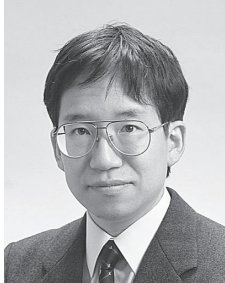


Foundation of Computer Science Laboratory



Takafumi Hayashi
Professor



Shuxue Ding
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TSAI Joseph Cheng-wei
Special Researcher

The research and education activities in the laboratory focus on the theoretical foundations of computers and computations, including broad applications in computer science and engineering. Our work covers algorithms and computation, programming languages, discrete mathematics, statistical signal processing, cryptography, neuro-computing, optimization, simulated acoustics and related topics.

Areas of our research interest include

- Combinatorics and its applications;
- Application of Information Geometry to Big Data analysis
- Application of Robust Computational Geometry and Ultra Discrete to Information Geometry
- Spread spectrum communication;
- Sparse representation and sparse component analysis;
- Content-Aware networking;
- Secure Cloud Computing, SOA, xAAS;
- Quantum cryptography,
- Signal processing;
- Image analysis for measurement;
- Enterprise Integration and Messaging Network:

- Information Security Management;
- Networks;
- GRID as a Service Oriented Architecture Based System;
- Security and management of computer system for e-Government;
- Blind source separation and independent component analysis, and their applications in acoustic signals and vital signs;
- Neural computing and brain-style signal processing;
- Optimization and machine learning;
- Time-reversal wave propagation in ergodic environment and its applications in acoustics, ultrasonics and telecommunications;
- Information theory and algorithmic complexity.
- smart grid
- radar pulse compression
- Computational Geometry
- Information Theory

The following combined research is running:

- independent component analysis and sequence design.
- independent component analysis and network anomaly detection.
- distributed data store grids loosely coupled integration and cryptography.

Faculty of the FCS laboratory teach Computer Literacy, Programming I, Algorithms and Data Structures, Advanced Algorithms, Digital Signal Processing, Statistical Signal Processing, Introduction to Topology, Information Security, SC-CPs and other selective courses. Students join faculty research and also develop their own research themes. Our laboratory participate in various research projects of JSPS, NIFS, RIKEN, ISM, AIST, University of Tokyo, Kyoto University, and Tohoku University.

Refereed Journal Papers

- [sdng-01:2013] Yan Sun and Shuxue Ding. An Enhanced Wu-Huberman Algorithm with Pole Point Selection Strategy. *Abstract and Applied Analysis*, 2013:Article ID 589386, 1–6, 2013.

The Wu-Huberman clustering is a typical linear algorithm among many clustering algorithms, which illustrates data points relationship as an artificial “circuit” and then applies the Kirchhoff equations to get the voltage value on the complex circuit. However, the performance of the algorithm is crucially dependent on the selection of pole points. In this paper, we present a novel pole point selection strategy for the Wu-Huberman algorithm (named as PSWH algorithm), which aims at preserving the merit and increasing the robustness of the algorithm. The pole point selection strategy is proposed to filter the pole point by introducing sparse rate. Experiments results demonstrate that the PSWH algorithm is significantly improved in clustering accuracy and efficiency compared with the original Wu-Huberman algorithm.

- [sdng-02:2013] Zunyi Tang and Shuxue Ding. Dictionary Learning with Incoherence and Sparsity Constraints for Sparse Representation of Non-negative Signals. *IEICE Transactions on Information and Systems*, E96-D(5):1192–1203, 2013.

This paper presents a method for learning an overcomplete, nonnegative dictionary and for obtaining the corresponding coefficients so that a group of nonnegative signals can be sparsely represented by them. This is accomplished by posing the learning as a problem of nonnegative matrix factorization (NMF) with maximization of the incoherence of the dictionary and of the sparsity of coefficients. By incorporating a dictionary-incoherence penalty and a sparsity penalty in the NMF formulation and then adopting a hierarchically alternating optimization strategy, we show that the problem can be cast as two sequential optimal problems of quadratic functions. Each optimal problem can be solved explicitly so that the whole problem can be efficiently solved, which leads to the proposed algorithm, i.e., sparse hierarchical alternating least squares (SHALS). The SHALS algorithm is structured by iteratively solving the two optimal problems, corresponding to the learning process of the dictionary and to the estimating process of the coefficients for reconstructing the signals. Numerical experiments demonstrate that the new algorithm performs better than the nonnegative K-SVD (NN-KSVD)

algorithm and several other famous algorithms, and its computational cost is remarkably lower than the compared algorithms.

