Takada Laboratory

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Professor Jun-ichi Takada

Prof. Jun-ichi Takada was born in 1964, Tokyo, Japan. He received the B.E. and D.E. degree from Tokyo Institute of Technology in 1987 and 1992 respectively. From 1992 to 1994, he was a Research Associate at Chiba University. From 1994 to 2006, he was an Associate Professor at Tokyo Institute of Technology, where he has been a Professor since 2006. He is currently with the Department of Transdisciplinary Science and Engineering, School of Environment and Society. He is appointed as Vice President for International Affairs in March 2019. He was also a part time researcher in National Institute of Information and Communications Technology from 2003 to 2007. His current research interests are the radio wave propagation and channel modeling for various wireless systems, applied radio measurements and information technology for regional/rural development. He is fellow of IEICE, senior member of IEEE, and member of Japan Society for International Development (JASID).

Assistant Professor Kentaro Saito

Assistant Professor Kentaro Saito was born in Kanagawa, Japan, in 1977. He received his B.S. and Ph.D. degrees from the University of Tokyo, Japan, in 2002 and 2008, respectively. He joined NTT DOCOMO, Kanagawa, Japan, in 2002. Since then, he has been engaged in the research of IP networks, transport technologies, MAC technologies, and radio propagation for mobile communication systems. He has been engaged in the development of the LTE base station. He joined Tokyo Institute of Technology, Japan in 2015. Since then, he has been engaged in research of radio propagation measurements and MIMO channel modeling. He is a senior member of IEICE and a member of IEEE.

Specially Appointed Lecturer Azril Haniz

Dr. Azril Haniz received the B.E. degree in electrical and electronic engineering in 2010, and the M.Eng and Dr.Eng. degrees from the Dept. of International Development Engineering in Tokyo Institute of Technology, Japan in 2012 and 2016, respectively. He is currently working as a specially appointed associate professor in the same university. He won the best student paper award in the Singapore-Japan International Workshop on Smart Wireless Communications (SmartCom) in 2014, and is a recipient of the 2016 Tejima Seiichi Doctoral Dissertation Award. He also won the best paper award in ICREST 2019. His research interests include localization, cognitive radio, sensor networks and signal processing. He is currently a member of IEEE and IEICE.

Our Research Interests

Takada Laboratory has been conducting research on the characterization and modeling of the radio propagation channel for wireless communications as well as the application of radio wave technology in various use cases. In particular, research on the radio propagation channel is conducted through extensive channel sounding measurements in various environments (indoor hall environment, urban microcells, subway tunnels, outdoor agricultural fields etc) and various frequency bands (UHF, SHF bands etc). In addition to measurements, simulations of the radio propagation channel are also conducted using several electromagnetic simulation techniques such as ray-tracing, physical optics (PO) and the parabolic equation method.

The use of radio wave technology for various applications is also a main topic of research for Takada Lab. Research on human motion and recognition using radio waves is conducted using measurement data obtained from commercial off-the-shelf Wi-Fi devices, and also through electromagnetic simulations of the human body. Application of radio wave technology for indoor and outdoor localization is also being considered, with hardware implementations using Raspberry Pi devices, and specialized hardware developed by collaborating companies.

Recent Research Topics

■ Channel sounding, propagation channel measurement and modeling

- Frequency Dependency Analysis of Clusters in Indoor Hall Environment at SHF Bands
- Visual Inspection of Scattering Objects for 11 GHz Urban Microcell Channel
- Superresolution Subspace-based Joint Delay and Angle of Arrival Estimation of Coherent Signals for Millimeter Wave Channel Sounding
- Research on the Formation of Radio Channel in Subway Train Control System
- Radio Propagation Channel Analysis and Modeling in Outdoor Agricultural Environments for Wireless Sensor Networks
- Radio Propagation Prediction in Tunnel using Parabolic Equation Method
- Path Loss Prediction by Artificial Neutral Network for Wireless Network Cell Planning
- Channel Capacity Evaluation of Large Array MIMO System from Propagation Parameters based on Directional Channel Model

■ Human motion and gesture recognition using radio waves

- Development of Hand Motion Tracking System using Channel State Information from Wi-Fi Devices
- Studies on Human Motion Recognition through wireless Sensing with Communication Signals

■ Application of radio technology for indoor and outdoor localization

- Device-free indoor localization utilizing BLE devices by controlling advertising channels
- Radio Map Interpolation for Localization of Unknown Radios

Frequency Dependency Analysis of Clusters in Indoor Hall Environment at SHF Bands

(A collaborative research with Aalborg University)

Due to the rapid increase in high data rate applications, 5G wireless systems exploiting several frequencies with large bandwidth have been considered. Frequency dependency analysis and characterization of multipath clusters is necessary as the channel performance depends strongly how they interact with interacting objects (IOs) in the environment, which varies across different frequencies. Thus, this study analyzes the frequency characteristics of clusters at SHF bands with the assistance of physical optics. **Fig. 1** shows the hall environment with the major cluster trajectories, and Table 1 shows the scattering intensities (SIs) of clusters at 3, 10 and 28 GHz bands, in which the cluster power is normalized by the free space at the same distance. Reflection from tube, pillar and elevator was the major mechanism where the clusters are frequency independent, whereas diffraction, scattering and Fresnel zone plate effect from elevator, stud, brick and plasterboard resulted in the various frequency characteristics.

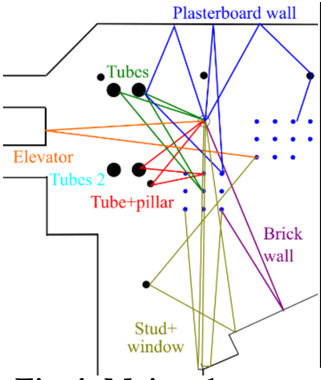

Fig. 1: Major cluster trajectories.

