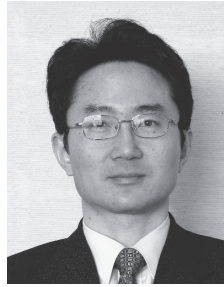


Computer Industry Laboratory



Shigeru Kanemoto
Professor



Incheon Paik
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Associate Professor

Computer Industry Laboratory

Research by faculties and students in the Computer Industry Laboratory has been carried out in the fields of both basic computer science and industrial applications, such as Semantic Web Services, Web Data Mining and Security, Semantic e-Business, Situation Awareness, Signal processing, Simulation engineering, and Functional Safety, and environmental impact analysis of energy industry. Several articles were published as book chapters, journal-contributions, proceedings-contributions in conferences, and technical reports.

The research activities of the Computer Industry Laboratory include the following topics:

[Shigeru KANEMOTO] - Signal processing for plant monitoring and control - Dynamical system identification and analysis - Image processing and 3D shape reconstruction - Human-Computer hybrid simulation - Functional safety of embedded system [Incheon PAIK] - Semantic Web Service - Web Data Mining and Security - Semantic e-Business Application and Workflow - Situation Awareness - Software Engineering on Smart Mobile Device [Kenta OFUJI] - Environmental impact of energy industry - Environmental economics and computer simulation - Assessment of new technologies in electric power generation and consumption

Refereed Journal Papers

- [kanemoto-01:2013] T.UCHIMOTO S.KANEMOTO
T.OHIRA T.KIKUCHI R.URAYAMA, T.TAKAGI. Im-
plementation of electromagnetic acoustic resonance in pipe
inspection. *E-Journal of Advanced Maintenance*, 5(1):25–33,
2013.

Electromagnetic acoustic resonance (EMAR) provides accurate and stable evaluation. Its capability has been demonstrated through online monitoring using a large-scale corrosion test loop operating at high temperature. This study uses EMAR to evaluate the thickness of pipes in a nuclear power plant during its shutdown through signal processing based on superposition of nth compression. Sections of piping evaluated with EMAR include those in long-term service, where thinning may produce scale-like surfaces, and those having complicated geometry. Moreover, we compare measurement results obtained with EMAR and with ultrasonic testing (UT). The accuracy of EMAR depends on the pipe geometry, such as the pipe diameter and whether the pipe is straight or an elbow, the presence of welding, and complicated wall thinning. We consider the causes of the difference in thickness values between EMAR measurements and UT. Finally, we discuss how to implement EMAR in pipe inspection.

- [o-fu-01:2013] Kenta Ofuji and Naoki Tatsumi. A Count Model Analysis on the Forward Contracts Traded in JEPX. *IEEJ Transactions on Power and Energy*, 133(10):770–776, 2013.

The number of forward contracts traded in Japan Electric Power Exchange (JEPX) is desired to increase. However, few studies have clarified what factors have contributed to impacting the number of forward contracts traded. In this study, the authors analyzed the number of forward contracts using four kinds of count regression models. As a result, negative binomial regression model and zero-inflated models were able to better express the expected counts, by incorporating the overdispersion and excess zeros present in the observed data. Among others, the spot market can carry positive influences on the expected counts, by about 12 % for 1 yen/kWh increase in price, and by about 27 % for 0.1%-point increase in volumes. The zero-inflated models revealed that as many as three fourth of the entire forward products have high probability of zero

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counts, while the rest one fourth may see an increased number of counts as the spot market price and/or the spot volume become higher.

- [o-fu-02:2013] Kenta Ofuji and Naoki Tatsumi. A quantile regression analysis on the determinants of credit issuance rates of CDM projects. *Journal of Public Utility Economics, Japan Society of Public Utility Economics*, 64(2):31–44, 2013.

Credit issuance is among the major determinants of commercial viability in CDM projects. In this paper, we empirically analyzed the factors that impacted the realized credit issuance rates in existing CDM projects. We found that project type choice had the greatest impact, ranging from -48% to +22% on the issuance rates, followed by host country choice with -23% to +38%. While the investing country in general did not influence the issuance rate variations as much, certain combinations of project type and investing countries, such as wind power projects developed by Japan, are found to be issuing statistically lower amount of credits.

- [o-fu-03:2013] Kenta Ofuji and Naoki Tatsumi. An Error Correction Model Analysis on the Traded Volumes in JEPX Day-ahead Spot Market. *IEEJ Transactions on Power and Energy*, 133(8):664–671, 2013.