- [sding-03:2013] Xiaohong Ma, Shuxue Ding, Liangsheng Wei, and Jie Yang. Blind Identification of Underdetermined Mixing Matrix and Source Separation by Finding and Solving a Row Echelon-Like Form of System in the Time-Frequency Domain. *ICIC Express Letters, Part B: Applications*, 4(3):739–746, 2013.

This paper presents a novel two step underdetermined blind source separation approach for non-disjointed signals. First, the single-source-points (SSPs), each of that is occupied by a single source, are detected in the mixtures; the mixing matrix is then estimated accurately by employing K-means algorithm among those SSPs. In the separation procedure, we finds the time-frequency points that incorporates one source, two sources, and so on, so that they construct a row echelon-like form a system. Then, these sources at the points can be solved out explicitly under weak assumptions. The highlight is that algorithm does not rely on the non-stationarity, independence or the non-Gaussianity, as in the conventional ICA algorithms. Experimental results indicate the validity of the method.

- [sding-04:2013] Zunyi Tang, Shuxue Ding, Zhenni Li, and Linlin Jiang. Dictionary Learning Based on Nonnegative Matrix Factorization Using Parallel Coordinate Descent. *Abstract and Applied Analysis*, 2013:Article ID 259863, 1–11, 2013.

Sparse representation of signals via an overcomplete dictionary has recently received much attention as it has produced promising results in various applications. Since the nonnegativities of the signals and the dictionary are required in some applications, for example, multispectral data analysis, the conventional dictionary learning methods imposed simply with nonnegativity may become inapplicable. In this paper, we propose a novel method for learning a nonnegative, overcomplete dictionary for such a case. This is accomplished by posing the sparse representation of nonnegative signals as a problem of nonnegative matrix factorization (NMF) with a sparsity constraint. By employing the coordinate descent strategy for optimization and extending it to multivariable case for processing in parallel, we develop a so-called parallel coordinate descent dictionary learning (PCDDL) algorithm, which is structured by iteratively solving the two optimal problems, the learning process of the dictionary and the estimating process of the coefficients for constructing the signals. Numerical experiments demonstrate that

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the proposed algorithm performs better than the conventional nonnegative K-SVD (NN-KSVD) algorithm and several other algorithms for comparison. What is more, its computational consumption is remarkably lower than that of the compared algorithms.

[sding-05:2013] Zhenni Li, Changshui Yu, Shuxue Ding, and Zunyi Tang. Nondestructive Probing Scheme of Quantum State without Quantum Correlation. *International Journal of Theoretical Physics*, 52(7):1–7, 2013.

We study a scheme that an auxiliary qubit is introduced for probing the information of the given bipartite quantum state, while the correlations of the probed quantum state and even the probed state itself are not disturbed after the probing, which means nondestructive probing. We find that, in order to guarantee the invariance of the correlations of the probed state, neither quantum entanglement nor quantum discord between the auxiliary qubit and the probed states can be present. This could make us reconsider the role of quantum correlation in some quantum information processing tasks.

[sding-06:2013] Yan Sun, Ying Bai, Shuxue Ding, Yi-Yuan Tang, Yifen Cui, and Yan Wang. Intelligent Diagnostic System for Cerebrovascular Diseases Based on a Bayesian Network with Information Gain. *International Journal of Innovative Computing, Information and Control*, 9(11):4545–4554, 2013.