Object	Mechanism	SI mean (dB)		
		3 GHz	10 GHz	28 GHz
Tube	Reflection	-9.7	-9.2	-9.8
Elevator	Reflection, shadowing	-2.1	-2.2	-1.1
	3 GHz zone plate	5.3	0.7	0.9
	28 GHz zone plate	-2.1	-2.1	1.1
Tube+pillar	Reflection	-9.9	-10.6	-10.4
Stud+window	Diffraction	-9.4	-14.3	NA
	10 GHz zone plate	-6.5	-3.3	-8.8
Brick	Scattering	-5.4	-6.8	-10.9
Plasterboard	Scattering	-4.4	-7.3	-9.7
	Shadowing, scattering	-8.9	-13.1	-10.3

Table 1: SI of major clusters.

Visual Inspection of Scattering Objects for 11 GHz Urban Microcell Channel

The frequency bands in the range below 6 GHz are already congested with a limited bandwidth for further use due to the big amount of usage in the wireless services. To satisfy the demand of high data rates, it requires exploring higher frequency with wider bandwidth. At higher frequency, however, the attenuation due to the obstruction of propagation path is more obvious. Considering multiple input multiple output (MIMO) or massive MIMO technology, it is important to characterize the spatial property of the scattered paths for the evaluation of the performance under the line-of-sight obstruction. This study aims at understanding the governing mechanism of the non-line-of-sight propagation paths in a street microcell environment by identifying and characterizing the interacting objects (IO) which are visually identified by superposing the identified paths on to the spherical photo (**Fig.**). Double directional inspections ensure that we find the identical IO from both sides. The software S2 Lite A-GIS can identify the 3D location of the object via a GUI, so that empirical ray tracing is possible betwenen Tx, IO and Rx to calculate the propagation delay time, which then is compared with the measured delay time for further confirmation.

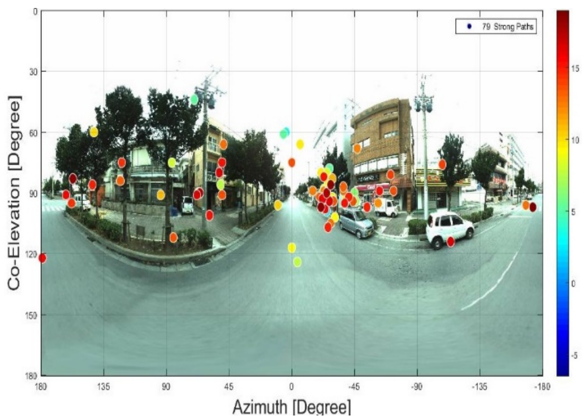

Fig. Spherical view at the Tx and measured paths colored with interaction loss.

Superresolution Subspace-based Joint Delay and Angle of Arrival Estimation of Coherent Signals for Millimeter Wave Channel Sounding

(A collaborative research with NTT)

Measurement campaign was conducted utilizing a 66.5 GHz channel sounder in an anechoic chamber. In order to estimate the parameters of the incoming wave, the subspace-based parameter estimation algorithm, specifically a variant of multiple signal classification (MUSIC) called JADE-MUSIC, is utilized to jointly estimate delay and angle of the multipaths. Accommodating the limitation of the algorithm in the coherent environment with multipaths of the same signal, smoothing preprocessing techniques is done in the frequency domain to decorrelate the incoming multipaths. Measured array response based on the calibration measurement data is also utilized to improve the estimation. The modifications towards JADE-MUSIC that was utilized showed better performance in estimating coherent multipaths.

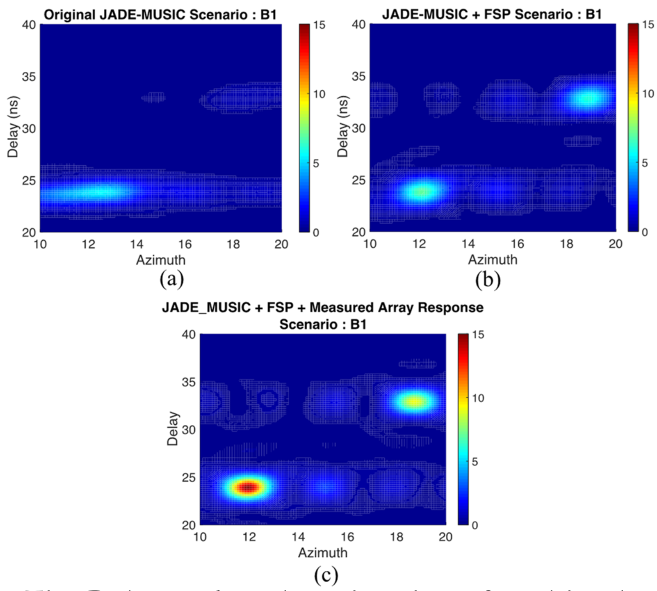

Fig. Delay and angle estimation of multipaths utilizing (a) JADE-MUSIC (b) JADE-MUSIC with FSP (c) JADE-MUSIC with FSP and measured array response.

Research on the Formation of Radio Channel in Subway Train Control System (A collaborative research with Kyosan Electric MFG. Co., LTD.)

Recently, radio communication is introduced for train control based on the advantage that it can simplify way side equipment and maintenance. We are studying three issues for the reliability improvement of the train control system called Communication-based Train Control, CBTC.

(1) Research on the radio wave propagation in a subway tunnel

(2) Research on the radio environment in a railway area, such as stations and way sides

(3) Research on the low rate communication under the congested environment of radio communication

Subway tunnels are rich in curves and slopes compared to high-speed railway tunnels. We would like to use radio waves to achieve better train control communication through research of radio wave propagation and interference. Radio wave propagation measurement campaign was conducted in a subway, and the congestion situation on a platform was simulated. Based on these measurements, we aim at developing a design method for suitable radio base station layout, and a wireless communication system based on analysis from ray-trace simulations and electromagnetic simulations.

