External Awards

42th CHEMINAS Poster Award
Winners: Koji Sakai, Tetsuhiko Teshima, Yuko Ueno, Hiroshi Nakashima, and Masumi Yamaguchi, NTT Basic Research Laboratories
Date: October 28, 2020
Organization: Society for Chemistry and Micro-Nano Systems (CHEMINAS)

For "Three-dimensional Extracellular Recording by Self-folding Graphene Electrode Array."
Published as: K. Sakai, T. Teshima, Y. Ueno, H. Nakashima, and M. Yamaguchi, "Three-dimensional Extracellular Recording by Self-folding Graphene Electrode Array," 42th CHEMINAS, Oct. 2020.

Spotlight on Optics
Winners: Yoko Yamashita, Takashi Matsui, Taiji Sakamoto, Shinichi Aozasa, Masaki Wada, Takayoshi Mori, and Kazuhide Nakajima, NTT Access Network Service Systems Laboratories
Date: November 24, 2020
Organization: The Optical Society (OSA)

For "Reduction of Differential Modal Gain in a Two-mode Amplifier Using a Void-inscribed EDF."
Published as: Y. Yamashita, T. Matsui, T. Sakamoto, S. Aozasa, M. Wada, T. Mori, and K. Nakajima, "Reduction of Differential Modal Gain in a Two-mode Amplifier Using a Void-inscribed EDF," Applied Optics, Vol. 59, No. 30, pp. 9574–9580, Oct. 2020.

The Minister of Internal Affairs and Communications Award, the Fourth Infrastructure Maintenance Awards
Winner: NTT (NTT Access Network Service Systems Laboratories)
Date: November 27, 2020
Organization: The Ministry of Land, Infrastructure and Transport, the Ministry of Internal Affairs and Communications, the Ministry of Education, Culture, Sports, Science and Technology, the Ministry of Health, Labour and Welfare, the Ministry of Agriculture, Forestry and Fisheries, the Ministry of Economy, Trade and Industry, and the Ministry of Defense

For the development of technology for visualizing the uneven load applied to utility poles and other facilities.

Outstanding Paper Award
Winners: Zubair Md. Fadlullah, Fengxiao Tang, Bomin Mao, and Nei Kato, Tohoku University; Osamu Akashi, Takeru Inoue, and Kimihiro Mizutani, NTT Network Innovation Laboratories
Date: December 8, 2020
Organization: IEEE Asia-Pacific Region Paper Award Committee

For "State-of-the-art Deep Learning: Evolving Machine Intelligence Toward Tomorrow's Intelligent Network Traffic Control Systems."
Published as: Z. Md. Fadlullah, F. Tang, B. Mao, N. Kato, O. Akashi, T. Inoue, and K. Mizutani, "State-of-the-art Deep Learning: Evolving Machine Intelligence Toward Tomorrow's Intelligent Network Traffic Control Systems," IEEE Communications Surveys & Tutorials, Vol. 19, No. 4, pp. 2432–2455, May 2017.

Papers Published in Technical Journals and Conference Proceedings

Behavioral and Physiological Correlates of Kinetically Tracking a Chaotic Target
A. Takagi, R. Furuta, S. Saetia, N. Yoshimura, Y. Koike, and L. Minati
PLOS ONE, Vol. 15, No. 9, e0239471, September 2020.

Humans can innately track a moving target by anticipating its future position from a brief history of observations. While ballistic trajectories can be readily extrapolated, many natural and artificial systems are governed by more general nonlinear dynamics and, therefore, can produce highly irregular motion. Yet, relatively little is known regarding the behavioral and physiological underpinnings of prediction and tracking in the presence of chaos. Here, we investigated in lab settings whether participants could manually follow the orbit of a paradigmatic chaotic system, the Rössler equations, on the (x,y) plane under different settings of a control parameter, which determined the prominence of transients in the target position. Tracking accuracy was negatively related to the level of unpredictability and folding. Nevertheless, while participants initially reacted to the transients, they gradually learned to anticipate it. This was accompanied by a decrease in muscular co-contraction, alongside enhanced activity in the theta and beta electroencephalographic bands for the highest levels of chaoticity. Furthermore, greater phase synchronization of breathing was observed. Taken together, these findings point to the possible ability of the nervous system to implicitly learn topological regularities even in the context of highly irregular motion, reflecting in multiple observables at the physiological level.