In this paper, we present an intelligent system for analyzing the probabilistic dependencies that evaluate the relationships of risk factors of cerebrovascular diseases (CVDs). We demonstrate the process used by the system to diagnose CVDs. To construct the system, we select age, gender, hypertension, diabetes mellitus, coronary heart disease, and hyperlipemia as risk factors of CVDs, which are based on the advice of experienced CVD doctors. The associations of CVDs with these risk factors are analyzed. To diagnose CVDs based on these risk factors objectively, we propose a novel system model based on a Bayesian network (BN) and information gain. By training the model using standard datasets, we obtain a diagnosis system that can automatically generate a diagnosis result when a group of data incorporating the risk factors is inputted. Finally, we test and evaluate the system using standard datasets and compare the results with those of support vector machine analysis. We also present the evaluation results from three experienced CVD doctors, who confirm that the diagnosis results of the system are beneficial to the realistic diagnosis and prediction of CVDs.

- [takafumi-01:2013] Takao Maeda and Takafumi Hayashi. Fourier Analysis of Sequences over a Composition Algebra of the Real Number Field Date of Evaluation. *IEICE Trans. Fundamentals*, E96-A(12):2452–2456, Dec. 2013.

To analyze the structure of a set of perfect sequences over a composition algebra of the real number field, transforms of a set of sequences similar to the discrete Fourier transform (DFT) are introduced. The discrete cosine transform, discrete sine transform, and generalized discrete Fourier transform (GDFT) of the sequences are defined and the fundamental properties of these transforms are proved. We show that GDFT is bijective and that there exists a relationship between these transforms and a convolution of sequences. Applying these properties to the set of perfect sequences, a parameterization theorem of such sequences is obtained.

Refereed Proceeding Papers

- [sdng-07:2013] Zhenni Li, Zunyi Tang, and Shuxue Ding. Dictionary Learning by Nonnegative Matrix Factorization with $l_{1/2}$ -Norm Sparsity Constraint. In *Proc. 2013 IEEE International Conference on Cybernetics*, pages 63–67, Lausanne, Switzerland, June 2013. CYBCONF 2013, IEEE.

In this paper, we propose an overcomplete, nonnegative dictionary learning method for sparse representation of signals, which is based on the nonnegative matrix factorization (NMF) with $l_{1/2}$ -norm as the sparsity constraint. By introducing the $l_{1/2}$ -norm as the sparsity constraint into NMF, we show that the problem can be cast as sequential optimization problems of quadratic functions and quartic functions. The optimization problem of each quadratic function can be solved easily since the problem has closed-form unique solution. The optimization problem of quartic function can also be formulated as solving a cubic equation, which can be efficiently solved by the Cardano formula and selecting one of solutions with a rule. To implement this nonnegative dictionary learning, we develop an algorithm by employing coordinate-wise decent strategy, i.e., coordinate wise decent based nonnegative dictionary learning (CDNDL). Numerical experiments show that the proposed algorithm performs better than the nonnegative K-SVD (NN-KSVD) and the other two compared algorithms.

- [sdng-08:2013] Linlin Chen, Jifei Song, Xiaohong Ma, and Shuxue Ding. One

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Source Signal Extraction Based on Metrics Transform. In *Proc. The 5th IEEE International Conference on Awareness Science and Technology*, pages 508–512, Aizu-Wakamatsu, Japan, November 2013. iCAST 2013, IEEE.

A new approach for one source signal extraction based on metrics transform is proposed and investigated in this paper. First, the mixing matrix is estimated by employing the K-means algorithm on single-source-points with higher energies. Then, the time-frequency points that incorporate one source, which can be used to approximately denote the source signals that include main information of them, are found out by employing a novel metrics transform separation algorithm. Next, the Mel Frequency Cepstral Coefficients of these signals as well as the referenced signal are extracted respectively. And here we will get the index of the target signal which has the maximum similarity to the referenced signal. After that, we apply the metrics transform step by step to find the time-frequency points that incorporate two sources, three sources and so on. A key point is that only those points which contain the contributions of the target signal will be processed. Finally the target signal is obtained through the inverse short-time Fourier transform. Compared with existing methods, our approach can be used even for the case in which the number of mixtures is smaller than that of sources and does not need any extra process after the separating. Experimental results indicate the validity of the method.