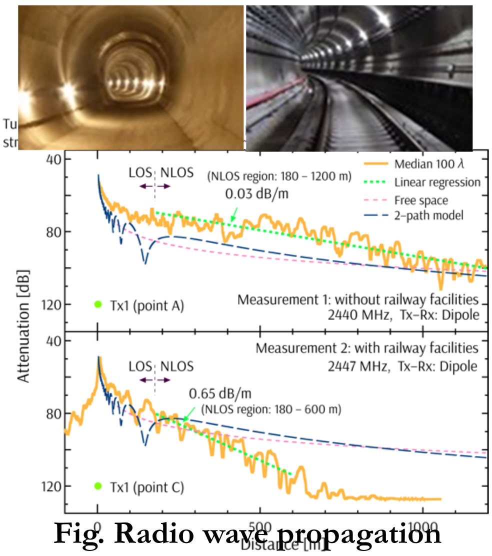

Fig. Radio wave propagation characteristics in a subway tunnel with and without railway facilities.

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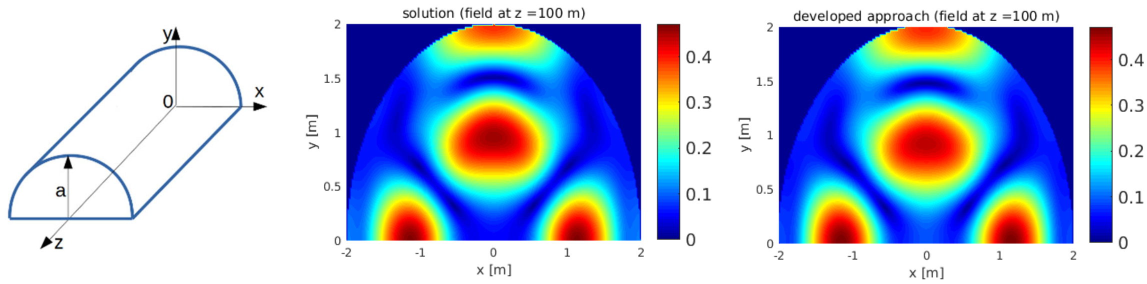
Radio Propagation Prediction in Tunnel using Parabolic Equation Method (A collaborative research with Kyosan Electric MFG. Co., LTD.)

Controlling the train using wireless communication is an alternative approach to the traditional wire-based approach. The knowledge of radio propagation characteristics in a tunnel is useful for designing such a controlling system. This research developed a radio propagation prediction approach using the Alternate direction implicit Parabolic Equation (ADI-PE) method. By applying the so-called six-points scheme together with the first order interior interpolation technique on the boundary wall of the tunnel, the general matrix form of ADI-PE is obtained. This form can be solved numerically. The figures present one of the validation results in which the developed approach is applied for the straight semi-circular cross section tunnel under the Neumann boundary condition with frequency =3 GHz, a = 2 and mesh size=0.2 λ , 0.2 λ and 5 λ in the x, y and z directions, respectively. It shows good agreement between the developed approach and the analytic solution of the waveguide theory. The agreement is even better if a smaller mesh size is used.



Radio Propagation Channel Analysis and Modeling in Outdoor Agricultural Environments for Wireless Sensor Networks

(A collaborative research with National Electronics and Computer Technology Center, Thailand. This work is partly supported by The Fujikura Foundation)

Information of the radio propagation path loss in an agriculture field is useful for wireless sensor network planning in smart farming. Using the measurement finding that the magnitude of vegetation obstruction causes the variation of the path loss in the field, this research proposed two path loss models for two common types of the tropical agriculture environments; the vegetation obstruction (VO) model for the tall food grass and the equivalent vegetation obstruction (EVO) model for the fruit orchard. Especially, this research developed the approach to determine the equivalent vegetation obstruction by using the electromagnetic simulation. The figures present one of the validation results of the proposed model where the measurement was conducted in a sugarcane field (tall food grass type) with different angular directions. This confirms that the proposed model can represent the measurement results in every angular direction well. Therefore, this model can be used to predict the loss at any point in the field.

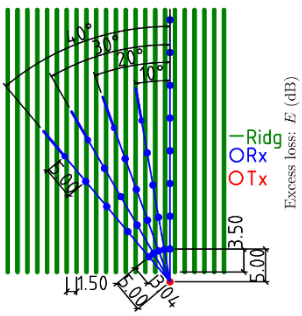


Fig. 1: Part of the measurements in sugarcane field.

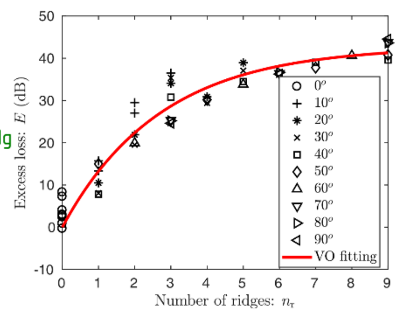


Fig. 2: Measurement result fitted with the VO model in sugarcane field.

Path Loss Prediction by Artificial Neutral Network for Wireless Network Cell Planning (This work is supported by MIC SCOPE No. 185103006)

As global mobile traffic is forecasted to increase, more devices will be connected to wireless networks. We have to deploy more efficient wireless networks to satisfy the growing demands. Path loss information is vital for determination of coverage and optimization efficiency of wireless networks. Therefore we propose path loss prediction model based on artificial neutral network (ANN) and ray tracing (RT) simulations for wireless network cell planning.

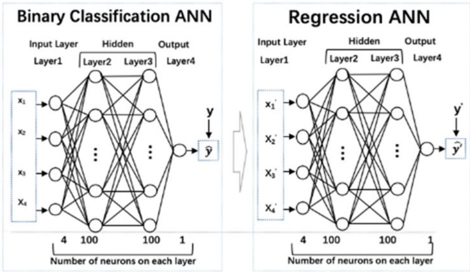


Fig. 1: ANN structure.

Due to constraint conditions in RT simulations, we obtain two types of data, continuous and discrete. Since discrete data is not suitable for directly performing regression, as **Fig. 1** shows we proceed in two steps. We first adopt a binary classification ANN model for predicting whether the receiver is located inside or outside the targeted area, and then we utilize a regression ANN model for estimating path loss only for in-area located receivers. By iteratively utilizing both ANN models we can obtain the path loss distribution for a relatively complicated environment as **Fig. 2** shows.