The traded volumes in Japan Electric Power Exchange (JEPX) are desired to increase. However, few studies have clarified what factors have contributed to impacting the traded volumes, including the time-wise changes of these contributions. In this study, the authors analyzed the traded volume using error correction models. As a result, a cointegration relationship was found where the traded volume of 1GWh was mainly associated with the buying bids of 2.8-4.0GWh, while such association with the selling offers was minor. In addition, the traded volume was also influenced by short-term disturbances that reverted to this cointegration equilibrium in about three weeks. However, much of such short-term disturbances were based on the past deviation from the cointegration equilibrium, implying the importance of buying bid increases.

- [o-fu-04:2013] Kenta Ofuji. Fukushima's Non-Nuclear Power Plants: Their History, Damage by Disasters, and Prospects for the Future. *Energy and Environment*, 24(5):711–725, 2013.

The Great East Japan Earthquake that struck in March 2011 directly damaged Fukushima Prefecture. Due to the ensuing nuclear accident

of Fukushima Daiichi plant, the Prefecture's power output decreased by 9GW. However, Fukushima Prefecture has more than just nuclear power. Prior to the earthquake, the prefecture was Japan's biggest power-supplying prefecture because of its abundant hydro and thermal power. After the nuclear power plant accident, aversion to nuclear power naturally intensified in Fukushima Prefecture. Despite this, in the future, the prefecture will continue to be a power-supplying prefecture primarily via thermal and hydro power. The author, living in Fukushima, argues that the revival and bolstering of thermal and hydro power will help to dispel concerns about Japan's power supply and may also facilitate local economic recovery.

- [o-fu-05:2013] Kenta Ofuji and Ken ichiro Nishio. Analysis of residential water heater choice using multinomial logit models. *Journal of Environmental Engineering, Architects Institute of Japan*, 78(689):89–95, 2013.

Choice of water heaters in the housings built in 2010 across Japan is analyzed using multinomial choice models, with a focus on custom-made single-family housings. It was found that the most influential parameter is the resident's perceived importance towards water heaters, generating higher preference to energy-efficient, and in particular electric, water heaters. As such, the perceived importance greatly influences the macroscopic substitution within the water heater market, in particular that of the energy-efficient electric water heaters.

- [o-fu-06:2013] Kenta Ofuji. Situations surrounding Electric Power Stations in Fukushima before and after 3.11-Importance of Existing Generation Technologies and Expectations on Renewables Energy Sources -. *Journal of Public Utility Economics, Japan Society of Public Utility Economics*, 64(2):45–56, 2013.

In this paper, the author analysed the situation surrounding electric power stations in Fukushima prefecture before and after the March 11th disaster. Before the nuclear incident, Fukushima had a rich variety of generation technologies not limited to nuclear, ranging from conventional hydro, coal and oil thermal and recent IGCC(Integrated coal Gasification Combined Cycle) plants, to large-scale renewable technologies like wind, biomass and geothermal. The article first surveys historical background of such generation stations, followed by the damages as well as the restoration work after the great earthquake and tsunami. The contribution of the prefecture to the national demand of electricity

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was significant, coupled with strong economic benefit brought back to the region. In contrast, after the March 11th, the region sees a rising expectation towards renewables because of the surge in unemployment and the fear from nuclear energy. By 2020, the official installation target in particular for wind and photovoltaic generation amounts to 3,000MW altogether, equivalent to the gross hydro capacity of the Tadami- and Agano-river basins. The author calculated the expected job creation level due to the renewables, and concluded that within the gross potential impact of more than 2,000 jobs for 20 years, manufacturing and installation jobs play the vital role, while operation and maintenance jobs are marginal. Caveats include that this is realised only under the condition that the bold installation target is met despite the various technical difficulties and international manufacturing competitions.

[o-fu-07:2013] Kenta Ofuji Ken-ichiro Nishio and Anna Won. TRENDS IN THE RESIDENTIAL WATER HEATER REPLACEMENT IN JAPAN-A Questionnaire Survey to Existing Housing Residents who Experienced Replacement in 2010. *Journal of Environmental Engineering, Architects Institute of Japan*, 78(691):711–718, 2013.

The water heating is an important target for energy efficiency policy, comprising 30in Japanese housings. However, facts about replacement patterns of water heaters and their determinants have not been well studied. We conducted a questionnaire survey concerning the existing housings that replaced water heaters in 2010. We found that the share of energy-efficient water heaters varies much around an average of 30its ownership. In the single-family, owned housings sector, factors such as defects and ages of, and resident's interest in, water heaters, can result in different choices.

[paikic-01:2013] Michal N. Huhns Incheon Paik, Wuhui Chen. A Scalable Architecture for Automatic Composition. *IEEE Transactions on Services Computing*, 7(1):82–95, 2014.