[sding-09:2013] Wenlong Liu, Nana Sun, Minglu Jin, and Shuxue Ding. A Low Complexity Detection for the Binary MIMO System Using Lagrange Multipliers. In *Proc. The 5th IEEE International Conference on Awareness Science and Technology*, pages 486–490, Aizu-Wakamatsu, Japan, November 2013. iCAST 2013, IEEE.

Maximum-likelihood (ML) detection for binary Multiple-Input-Multiple-Output (MIMO) systems can be posed as a binary quadratic programming (BQP) which belongs to a nondeterministic polynomial-time hard (NP-hard) problem in general. In this paper, we translate the binary constraints of BQP into the equivalent quadratic equality constraints and employ the Lagrange multipliers method to deal these equivalent constraints. We derive the relation among the Lagrange multiplier, transmitting signal and noise. Since both transmitting signal and noise are unknown, it is impossible to solve the Lagrange multipliers exactly. However, in this paper, an estimation method is proposed to obtain the approximations of the Lagrange multipli-

ers with low computational complexity. Numerical experiments show that the performance of the proposed method is very near to that of the ML detection.

- [sding-10:2013] Zunyi Tang, Toshiyo Tamura, Shuxue Ding, and Zhenni Li. Sparse Representation and Dictionary Learning Based on Alternating Parallel Coordinate Descent. In *Proc. The 5th IEEE International Conference on Awareness Science and Technology*, pages 491–496, Aizu-Wakamatsu, Japan, November 2013. iCAST 2013, IEEE.

Recently, sparse representations via an overcomplete dictionary has become a major field of research in signal processing. Much efforts have been focused on the development of dictionary learning algorithms so that the sparse representation of signals can be efficiently performed. In this paper, we propose a method for learning a signal dependent overcomplete dictionary. This is accomplished by posing the sparse representation of signals as a problem of matrix factorization with a sparsity constraint. By generalizing the conventional coordinate descent method, we develop a so-called sparse alternating parallel coordinate descent (SAPCD) algorithm, which is structured by iteratively solving the two optimal problems, the learning process of the dictionary and the estimating process of the coefficients for constructing the signals. Numerical experiments demonstrate that the proposed algorithm performs better than the famous K-SVD algorithm and several other algorithms for comparison

- [takafumi-02:2013] Takafumi Hayashi, Takao Maeda, , and Shigeru Kanemoto and Shinya Matsufuji. Fourier Analysis of Sequences over a Composition Algebra of the Real Number Field. In *Proc. IWSDA 2013*, pages 72–75. IEICE, Sept. 2013.

The present paper introduces a novel method for the construction of sequences that have a zero-correlation zone. For the proposed sequence set, both the cross-correlation function and the side lobe of the auto-correlation function are zero for phase shifts within the zero-correlation zone. The proposed sequence set can be generated from an arbitrary Hadamard matrix of order n and a set of $2n$ trigonometric-like function sequences of length $4n$. The proposed construction can generate an optimal sequence set that satisfies, for a given zero-correlation zone and sequence period, the theoretical bound on the number of members. The peak factor of the proposed sequence set is equal to $\sqrt{2}$.

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- [takafumi-03:2013] Toshiaki Miyazaki, Hiroki Iwata, Koji Kobayashi, Shoichi Yamaguchi, Deze Zeng, Song Guo, Junji Kitamichi, and Takafumi Hayashi and Tsuneo Tsukahara. A Software Defined Wireless Sensor Network. In *Proc. the 8th ICNC '14*, pages 847–852. IEEE, Feb. 2014.

We propose a software-defined wireless sensor network system whose behavior can be redefined even after deployment by the injection of sensor node roles by means of wireless network communications. Two main technologies are used to develop this system, role generation and delivery mechanism, and a reconfigurable wireless sensor network with many reconfigurable sensor nodes. In the role generation and delivery mechanism, a scenario compiler generates roles for sensor nodes based on a user-defined scenario description and then delivers the roles to appropriate nodes. We also propose a reconfigurable sensor node composed of an ultra-low power field programmable gate array (FPGA) and a microcontroller unit (MCU) for altering network behavior. By assigning heavy tasks such as sensor and data processing to the FPGA, overloading of the MCU can be avoided. Using wireless communication, both configuration data for the FPGA and programs to run on the MCU can be injected as roles from outside of the sensor node, enabling easy alteration of sensor node functionality depending on situation and/or application. After introduction of a system overview, a prototype system is described and some experimental results are discussed.