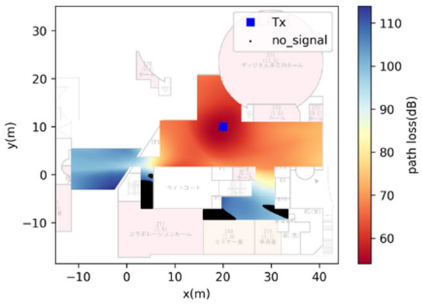


Fig. 2: Path loss distribution.

Channel Capacity Evaluation of Large Array MIMO System from Propagation Parameters based on Directional Channel Model

In recent years, with the spread of various application services using the network, the demand for high speed mobile radio communication system is increasing. In such a system, Multi-Input, Multi-Output (MIMO) transmission aiming at realizing a high data rate has attracted attention as one of the main technologies. Furthermore, because of the congestion in low frequency, we need to utilize higher frequency with large bandwidth. However, the higher frequency will cause shorter propagation range, so the directional channel will be applied to solve this problem. Meanwhile, the directional channel parameter used for the evaluation of the MIMO channel needs to be measured with element spacing of the array antenna being less than half a wavelength, so it becomes a comparatively small array antenna and the angular resolution is also restricted. Therefore, it is not always applicable to large array antennas. From the above, we aim to evaluate the predictable range by predicting the channel response of a large array antenna using the propagation parameters measured by a small array antenna, and compare it with the actual result measured by the large array antenna. Figure shows the eigenvalue percentile result of the measurement and synthesis data. From the figure, we can see a very good agreement between the measurement result and synthesis result.

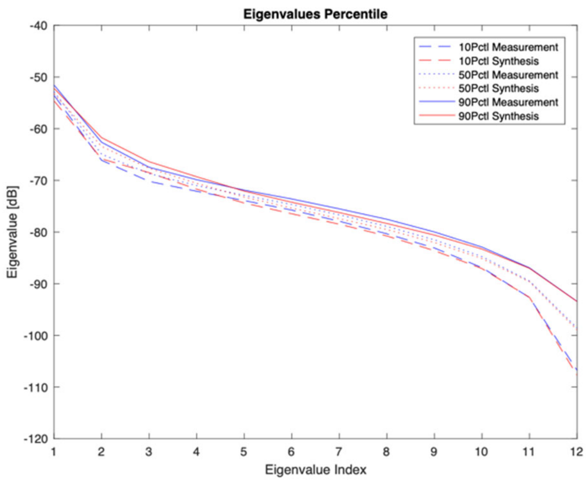


Fig. Eigenvalue percentile of measurement and synthesis data.

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Development of Hand Motion Tracking System using Channel State Information from Wi-Fi Devices Calibration of CSI Phase Rotation Utilizing B2B Connection

(This work is partly supported by The Fujikura Foundation)

Wi-Fi has been widely leveraged in RF motion sensing due to its low cost, ubiquitous, and easiness to deploy. In the presence of any motion, the phase component of channel state information (CSI) will experience temporal rotation due to the change of propagation delay, and this phenomenon is the key to sense the motion. In practice, however, the time-varying frequency offset of local oscillators (LOs) between two Wi-Fi transceivers due to the absence of synchronization obscures the CSI phase. Therefore, it is virtually impossible to realize motion analysis without acquiring the parameters that cause this undesired rotation from Wi-Fi chips.

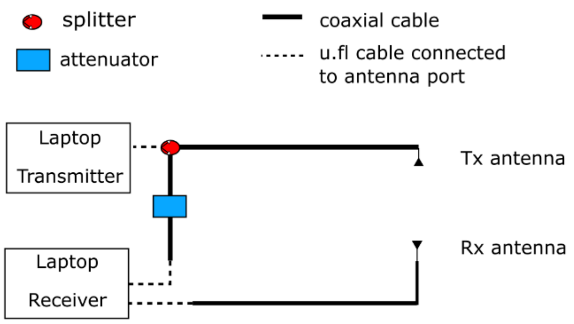

Fig. 1 ×2 SIMO configuration of the proposed b2b calibration.

Our work introduces the use of a back-to-back (b2b) channel as the reference CSI to effectively suppress the phase rotation without contaminating the target CSI itself. An experiment was performed to compare the calibrated CSI with the channel measured using a Vector Network Analyzer as ground truth. The results have successfully shown similarity of the CSI phase component relative to the ground truth albeit with the constant residual phase offset. After removing the constant residual offset, the CSI phase closely resembled the ground truth with 0.117 radians root mean square error (RMSE).

Studies on Human Motion Recognition through wireless Sensing with Communication Signals

Electromagnetic signals from communication devices can be also used for wireless sensing. This potentially leads to contact-less, device-less, camera-less applications of human motion recognition by ubiquitous radio frequency (RF) sensing. However, the time-variant physical phenomena of RF scattering from deformable biological human bodies are complicated, which depend on many factors such as shape, material properties, polarization, geometry, etc. And there is a lack of extensive data for analysis because it is difficult and costly to get by measurement. In this research, physically plausible large data is generated. This deterministic and flexible simulator uses inputs of measured motion data, generative human models in various postures, and a numerical EM high frequency asymptotic method of physical optics (PO). Results shows the importance of doppler signature and the geometry dependent nature of RF sensing, and a simple classifier can be built with inputs of such time-frequency spectrograms.

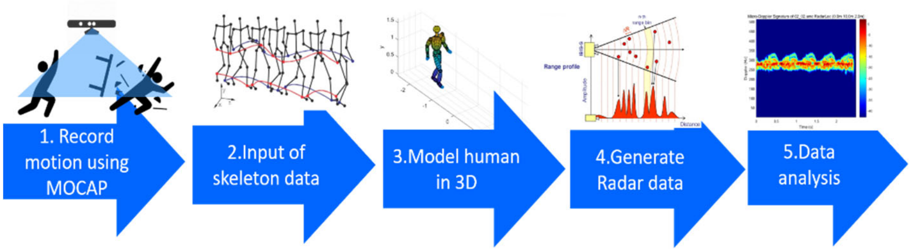

Fig. Methodology.

