Newsletter

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IEEE Tokyo Section
Life Members Affinity Group

This issue reports the technical visit and lectures on radio communications, commemorative lectures by IEEE award recipients, and International Year of Light (IYL) commemorative lecture meeting.

1. Technical Visit and Lectures on Radio Communications

On Friday, July 17, 2015, the technical visit to the UEC Communication Museum and the lecture meeting were held in the University of Electro-Communication. The participants for the technical visit and the lecture meeting are respectively 33 and 67 in number. After the events, many of participants joined a get-together party.

(1) Visit to UEC Communication Museum

This museum displays vacuum tubes, radio transmitters and receivers, broadcasting and navigation apparatuses and so on from the dawn of the radio communications to recent years. Particularly, this museum holds a lot of very valuable vacuum tubes worldwide. The participant more than 30 capacity finished a planned one-hour visit with earnest questions and moved to the lecture hall.

Fig.1 Visit to UEC Communication Museum

(2) Lecture 1 “Who wrote a Maxwell’s Equations? — with the Contribution on Electro-Magnetic Theory by Japanese Researchers —”

Prof. Takehiko Kobayashi (Tokyo Denki University) performed the lecture of the title. It is the outline of the lecture as follows.

Those person may be rare who knows well-known Maxwell’s equations (four simultaneous equations) are different from the original one Maxwell (1831–1879) announced firstly. The Maxwell’s equations are known as basic theory for radio wave propagations, antennas, microwave circuits, etc. In fact, the Maxwell’s equations appeared in today’s textbooks was written by Heaviside (1850-1925).

By this lecture, it was introduced the real process led to today’s four simultaneous equations.

Fig.2 Oliver Heaviside (from Wikimedia Commons)

In the article "A dynamic theory of electromagnetic field" which Maxwell announced first in 1865, his theory consisted of 20 simultaneous equations. As for these equations, electromagnetic fields in vacuum space was formulated based on related theorems such as Faraday law of electromagnetic Induction. On formulating space fields, Maxwell premised and thought "the electro- magnetic phenomenon was the electrical strain property of the ether which was believed to fill up vacuum space". His thought was based on a hypothesis that an electric displacement occurs to the ether as is like a dielectric is polarized by electric force, thereby a displacement current is generated. Though the existence of the ether was denied by the experiment later year, his theory derived right electromagnetic field equations.

Fig.2 Lecture by Prof. Takehiko Kobayashi

Heaviside who read the article entitled "A Treatise on Electricity and Magnetism" published by Maxwell in 1873 which was the complete achievement of his theory, was astonished and felt it really great with infinite possibility. Then, he spent several years to understand it and followed logic by himself, and had derived the today's "Maxwell equations" formulated by vector expression at last. Heviside published his research results with the article "Electromagnetic induction and its propagation" in 1885.

At the last part of the lecture, he introduced to two early contributions related to electromagnetic theory by Japanese as are followings. One is Rinzaburo Shida who calculated the speed of the electro-magnetic wave based on his original experimental results, and published it in 1880. The other is Hantaro Nagaoka who derived the coefficient (Nagaoka coefficient) that the magnetic induction of solenoid coils with limited length is smaller than the theoretical value of an infinite long coil.

Reference: James C. Rautio, "The Long Road to Maxwell's Equations" IEEE Spectrum, Dec. 2014.

(3) Lecture 2 "History of Mobile Phone and Way to 5G"

Seizo Onoe (NTT DOCOMO) came directly to the lecture meeting place from international conference "Mobile World Congress Shanghai 2015", and gave the impassioned lecture with humor without showing fatigue as is following.

The history of the mobile phone can express each generation (G) as follows sequentially.

1G 1980s: Analog (FDMA)
2G 1990s: Digital (TDMA)
3G 2000s: W-CDMA, CDMA2000 (CDMA)
4G 2010s: LTE/LTE-Advanced (OFDMA/ SCFDMA)
5G 2020s: Under discussion, for example Massive MIMO and C-RAN

An introduction timing was important to the new technology. In the case of 3G, NTT DoCoMo rushed its deployment too much as a result. We considered to run one year ahead of others, but actually around two years earlier. Nobody came with us and we had a hard time, because it was necessarily good to be early.

As for 4G, DOCOMO was going to deploy it as one of the world leader companies and matched a pace with them. We devoted to international standardization as well as our own development, and these behavior was tied to success. Nevertheless, analyst had the concern that DOCOMO might run alone again in the LTE. The LTE service was started initially by TeliaSonera in 2010, and DOCOMO started its service soon as a leader company according to policy.

About 5G, an ecosystem and business are discussed at first, whereas technical issues led service and business in the case of 3G and 4G. The requirements for 5G are discussed in various groups and forums, but they are all in the similar direction and can be arranged as follows.

- System capacity, high-speed data, and low cost: Everlasting requirements to be always pursued.
- Delay time: Relatively new requirement.
- Huge connection and very low power consumption: New requirements for IoT.