- [takafumi-04:2013] Toshiaki Miyazaki, Hiroki Iwata, Koji Kobayashi, Shoichi Yamaguchi, Deze Zeng, Song Guo, Junji Kitamichi, Takafumi Hayashi, and Tsuneo Tsukahara. DASN: Demand-Addressable Aensor Network for Active Information Acquisition. In *Proc. of ICUIMC '14*, page 1. ACM, Jan. 2014.

In this paper, we propose a new type of sensor network called the demand-addressable sensor network (DASN). DASN actively gets desired information by delivering or addressing users' demands to appropriate places that are expected to have the information. This is in contrast to conventional sensor networks, which simply send sensed data to users. DASN is useful for finding desired information in a short amount of time from a large amount of sensed data generated by a large-scale sensor network. DASN is constructed with a demand-addressable network that integrates many reconfigurable wireless sensor networks and other existing systems. In addition to the demand-addressing mechanism, the demand-addressable network has an in-network data mashup mechanism. The mashed-up data are displayed

on the user terminal without any need to install a dedicated application program. It can also mashup useful information acquired from systems already existing in the network without modifying each system. The functions of the reconfigurable wireless sensor network can be dynamically customized by injecting roles specified by the user. Thus, the user can actively get desired information by customizing the sensor network function. The main target of DASN is wide-area disaster site monitoring—for which the DASN features outlined above are suitable. In this paper, we present the concept underlying DASN, its architecture, and current status of development. We also present preliminary experimental results.

- [takafumi-05:2013] Takafumi Hayashi, Hideyuki Fukuhara, Yasuhiro Abe, Masayuki Hisada, Jiro Yamazaki, Hajime Tokura, Daishi Yoshino, Jian CHEN and Yuichi Takahashi, Yoshinobu Tanno, Tetsu Saburi, Ryutaro Fujita, Tōshiaki Miyazaki, and Jiro Iwase. A Network-Centric Approach to Sensor-Network for Smart Grid. In *Proc. SICE 2013*, pages 28–33. SICE, Sept. 2012.

The computational infrastructure of a Smart Grid requires the handling of an enormous amount of information produced by numerous networked systems and sensors, such as smart meters for power consumption, home power generators, and power controllers, to be handled. However, various data formats are used by sensors and systems in a Smart Grid. As such, system integration for a Smart Grid is a difficult task. In order to ensure a Smart Grid to be sustainable during its life-cycle and evolution, a smart scheme to connect the various components with each other is required. In the present paper, a network-centric messaging mediation scheme is proposed to enable smart management of sensor and power control networks, including heterogeneous vendor devices and systems. The proposed scheme creates an overlay network on an ordinary IP network. Therefore, it is easy to introduce the proposed scheme to create a Smart Grid if the individual system is connected to a legacy IP network. The proposed scheme also enables an efficient energy management system for Smart Grid and a sensor-network with data-error handling.

- [takafumi-06:2013] T. Miyazaki, S. Yamaguchi, K. Kobayashi, J. Kitamichi, S. Guo, T. Tsukahara, and T. Hayashi. Programmable wireless sensor node featuring low-power FPGA and microcontroller. In *Proc. iCAST-UMEDIA 2013*, pages 596–601. IEEE, Novt. 2013.

A sensor node often uses a low-performance microcontroller unit (MCU)

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to reduce its power consumption. However, it is difficult to handle heavy tasks with the MCU. To solve this problem, we developed a new sensor node that uses an ultra-low power field-programmable gate array (FPGA) in addition to an MCU. By assigning heavy tasks, such as sensor and data processing, to the FPGA, we can avoid overloading the MCU. Both the configuration data for the FPGA and the programs running on the MCU can be injected from outside the sensor node using wireless communication. Thus, the functionality of the sensor node can be easily changed depending on the situation and/or the applications. In this paper, we describe the sensor node architecture and its prototype, and then we show the experimental results.