Device-free indoor localization utilizing BLE devices by controlling advertising channels

Recently indoor localization systems have become a focus of research and development. In this research, a device-free indoor localization system by utilizing Raspberry Pi2 is established. The fingerprinting technique is employed. In our proposed system, the Received Signal Strength Indicator (RSSI) of Bluetooth Low Energy (BLE) signals are used as location fingerprints. BLE is a narrow band communication system and transmits advertising packets on three different frequency channels. In conventional approaches, the RSSI from each frequency channel is not individually considered, thus it may suffer from large fluctuations, resulting in low localization accuracy. Therefore, in this study, two methods are utilized to employ channel specific features. First, the device is controlled to transmit advertisements on one pre-set advertising channel. Second, all the advertisements with known channel numbers are received one by one. Thus, we can have triple features at one position's fingerprint, resulting in possibly better localization accuracy. Experiments were conducted in office environment and results showed that combining of all the advertising channels with their channel numbers can achieve better results.

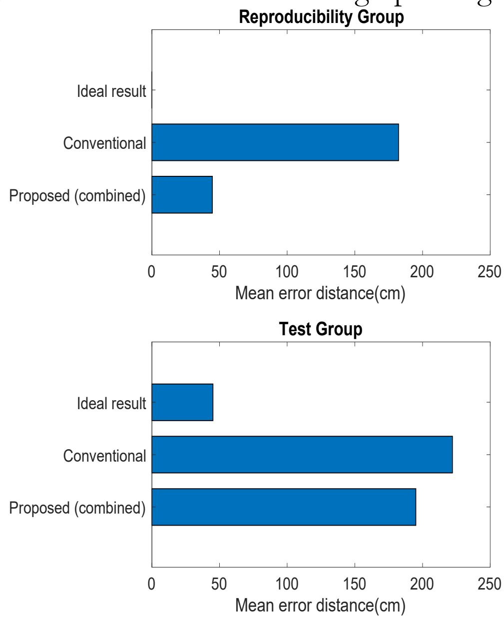

Fig. Localization accuracy of proposed system.

Radio Map Interpolation for Localization of Unknown Radios

(A collaborative research with Koden Electronics Co., Ltd.)

Conventional localization based on radio maps, also known as fingerprinting, is only reliable in scenarios where the center frequency of the target radio is the same as that used when constructing the radio map. However, for unknown radios, it is very unlikely that the precise center frequency used is known in advance. In order to address this issue, a novel approach to interpolate the radio map is proposed in this research. Firstly, the RSS radio map is measured at multiple frequencies, and hardware architecture which can support the sequential measurement of a multi-frequency radio map is also proposed. Then, a novel algorithm is employed to interpolate the radio map in the frequency and spatial domains, based on the log-linear frequency characteristics and spatial correlation of the RSS, respectively. In order to evaluate the proposed algorithm, a measurement campaign was conducted in the Tokyo Tech O-okayama campus area. The radio map measured at two different center frequencies was used to predict the radio map at 1297MHz. Results showed that the sproposed algorithm could achieve a RMSE (root mean squared error) of about 2.5dB on average, which led to an improvement of localization accuracy by about 5m.

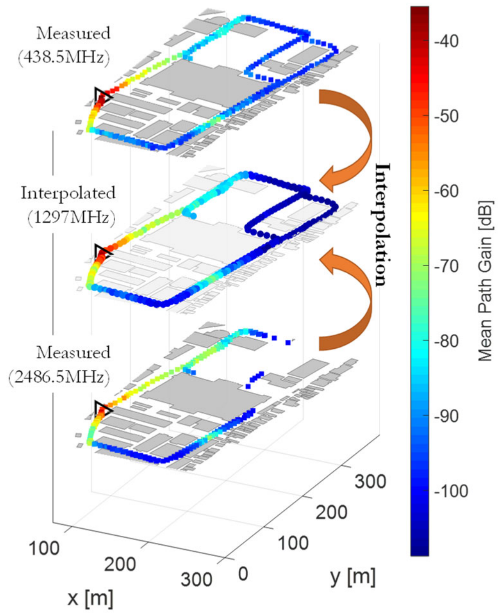

Fig. Measured and interpolated radio maps in O-okayama campus.