In addition, the flexibility for new business model and ecosystem is the new requirements that many people insist on the importance.

Regarding the technical discussion, many people have such a view "5G needs very high speed data rate which require very wide band. Then the cell size must be small because of using higher microwave frequency. So, 5G is mainly used as a complimentary technique for the hotspot areas. But, this view is incorrect. It is the ambition of 5G that realize cellular systems enabling reliable communications even if higher microwave frequency band is used. The new technologies for 5G are massive MIMO, C-RAN and so on. The combination of these technologies are effective to provide stable communication to customers.

Furthermore, he introduced to the research and development related to 5G that DoCoMo is now pursuing, and to the joint experiments performing with overseas companies. As an end, he told "the LTE made a big success by the global development. We learned a lot of matters for the future from this history". This is a remark carried weight by person who involved research and development in DoCoMo for a long time.

Note: LTE: Long Term Evolution (4G standard)
C-RAN: Centralized Radio Access Network

Fig.3 Lecture by Seizo Onoe

2. IEEE Awards Commemorative Lectures

Dr. Hirokazu Ihara, International Institute of Intelligence and Information, received 2015 IEEE Innovation in Societal Infrastructure Award. And, Prof. Hiroshi, Tokyo Institute of Technology, received 2015 IEEE Cledo Brunetti Award. The Lecture Meeting was held sponsored by IEEE Tokyo Section TPC and co- sponsored by LMAG-Tokyo on

Tuesday, August 4 and on Saturday, September 26 respectively, at Kikai Shinko Kaikan, as are following.

(1) Hirokazu Ihara's Lecture "From the Concept of Autonomous Distributed System to an Avatamska Sutra view of the world"

Dr. Ihara explained that the received prize is not only for technically superior, but also for contribution to social infrastructure. And, he added the comment on the prize that was jointly received with Dr. Takemochi Ishii and Dr. Atsunobu Ichikawa.

At first, Dr. Ihara explained the progress of research and the practical use for railroads regarding an Autonomous Distributed System (ADS) which made the core of a technique suggested in 1980. Then, he showed its concept and the difference with other methods. ADS was characterized by the equally autonomous controllability and co-operability that I measured with equality. Later, an Extended Autonomous Distributed System (EADS) was suggested in 2000 which has additionally observation characteristics. EADS is related to symbiosis society system by the orient thought, and has something common with view of the world of Kegonzou on the Avatamska Sutra Creed of the Buddhism that has similarity with the modern philosophy by Ikutaro Nishida or the view of the world by Daisetsu Suzuki. As for the concept of EADS, a unit (subsystem) and a whole (system) are related each other similar to "Jijimuge", and connected by "Indaramou" (network).

Furthermore, we may apply the latest know-ledge of embryology to EADS. The genetic information is inherited between individuals, and changes in environment. This biological image is useful to study on the composition and the adaptability of information systems. Finally, he told a possibility that the above mentioned approach might give us suggestion for the optimization of information systems by a cloud technology, a knowledge database, and so on, as well as the counter-measure for the attack to mobile and social information services.

Fig.4 Lecture by Hirokazu Ihara

(2) Hiroshi Iwai's Lecture "Future of Electronic Devices approaching to Nano-structure Limit"

Dr. Iwai explained the history and the present situation of the electronic device miniaturization, and gave a lecture on the future prospects of the device technology approaching a limit of the miniaturization.

By IoT, big data processing, development of the ICT including the artificial intelligence, our society is accomplishing a big change. We require to process the enormous information that continue increasing at a surprising pace with low cost, high speed and low power consumption, and the electronic devices mainly semiconductor devices must fulfill these demands. The electronic device changed materials into a semiconductor from a vacuum tube during these 100 years and evolved, and the key technology of the information processing evolution for cost reduction, speedup and low power consumption was miniaturization of device elements. In the next ten years, the device fabrication scale is predicted to become minimized to a few nm scale where the quantum mechanics-like effects such as tunnel phenomena are seen, and it is going to the limit.

Prof. Iwai gave his perspectives to a device technology were talked about the future how the system which accumulated electronic device and it after having reached a miniaturization limit would develop in future.

Fig.5 Lecture by Prof. Hiroshi Iwai

3. International Year of Light Commemorative Lecture Meeting (Breaking News)

2015 was 1,000 years from origin of optics study by Ibn Al-Haytham, and this year 2015 was proposed with International Light Year (IYL) by UNESCO. So, LMAG-Tokyo organized IYL Commemorative Lecture Meeting "Optical Communication Technology: The Past Half a Century and the Future" cosponsored by TPC of IEEE Tokyo Section on December 7, 2015. There were three lectures and 73 participants. The details of the lecture meeting will be reported by the next issue.

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Kikai-Shinko-Kaikan Bldg., 517
3-5-8 Shibakoen, Minato-ku, Tokyo 105-0011 JAPAN
URL: http://www.ieee-jp.org/section/tokyo/lmag/index.htm
E-Mail: tokyosec@ieee-jp.org