[takafumi-07:2013] Jian Chen, Jiro Yamazaki, Daishi Yoshino, Yuichi Takahashi, Yoshinobu Tanno, Yasuhiro Abe, Hajime Tokura, Jiro Iwase, Hideyuki Fukuhara, Tetsu Saburi, Ryutaro Fujita, and Takafumi Hayashi. Semantic-Addressable Messaging Network based on Event Ontology for Sensor and Controller Network. In *Proc. SICE 2013*, pages 21–27. SICE, Sept. 2013.

With the rapid development of sensor networks, the problems, such as how to improve the efficiency of data transmission, how to make sensor network more intelligent, are focused by more and more researchers. In this study, we propose an integrated solution, in which a semantic-addressable messaging network is created and overlaid on an IP network, and then, an event ontology method is used to analyze the data of sensor network and the analysis results are then used for the controller of sensor network. Based on this proposal, 1) the nodes of messaging network can be divided into some related groups according to the message tags and semantic dictionary, therefore, this approach can be used to reduce the transmission hop destinations by creating a series of virtual layers on messaging network; 2) the event ontology method can be used to control the sensor network according to the event conditions. Furthermore, this approach can be used to improve the performance for wide fields such as smart-grid, big data exchange in real time

[takafumi-08:2013] Takafumi Hayashi, Hideyuki Fukuhara, Yasuhiro Abe Masayuki, Hi sada, Jiro Yamazaki, Hajime Tokura, Toshiaki Miyazaki, and jiro Iwase. A Novel Network-centric Infrastructure for Social Networking Services using a Messaging Network. In *Proc. APNOMS 2013*, pages 1–3. IEEE, Sept. 2013.

The present paper introduces an intelligent infrastructure for social network-

ing services using a messaging network. The proposed messaging network can provide content/topic-based routing and filtering. The proposed scheme provides a network-centric approach to ensure flexible information aggregation and message mediation for social networking services.

Unrefereed Papers

[sding-11:2013] Zhenni Li, Shuxue Ding, Yujie Li, and Zunyi Tang. Sparse Representation by Nonnegative Matrix Factorization with the Itakura-Saito Divergence and Sparsity Constraint. In *Technical Report of The Society of Instrument and Control Engineers (SICE) Tohoku chapter 284-th workshop*, volume 284-11, pages 1–5. SICE, 2013.

In this paper, we propose a novel and efficient dictionary learning method for sparse representation of signals. The proposed algorithm is based on the nonnegative matrix factorization (NMF). We adopt the Itakura-Saito (IS) divergence as the error function and impose l1-norm as the sparsity constraint. The error function is quite different from conventional dictionary methods using the Euclidean (EUC) distance as the error function. Numerical experiments show that the proposed algorithm performs better than the other three compared algorithms which all use the Euclidean distance as the error function.

[takafumi-09:2013] Takafumi Hayashi, Takao Maeda, Shinya Matsufuji, and Yodai Watanabe. Visible Secret Sharing using Binary Zero-Correlation Zone Array. In *Proc. of Annual Conf. of JSIAM*, volume 2013, pages –. JSIAM, 2013.

A novel scheme of Visible Secret Sharing using Binary Zero-Correlation Zone Array is proposed. The proposed scheme enables the position matching of images for visible secret sharing.

[takafumi-10:2013] Jiro Yamazaki, Taishi Yoshino, Yasurhiro Abe, Hajime Hajime Tokura, Hideryuki Fukuhara, Toru Toru, Ryutaro Fujita, Takafumi Hayashi, and Masayuki Hisada. Messaging Infrastructure Providing Functions for Industries related to Energies for Realizing Sustainable and Recycling-Oriented Society. In *Proc. of SII 2013*, 9 2013.