Receiver Integration with Arrayed Waveguide Gratings toward Multi-wavelength Data-centric Communications and Computing

Y. Doi, T. Yoshimatsu, Y. Nakanishi, S. Tsunashima, M. Nada, S. Kamei, K. Sano, and Y. Ishii

Applied Science, Vol. 10, No. 22, 8205, November 2020.

This paper reviews receivers that feature low-loss multimode-output arrayed waveguide gratings for wavelength division multiplexing (WDM) as well as hybrid integration techniques with high-speed throughput of up to 100 Gb/s and beyond. A design of optical coupling between higher-order multimode beams and a photodiode for a flat-top spectral shape is described in detail. The WDM photoreceivers were fabricated with different approaches. A 10-Gb/s photoreceiver was developed for a 1.25-Gb/s baud rate and assembled for eight-channel WDM by mechanical alignment. A receiver with 40-Gb/s throughput was built by using visual alignment for a 10-Gb/s baud rate and four-channel WDM. A 100-Gb/s receiver assembled by active alignment with a four-channel by 25-Gb/s baud rate is the basis for beyond-100 Gb/s and future multi-wavelength integrated devices toward data-centric communications and computing.

Independent Control of Cocontraction and Reciprocal Activity during Goal-directed Reaching in Muscle Space

A. Takagi, H. Kambara, and Y. Koike

Scientific Reports, Vol. 10, 22333, December 2020.

The movement in a joint is facilitated by a pair of muscles that pull in opposite directions. The difference in the pair's muscle force or reciprocal activity results in joint torque, while the overlapping muscle force or the cocontraction is related to the joint's stiffness. Cocontraction knowingly adapts implicitly over a number of movements, but it is unclear whether the central nervous system can actively regulate cocontraction in a goal-directed manner in a short span of time. We developed a muscle interface where a cursor's horizontal position was determined by the reciprocal activity of the shoulder flexion–extension muscle pair, while the vertical position was controlled by its cocontraction. Participants made goal-directed movements to single and via-point targets in the two-dimensional muscle space, learning to move the cursor along the shortest path. Simulations using an optimal control framework suggest that the reciprocal activity and the cocontraction may be controlled independently by the central nervous system, albeit at a rate orders of magnitude slower than the muscle's maximal activation speed.

Analogous Adaptations in Speed, Impulse, and Endpoint Stiffness When Learning a Real and Virtual Insertion Task with Haptic Feedback

A. Takagi, G. De Magistris, G. Xiong, A. Micaelli, H. Kambara, Y. Koike, J. Savin, J. Marsot, and E. Burdet

Scientific Reports, Vol. 10, 22342, December 2020.

Humans have the ability to use a diverse range of handheld tools. Owing to its versatility, a virtual environment with haptic feedback of the force is ideally suited to investigating motor learning during tool use. However, few simulators exist to recreate the dynamic interactions during real tool use, and no study has compared the correlates of motor learning between a real and virtual tooling task. To this end, we compared two groups of participants who either learned to insert a real or virtual tool into a fixture. The trial duration, the movement speed, the force impulse after insertion and the endpoint stiffness magnitude decreased as a function of trials, but they changed at comparable rates in both environments. A ballistic insertion strategy observed in both environments suggests some interdependence when controlling motion and controlling interaction, contradicting a prominent theory of these two control modalities being independent of one another. Our results suggest that the brain learns real and virtual insertion in a comparable manner, thereby supporting the use of a virtual tooling task with haptic feedback to investigate motor learning during tool use.

Seeing the World through Text: Evaluating Image Descriptions for Commonsense Reasoning in Machine Reading Comprehension

D. Galvan-Sosa, J. Suzuki, K. Nishida, K. Matsuda, and K. Inui

Proc. of the Second Workshop on Beyond Vision and Language: Integrating Real-world Knowledge (LANTERN), pp. 23–29, Barcelona, Spain (Online), December 2020.

Despite recent achievements in natural language understanding, reasoning over commonsense knowledge still represents a big challenge to artificial intelligence systems. As the name suggests, common sense is related to perception and as such, humans derive it from experience rather than from literary education. Recent works in the natural language processing and the computer vision field have made the effort of making such knowledge explicit using written language and visual inputs, respectively. Our premise is that the latter source fits better with the characteristics of commonsense acquisition. In this work, we explore to what extent the descriptions of real-world scenes are sufficient to learn common sense about different daily situations, drawing upon visual information to answer script knowledge questions.