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Transactions and Letters

[1] Sukhumarn Archasantisuk, Takahiro Aoyagi, Min-Seok Kim, and Jun-ichi Takada, "Temporal correlation model-based transmission power control in wireless body area network," IET Wireless Sensor Systems, (9 p), Apr. 2018.
[2] Shengru Li, Shinobu Yamaguchi, and Jun-ichi Takada, "The Influence of Interactive Learning Materials on Self-Regulated Learning and Learning Satisfaction of Primary School Teachers in Mongolia," Sustainability, vol. 10, no. 4, 1093 (19 p), Apr. 2018.
[3] Kosorl Thourn, Takahiro Aoyagi, and Jun-ichi Takada, "Development of Broadband Parametric Permittivity Model of Dielectric Absorbing Material for Time-domain Electromagnetic Wave Simulation," IEEJ Transactions on Fundamentals and Materials, vol.138, no.6, pp.302-308, Jun. 2018.
[4] Kentaro Saito, Yunyi Yao, and Jun-ichi Takada, "Parameter estimation refinement of MIMO propagation channel by nonlinear conjugate gradient approach," IEICE Communications Express, vol. 7, no. 9, pp. 328-333, Sep. 2018.
[5] Brecht Hanssens, Kentaro Saito, Emmeric Tanghe, Luc Martens, Wout Joseph, and Jun-ichi Takada, "Modeling the Power Angular Profile of Dense Multipath Components using Multiple Clusters," IEEE Access, vol. 6, pp. 56084-56098, Sep. 2018.
[6] Yu Tao, Azril Haniz, Kentaro Sano, Ryosuke Iwata, Ryouta Kosaka, Yusuke Kuki, Gia Khanh Tran, Jun-ichi Takada, Kei Sakaguchi, "A Guide of Fingerprint Based Radio Emitter Localization Using Multiple Sensors (invited)," IEICE Transactions on Communications, vol. E101-B, no. 10, pp. 2104-2119, Oct. 2018.
[7] Yang Miao, Jun-ichi Takada, Kentaro Saito, Katsuyuki Haneda, Andres Alayon Glazunov, and Yi Gong, "Comparison of Plane Wave and Spherical Vector Wave Channel Modeling for Characterizing Non-Specular Rough-Surface Wave Scattering," IEEE Antennas and Wireless Propagation, vol. 17, no. 10, pp. 1847-1851, Oct. 2018.
[8] Hiroki Ohara, Hirokazu Sawada, Masayuki Oodo, Fumihide Kojima, Hiroshi Harada, Kentaro Saito, and Jun-ichi Takada, "Characterization of Broadband Mobile Communication Channel in 200 MHz Band Based on Saleh-Valenzuela Model," IEICE Transactions on Communications, vol. E101-B, no.11, pp. 2277-2288, Nov. 2018.
[9] Kentaro Saito, Qiwei Fan, Nopphon Keerativoranan, and Jun-ichi Takada, "Vertical and Horizontal Building Entry Loss Measurement in 4.9 GHz Band by Unmanned Aerial Vehicle," IEEE Wireless Communications Letters, accepted.
[10] Tossaporn Srisooksai, Kamol Kaemarungsi, Jun-ichi Takada, and Kentaro Saito, "Radio Propagation Measurement and Characterization in Outdoor Tall Food Grass Agriculture Field for Wireless Sensor Network at 2.4 GHz Band," Progress In Electromagnetics Research C, Vol. 88, 43-58, 2018.
[11] Guojin Zhang, Kentaro Saito, Wei Fan, Xuesong Cai, Panawit Hanpinitsak, Jun-ichi Takada, and Gert Frolund Pedersen, "Experimental Characterization of Millimeter-Wave Indoor Propagation Channels at 28 GHz," IEEE Access, vol. 6, pp. 76516-76526, 2018.
[12] Nopphon Keerativoranan, Azril Haniz, Kentaro Saito, and Jun-ichi Takada, "Mitigation of CSI Temporal Phase Rotation with B2B Calibration Method for Fine-Grained Motion Detection Analysis on Commodity Wi-Fi Devices," Sensors, vol. 18, no. 11, pp. 3795 (1-18), Nov. 2018.
[13] Yang Miao, Wei Fan, Jun-ichi Takada, Ruisi He, Xuefeng Yin, Mi Yang, Jose Rodriguez-Pineiro, Andres Alayon Glazunov, Wei Wang, and Yi Gong, "Comparing Channel Emulation Algorithms by Using Plane Waves and Spherical Vector Waves in Multi-Probe Anechoic Chamber Setups," IEEE Transactions on Antennas and

Propagation, early access.
[14] Tossaporn Srisooksai, Kamol Kaemarungsi, Junichi Takada, and Kentaro Saito, "Path Loss Measurement and Prediction in Outdoor Fruit Orchard for Wireless Sensor Network at 2.4 GHz Band," Progress In Electromagnetics Research C, vol. 90, pp. 237-252, 2019.

International Conference

[15] Brecht Hanssens, Emmeric Tanghe, Wout Joseph, Luc Martens, Kentaro Saito, Jun-ichi Takada, and Claude Oestges, "Modeling the Power Angular Profile of Dense Multipath Components Using Multiple Clusters," 12th European Conference on Antennas and Propagation (EUCAP 2018), Apr. 2018 (London, UK).
[16] Kentaro Saito, Panawit Hanpinitsak, Jun-ichi Takada, Wei Fan, and Gert F. Pedersen, "Frequency Dependency Analysis of SHF band Directional Propagation Channel in Indoor Environment," 12th European Conference on Antennas and Propagation (EUCAP 2018), Apr. 2018 (London, UK).
[17] Yuji Hirai, Shinobu Yamaguchi, and Jun-ichi Takada, "Relationship between communication channels among teachers and the diffusion of teachers' ICT use in rural Mongolian education," 62nd Annual Conference of Comparative and International Education Society (CIES 2018), Mar. 2018 (Mexico City, Mexico).
[18] Shengru Li, Shinobu Yamaguchi, Jun-ichi Takada, and Javzan Sukhbaatar, "The effects of interactive learning materials on self-regulated learning and learning outcome in the case of Mongolian primary school teachers," 62nd Annual Conference of Comparative and International Education Society (CIES 2018), Mar. 2018 (Mexico City, Mexico).
[19] Xin Du, Kentaro Saito, Jun-ichi Takada, Mitsuki Nakamura, Motoharu Sasaki, and Yasushi Takatori, "Shadowing Measurement of Various Obstacles on Millimeter-Wave Bands in Indoor Environment," 2018 Asian Workshop on Antennas and Propagation (AWAP 2018), July 2018 (Pattaya, Thailand).
[20] Kentaro Saito, Qiwei Fan, Nopphon Keerativoranan, and Jun-ichi Takada, "4.9 GHz Band Outdoor-to-Indoor Radio Propagation Measurement by an Unmanned Aerial Vehicle," 2018 Asian Workshop on Antennas and Propagation (AWAP 2018), July 2018 (Pattaya, Thailand).
[21] Tossaporn Srisooksai, and Jun-Ichi Takada, "Application of Hybrid T-matrix Method to Predict Vegetation Attenuation in Outdoor Agriculture Orchard and Comparison with Measurement," Progress In Electromagnetics Research Symposium (PIERS) 2018 Toyama, Aug. 2018 (Toyama, Japan).
[22] Makoto Sumi, and Jun-ichi Takada, "Unsymmetrical Rectangular Loops with Gaps for GNSS Applications," Progress In Electromagnetics Research Symposium (PIERS) 2018 Toyama, Aug. 2018 (Toyama, Japan).
[23] Nopphon Keerativoranan, Kentaro Saito, and Jun-Ichi Takada, "A Study of Hand Motion Trajectory Tracking by Utilizing Channel State Information of off-the-shelf Wi-Fi Devices," Progress In Electromagnetics Research Symposium (PIERS) 2018 Toyama, Aug. 2018 (Toyama, Japan).
[24] Kentaro Saito, Qiwei Fan, Nopphon Keerativoranan, and Jun-ichi Takada, "4.9 GHz band Outdoor-to-Indoor Radio Propagation Measurement by an Unmanned Aerial Vehicle," 2018 IEEE International Workshop on Electromagnetics (iWEM 2018), Aug. 2018 (Nagoya, Japan).
[25] Kentaro Saito, Panawit Hanpinitsak, Wei Fan, Jun-ichi Takada, and Gert F. Pedersen, "Frequency Characteristics of Diffuse Scattering in SHF band in Indoor Environments," COST IRACON 8th MCM TD(18)08040, Oct. 2018 (Podgorica, Montenegro).
[26] Djiby Marema Diallo, Jun-ichi Takada, and Kentaro Saito, "Identification of Scattering