This paper proposed a novel messaging infrastructure, which provides functions for industries related to energies, and its applications for realizing sustainable and recycling-Oriented Society

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- [takafumi-11:2013] Yuya Ito, Hayato Tabata, Syodai Watanabe, Kenta Monma, and Takafumi Hayashi. Network-Centric approach for dynamic linkage of messages using Messaging Infrastructure. In *Proc. of Annual Conf. of IEEJ 2014*, volume 2014, pages –. IEEJ, 2014.

A novel scheme for network centric dynamic linkage of messages using Messaging Infrastructure and Network-Centric Approaches is proposed. Sample implementations and their performance evaluations are reported

- [takafumi-12:2013] Jiro Yamazaki, Yuya Ito, Hideyuki Fukuhara, and Takafumi Hayashi. Automated Analysis of Sensor Data using a Sensor-Network for Smart Grid. In *2013 SICE Workshop Tohoku*, 2013.

This technical report proposed a novel scheme of automated analysis of sensor data using a sensor-network for Smart Grid

- [yodai-01:2013] Shjinya Matsufuji Takafumi Hayashi, Takao Maeda and Yodai Watanabe. Visual Secret Sharing using Two-dimensional Binary ZCZ sequences (in Japanese). In *2013 JSIAM Annual Meeting*, page 9189, 2013.

This work proposes the encryption for visual secret sharing by use of optimal two-dimensional binary ZCZ sequences constructed from two-dimensional binary perfect sequences.

- [yodai-02:2013] Yodai Watanabe and Ryutaro Ichise. Estimation of authors' contributions to their research papers (in Japanese). In *2013 JSIAM Annual Meeting*, page 9274, 2013.

This work is an attempt to estimate authors' contributions to their research papers by applying probabilistic inference on a simple statistical model of document generation to artificial and real publication data both consisting of text information.

- [yodai-03:2013] Yodai Watanabe. On similarity metric based on data compression (in Japanese). In *2013 JSIAM Annual Meeting*, page 9203, 2013.

The normalized compression distance (NCD) is a similarity distance between data, defined by use of the compressed length of data. This work modifies the definition of the NCD and compares the performance between the original NCD and the modified one.

Grants

[sdng-12:2013] Shuxue Ding. Research on the source signal recovery and shape image reconstruction from data with incomplete information based on sparse representation, 2011-2014.

This is supported as the project of Scientific Research C, No. 24500280, 2011 Grants-In-Aid for Scientific Research, Ministry of Education, Culture, Sports, Science and Technology, Japan.

[takafumi-13:2013] Toshiaki Miyazaki, Tsuneo Tsukahara, Takafumi Hayashi, Song Guo, and Junji. Demand Addressable Sensor Network : A-STEP, 2012-2014.

In this research project, novel demand addressable sensor network is researched

[takafumi-14:2013] Juni Yatabe, Takafumi Hayashi, and Yodai Watanabe. Health Care Information Infrastructure for high-blood pressure Patients : JSTP, 2012-2014.

In this research project, Health Care Information Infrastructure for high-blood pressure is researched

[takafumi-15:2013] Jiro Iwase, Takafumi Hayashi, Jiro Yamazaki, Hajime Tokura, and Incheon Paik. 地域イノベーション戦略支援プログラム（東日本大震災復興支援型）, 2012.

In this research project, an intelligent infrastructure for Regional Innovation is researched

[takafumi-16:2013] Takafumi Hayashi, Toshiaki Miyazaki, Takao Maeda, Tsuneo Tsukahara, and Yodai Watanabe. Novel Sequence Desig for Instrumentation :Grant-in-Aid for Scientific Research (C) (Kakenhi), 2012.

In this research project, various kinds of novel sequence are designed in order to develop a new insturmentaion for physics research and improve the performance of various kinds of instrumentation and communications.

Academic Activities

[sdng-13:2013] S. Ding, 2013.

Committee member of Technical Committee on Awareness Computing, Systems, Man & Cybernetics Society, IEEE.

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[sding-14:2013] S. Ding, 2013.

Special Sessions' Committee Member of the IEEE International Conference on Systems, Man, and Cybernetics (IEEE SMC 2013).

