixture of disulfide bonds and hydrophobic interactions. Assembly is reversible and the length of tube can potentially be controlled. Large quantities of hollow tubes 8.5 nm in overall diameter with lengths varying from 7 nm to over 1 μ m are produced. The structure is analyzed using transmission electron microscopy, atomic force microscopy, mass spectrometry, and single-particle analysis and it is found that component rings stack in a head-to-head fashion. The internal diameter of the tube is 2.5 nm, and the amino acid residues lining the central cavity can be mutated, raising the possibility that the tube can be filled with a variety of conducting or semiconducting materials.

Achievable Region in Slotted ALOHA Throughput for One-Relay Two-Hop Wireless Network Coding

D. Umehara, S. Denno, M. Morikura, and T. Sugiyama

ADHOCNETS2009, ICST, Vol. 1, No. 1, pp. 1–16, Niagara Falls, Canada

This paper presents achievable regions in slotted ALOHA throughput both without and with network coding for one-relay two-hop wireless networks between two end node groups. In this paper, there are no restrictions on the total traffic and the number of end nodes per group. It follows that the relay node will generally be involved with asymmetric bidirectional traffic. This paper derives closed-form expressions for the throughput and packet delay per group both without and with network coding from a theoretical perspective regardless of whether the buffer on the relay node is saturated or not. Furthermore, we show that the maximum throughput per group with network coding can be achieved at the boundary of the relay buffer saturation and unsaturation, which is expressed as the solution of a polynomial equation in two group node traffics. As a result, we clarify the enhancement of the achievable region in slotted ALOHA throughput achieved by applying network coding.

New Microscope Combines Optical and Electrical Excitation into a Single Scanning Tunneling Microscope Unit for Simultaneous Characterization of Near-field Luminescence from Individual Nanostructures

H. Omi, I. Sychugov, Y. Kobayashi, and T. Murashita

Japanese Society of Microscopy, Vol. 44, No. 3, pp. 174–178, 2009 (in Japanese).

A new microscope combines optical and electrical excitation into a single scanning tunneling microscope unit for simultaneous characterization of near-field luminescence from individual nanostructures.

Impact of Pulse Width and Pulse Oscillation Interval on Perception of Pseudo-Attraction Force

T. Amemiya and T. Maeda

2009 IEEE International Conference on Systems, Man, and Cybernetics, Vol. 1, No. 1, pp. 1724–1729, San Antonio, Texas, USA.

This paper discusses the effect of acceleration profiles on the kinesthetic illusion of being pulled (pseudo-attraction force perception). We have found that when a hand-held object oscillates in the hands, if the acceleration pattern is lopsided, one feels a pulling force sensation, although the object does move in two opposite directions. Our previous findings indicate that the pulse frequency of a lopsided oscillation determines the effective generation of the pseudo-attraction force. The objective of this study is to clarify the effect of pulse width and pulse interval on force perception at the pulse frequency. The experimental results suggest that (i) there were no significant differences between pulse widths as regards perceiving a pseudo-attraction force and (ii) there was a depressive interaction between pulse width and pulse interval with respect to force perception.

Navigation in Eight Cardinal Directions with Pseudo-Attraction Force for the Visually Impaired

T. Amemiya and H. Sugiyama

2009 IEEE International Conference on Systems, Man, and Cybernetics, Vol. 1, No. 1, pp. 33–38, San Antonio, Texas, USA.

We have proposed a haptic direction indicator that will help visually impaired pedestrians to travel a path and avoid hazardous areas intuitively and safely by means of force-based navigation. The haptic direction indicator uses the pseudo-attraction force technique, which generates a pulling or pushing force in portable or mobile devices by exploiting the nonlinear relationship between perceived acceleration and physical acceleration. We have investigated the angular resolution of the pseudo-attraction force for the visually impaired in a static posture to design a practical haptic direction indicator. This paper describes a prototype of a crosshair haptic direction indicator based on our previous findings. An experiment was performed to clarify the perceptual characteristics when a visually impaired pedestrian navigates by perceiving force sensation. The results show that most of the visually impaired participants could walk in a predetermined cardinal direction with the haptic direction indicator. Finally, we discuss the drawbacks of our system and design improvements.