Objects for 11 GHz Urban Microcell Radio Channel via Visual Inspection," The 5th International Workshop on Smart Wireless Communications (SmartCom 2018), IEICE Technical Report, vol. 118, no. 274, SR2018-77, pp. 41-43, Oct. 2018 (Bangkok, Thailand).

[27] Junming Jiang, Azril Haniz, Kentaro Saito, and Jun-ichi Takada, "Device-free Indoor Localization utilizing BLE devices by controlling advertisement channels," The 5th International Workshop on Smart Wireless Communications (SmartCom 2018), IEICE Technical Report, vol. 118, no. 274, SR2018-85, pp. 63-70, Oct. 2018 (Bangkok, Thailand).

[28] Jun-ichi Takada, "Sustainable Engineering Technology for International Development (session introduction)," 2018 Korean Association of International Development and Cooperation (KAIDEC) Winter Meeting, Dec. 2018 (Seoul, Korea).

[29] Jun-ichi Takada, "Challenges of Grassroot Deployment of ICT - A Case Study in Luang Prabang World Heritage, Lao PDR (invited)," 2018 Korean Association of International Development and Cooperation (KAIDEC) Winter Meeting, Dec. 2018 (Seoul, Korea).

[30] Azril Haniz, Gia Khanh Tran, Kei Sakaguchi, Jun-ichi Takada, Toshihiro Yamaguchi, Tsutomu Mitsui, and Shintaro Arata, "Construction and Interpolation of a Multi-frequency Radio Map," International Conference on Robotics, Electrical and Signal Processing Techniques (ICREST 2019), Jan. 2019 (Dhaka, Bangladesh).

[31] Tossaporn Srisooksai, Kamol Kaemarungsi, Jun-ichi Takada, and Kentaro Saito, "Small-fading and Wideband Propagation Characteristics in Fruit Orchard at 2.4 GHz for Wireless Network in Smart Farming Application," International Conference on Robotics, Electrical and Signal Processing Techniques (ICREST 2019), Jan. 2019 (Dhaka, Bangladesh).

[32] Guojin Zhang, Panawit Hanpinitsak, Xuesong Cai, Wei Fan, Jun-ichi Takada, Kentaro Saito, and Gert F. Pedersen, "Millimeter-Wave Channel Characterization at Large Hall Scenario in the 10 and 28 GHz Bands," 13th European Conference on Antennas and Propagation (EUCAP 2019), Mar. 2019 (Krakow, Poland).

Domestic Conference

[33] Panawit Hanpinitsak, Kentaro Saito, Jun-ichi Takada, Wei Fan, and Gert F. Pedersen, "Frequency Dependency Analysis of Multipath Clusters of Indoor Propagation Channel in SHF Bands," Japanese URSI-F Meeting, no. 623, May 2018 (Meguro, Tokyo).

[34] Kosuke Murakami, Kentaro Saito, and Jun-ichi Takada, "Development of 12GHz Band SIMO Channel Sounder using Radio-on-Fiber Technology," Japanese URSI-F Meeting, no. 623, May 2018 (in Japanese, Meguro, Tokyo).

[35] Jiayue Cheng, Kentaro Saito, and Jun-ichi Takada, "Visualization of Indoor Radio Wave Propagation by Using Augmented Reality Technology," 10th Multidisciplinary International Student Workshop (MISW2018), P-15, Aug. 2018 (Meguro, Tokyo).

[36] Dan Qiao, Kentaro Saito, and Jun-ichi Takada, "Diffuse Scattering Prediction for High Frequency Band," 10th Multidisciplinary International Student Workshop (MISW2018), P-20, Aug. 2018 (Meguro, Tokyo).

[37] Ahmad Salaam Mirfananda, Takada Jun-ichi, and Kentaro Saito, "Dynamic Channel Modeling in Millimeter Wave for Next Generation Wireless System," 10th Multidisciplinary International Student Workshop (MISW2018), A2-4, Aug. 2018 (Meguro, Tokyo).

[38] Tan Yong Hong, Kentaro Saito, and Jun-ichi Takada, "Rain Attenuation for Millimeter Wave Fixed Wireless Access System," 10th Multidisciplinary International Student Workshop (MISW2018), C2-2, Aug. 2018 (Meguro, Tokyo).