[sding-15:2013] S. Ding, 2013.

Organizing & Program Committee member of the First Mini Symposium on Intelligent Informatics (MSII2013).

[sding-16:2013] S. Ding, 2013.

Institute of Electrical and Electronics Engineers (IEEE), Membership.

[sding-17:2013] S. Ding, 2013.

IEEE Signal Processing Society, Membership.

[sding-18:2013] S. Ding, 2013.

The Institute of Electronics, Information and Communication Engineers (IEICE), Membership.

[sding-19:2013] S. Ding, 2013.

The Association for Computing Machinery (ACM), Membership.

[takafumi-17:2013] Takafumi Hayashi, 2013.

Reviewer of IEEE Signal Processing Letters

[takafumi-18:2013] Takafumi Hayashi, 2013.

Reviewer of IEEE Communication Letters

[takafumi-19:2013] Takafumi Hayashi, 2013.

Reviewer of IEICE Transactions

[takafumi-20:2013] Takafumi Hayashi, 2013.

Reviewer of ICC, IEEE

[takafumi-21:2013] Takafumi Hayashi, 2013.

Reviewer of OE Magazine, SPIE

[takafumi-22:2013] Takafumi Hayashi, 2013.

Reviewer of Electronics Letters, IET

[takafumi-23:2013] Takafumi Hayashi, 2013.

Program Chair of CIT2013

Ph.D and Others Theses

[sding-20:2013] Kuya Sakamoto. Graduation Thesis: Improvement of the Sparse Coding Algorithm for Reconstruction of Signal, University of Aizu, 2013.

Thesis Advisor: Shuxue Ding

[sding-21:2013] Kento Sagi. Graduation Thesis: Non-negative Matrix Factorization with Itakura-Saito Divergence as the Error Function, University of Aizu, 2013.

Thesis Advisor: Shuxue Ding

[sding-22:2013] Masato Johoji. Graduation Thesis: Independent Component Analysis Using the ABC Algorithm for Strengthening the Search Performance of the High-Dimensional Case, University of Aizu, 2013.

Thesis Advisor: Shuxue Ding

[sding-23:2013] Kazuki Tsuda. Graduation Thesis: Generalization of Gravitational Search Algorithm for Optimization with a Potential, University of Aizu, 2013.

Thesis Advisor: Shuxue Ding

[sding-24:2013] Zunyi Tang. Ph.D Thesis: Dictionary Learning Algorithms for Sparse Representation of Signals, University of Aizu, 2013.

Thesis Advisor: Shuxue Ding

[takafumi-24:2013] Seiya Kimura. Graduation thesis, School of Computer Science and Engineering, 2013.

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[takafumi-25:2013] Keiko Kuwana. Graduation thesis, School of Computer Science and Engineering, 2013.

Thesis Advisor: T. Hayashi

[takafumi-26:2013] Akinobu Naito. Graduation thesis, University of Aizu, 2013.

Thesis Advisor: T. Hayashi

Summary of Achievement

[takafumi-27:2013] Mizuki Takahashi. Graduation thesis, School of Computer Science and Engineering, March 2013.

Thesis Advisor: T. Hayashi

[takafumi-28:2013] Shohei Abe. Master thesis, Graduate School of Computer Science and Engineering, August 2013.

Thesis Advisor: T. Hayashi

[yodai-04:2013] Yoshiki Kayama. Graduation Thesis: Probabilistic Inference Algorithm Using Simulated Annealing, University of Aizu, 2014.

Thesis Advisor: Y. Watanabe

[yodai-05:2013] Yu Hasegawa. Graduation Thesis: Distribution of Access Structures of Visual Secret Sharing Schemes, University of Aizu, 2014.

Thesis Advisor: Y. Watanabe

[yodai-06:2013] Yoshitaka Morita. Graduation Thesis: A formulation of similarity metric based on compression, University of Aizu, 2014.

Thesis Advisor: Y. Watanabe

[yodai-07:2013] Shinya Washio. Graduation Thesis: Construction and Security of an Audio Secret Sharing Scheme with Bounded Shares, University of Aizu, 2014.

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