[39] Zhihang Chen, Kentaro Saito, Jun-ichi Takada, "SLAM-based Indoor 3D Environment Modeling for Electromagnetic Simulation," 10th Multidisciplinary International Student Workshop

(MISW2018), C2-4, Aug. 2018 (Meguro, Tokyo).
[40] Nopphon Keerativoranan, Kentaro Saito, and Jun-ichi Takada, "Calibration of Wi-Fi Phase Channel State Information for Dynamic Motion Analysis," 10th Multidisciplinary International Student Workshop (MISW2018), C2-5, Aug. 2018 (Meguro, Tokyo).
[41] Katsumi Seki, Kentaro Saito, and Jun-ichi Takada, "Improvement of Position Logging Accuracy for UAV-based Radio Measurement System," 10th Multidisciplinary International Student Workshop (MISW2018), E1-1, Aug. 2018 (Meguro, Tokyo).
[42] Deepak Gautam, Jun-ichi Takada, and Kentaro Saito, "Development of Measurement-based Radio Environment Map for Dynamic Spectrum Access," 10th Multidisciplinary International Student Workshop (MISW2018), E1-2, Aug. 2018 (Meguro, Tokyo).
[43] Traitip Siriruang, and Jun-ichi Takada, "Effects of the Study Abroad Program in ASEAN on Thai Students: ASEAN Awareness," 10th Multidisciplinary International Student Workshop (MISW2018), E1-4, Aug. 2018 (Meguro, Tokyo).
[44] Kosuke Murakami, Kentaro Saito, and Jun-ichi Takada, "Performance Analysis of Channel Sounding System Based on Radio-on-Fiber Technology," 10th Multidisciplinary International Student Workshop (MISW2018), E1-5, Aug. 2018 (Meguro, Tokyo).
[45] Haitao Pang, and Jun-ichi Takada, "Gesture Recognition with Wireless Devices," 10th Multidisciplinary International Student Workshop (MISW2018), E2-1, Aug. 2018 (Meguro, Tokyo).
[46] Djiby Marema Diallo, Jun-ichi Takada, and Kentaro Saito, "Visual Inspection Of Scattering Objects for 11 GHz Urban Microcell Channel," 10th Multidisciplinary International Student Workshop (MISW2018), E2-2, Aug. 2018 (Meguro, Tokyo).
[47] Azril Haniz, Gia Khanh Tran, Kei Sakaguchi, Jun-ichi Takada, Toshihiro Yamaguchi, Tsutomu Mitsui, Shintaro Arata, "Localization of Unknown Radios in Urban Environments -- On-campus Experiment Results," IEICE Technical Report, SRW2018-20, Aug. 2018 (Okayama).
[48] Kentaro Saito, Yukiko Kishiki, Jun-ichi Takada, "3-Dimensional Map Generation by User Camera and Depth Sensor Data and Application to Radio Propagation Simulation," 2018 IEICE Society Conference, BP-2-1, Sep. 2018 (in Japanese, Kanazawa, Ishikawa).
[49] Azril Haniz, Gia Khanh Tran, Kei Sakaguchi, Jun-ichi Takada, Toshihiro Yamaguchi, Tsutomu Mitsui, Shintaro Arata, "Multi-frequency Radio Map Database Construction and its Application in Positioning," 2018 IEICE Society Conference, BP-2-3, Sep. 2018 (Kanazawa, Ishikawa).
[50] Haitao Pang, Jun-ichi Takada, "Human Motion Recognition through Sensing with Telecommunication Devices," IEICE Multiple Innovative Kenkyu-kai Association for Wireless Communication (MIKA 2018), Sep. 2018 (Ito, Shizuoka).
[51] Kosuke Murakami, Kentaro Saito, Jun-ichi Takada, "Performance Analysis of 1x16 SIMO Channel Sounding System in 12 GHz Based on Radio-on-Fiber Technology," IEICE Multiple Innovative Kenkyu-kai Association for Wireless Communication (MIKA 2018), Sep. 2018 (Ito, Shizuoka).
[52] Itsuki Uemura, Shinobu Yamaguchi, and Jun-ichi Takada, "Analysis of Landscape Change in World Heritage Site - Case of Luang Prabang, Lao P.D.R," 29th Annual Conference of JASID, Nov. 2018 (Tsukuba, Ibaraki).
[53] Yiqiong Mai, Shinobu Yamaguchi, Jun-ichi Takada, and Shengru Li, "The influence of interactive learning materials on Self-Regulated Learning (SRL) processes and learning outcomes of primary school teachers," 29th Annual Conference of JASID, Nov. 2018 (Tsukuba, Ibaraki).
[54] Shengru Li, Shinobu Yamaguchi, and Jun-ichi Takada, "Understanding the self-regulatory processes affecting learning satisfaction and intention to apply learning contents in the case of

Mongolian primary school teachers," 29th Annual Conference of JASID, Nov. 2018 (Tsukuba, Ibaraki).

[55] Zhihang Chen, Kentaro Saito, Wataru Okamura, Yukiko Kishiki, and Jun-ichi Takada, "3D Point Cloud Data Simplification Method for Electromagnetic Simulation in Indoor Environment," IEICE Technical Report, SRW2018-49, Jan. 2019 (Kamakura, Kanagawa).

[56] Wataru Okamura, Yuki Matsuyama, Yuikiko Kishiki, Zhihang Chen, Kentaro Saito, Jun-ichi Takada, "Modeling Method for Ray Trace Simulation using 3D Point Cloud Data and Evaluation of Radiowave Propagation in Indoor Environment," IEICE Technical Report, AP2018-173, Feb. 2019 (Osaka).

[57] Nopphon Keerativoranan, and Jun-ichi Takada, "Development of Doppler CSI model for Wi-Fi based hand gesture detection application," IEICE Technical Report, ASN2018-111, Mar. 2019 (Meguro, Tokyo).

[58] Xin Du, Kentaro Saito, Jun-ichi Takada, Mitsuki Nakamura, Motoharu Sasaki, and Yasushi Takatori, "Shadowing Effect Prediction based on Physical Optics Approach for Millimetre Wave Mobile Communication," IEICE Technical Report, AP2018-192, Mar. 2019 (Fukushima).

[59] Jun-ichi Takada, Kentaro Saito, On the Prediction of the Over-the-Rooftop Propagation Loss in Urban Macrocellular Environments," 2019 IEICE General Conference BS-1-12, Mar. 2019 (Shinjuku, Tokyo),

[60] Yongri Jin, Kentaro Saito, Jun-ichi Takada, "Path Loss Prediction by Artificial Neural Network," 2019 IEICE General Conference, B-19-7, Mar. 2019 (Shinjuku, Tokyo).