This paper addresses automatic service composition (ASC) as a means to create new value-added services dynam-ically and automatically from existing services in service-oriented architecture and cloud computing environments. Manually composing services for relatively static applications has been successful, but automatically composing services requires advances in the semantics of processes and an architectural framework that can capture all stages of an application ' s lifecycle. A framework

for ASC involves four stages: planning an execution workflow, discovering services from a registry, selecting the best candidate services, and executing the selected services. This four-stage architecture is the most widely used to describe ASC, but it is still abstract and incomplete in terms of scalable goal composition, property transformation for seamless automatic composition, and integration architecture. We present a workflow orchestration to enable nested multilevel composition for achieving scalability. We add to the four-stage composition framework a transformation method for abstract composition properties. A general model for the composition architecture is described herein and a complete and detailed composition framework is introduced using our model. Our ASC architecture achieves improved seamlessness and scalability in the integrated framework. The ASC architecture is analyzed and evaluated to show its efficacy.

- [paikic-02:2013] W. Chen T. Tashiro and I. Paik. Constructing Web-Scale Functional Map on Global Social Service Network for Workflow-as-a-Service. *Proceedings of International Conference Awareness Science and Technology (iCAST 2013)*, pages 269–275, November 2013.

Web services has been considered to have a tremendous impact on the web, as a potential silver bullet for supporting distributed service-based economy at a global scale. However, despite the outstanding progress their uptake on a Web-scale has been significantly less prominent than initially anticipated. The main reasons are summarized as following: “Homepage-service” era has hampered service discovery and service composition. To solve this problem, we provide a new approach for automatic service composition based on social link. We propose global social service network which is constructed by linking services based on relationship between services. We define web-scale functional map to composite service based on the global social service network using social link.

- [paikic-03:2013] Incheon Paik Wuhui Chen and Tetsuya Tashiro. Connecting a single Global Service Space for Workflow-as-a-Service. *Journal of Computational Intelligence and Intelligent Informatics*, 17(4):561–572, 2013.

Web service discovery is becoming a challenging and time consuming task due to large number of Web services available on the Internet. Organizing the Web services into functionally similar clusters is one of a

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very efficient approach for reducing the search space. To cluster Web services, take out the Web services description languages documents and extract the features (e.g., service name) to measure the similarities. Complex terms are used as Web service features in some contexts. Current approaches do not consider about the hidden semantic pattern exists within the complex terms. We present an approach to cluster the Web services into functionally similar Web service clusters that mine Web Service Description Language (WSDL) documents and generate ontologies by using complex terms for the measuring purpose of similarity. We use both logic based reasoning and edge count base similarity measuring techniques for calculating the similarity using generated ontology. Experimental results show our clustering approach with ontology learning, has better performance comparing with approach which is not consider about the ontology learning

Refereed Proceeding Papers

[kanemoto-02:2013] Noritaka Yusa Masahiko Kawabata Shigeru Kanemoto, Norihiro Yokotsuka. Diversity and Integration of Rotating Machine Health Monitoring Methods. In *Prognostics and System Health Management Conference, PHM2013* ,, Milano, Italy, September 2013.

Health monitoring for rotating machines is investigated through two kinds of mock-up experimental data analysis. One is an anomaly mock-up test of roll bearing type rotating machine. Here, inner ring defect anomaly is simulated and its operating data are measured by both attached type accelerometer sensor and non-attached type microphone. Three kinds of signal pre-processing methods, frequency spectrum, principal component analysis and cepstrum, are applied to discriminate normal and abnormal states using several different classification algorithms, such as adaboost or random forest. Through analysis of their performance with the help of receiver operating characteristic (ROC) curve, the importance of diversified health monitoring methods is discussed. Another mock-up experiment is an accelerated test of roll bearing wear. Here, acoustic emission counts, accelerometer signal and wear particle number in lubricating oil are measured. Using these observation data, we make clear

the relationships between deterioration mechanisms of bearing and behaviour of different observations.

- [o-fu-08:2013] Ken ichiro Nishio and Kenta Ofuji. Are people continuing to save electricity?: Consistency of measures and behavior changes in the electricity crisis in Japan. In International Conference on Energy Efficiency in Domestic Appliances and Lighting (EEDAL), editors, *7th International Conference on Energy Efficiency in Domestic Appliances and Lighting (EEDAL13)*, page 107, Coimbra, Portugal, September 2013. International Conference on Energy Efficiency in Domestic Appliances and Lighting (EEDAL), International Conference on Energy Efficiency in Domestic Appliances and Lighting (EEDAL).

Due to the Great East Japan Earthquake and the subsequent reduction in the operating rate of nuclear power plants, there have been continued shortages of electric power, particular in the summer months in Japan. In the summer of 2011, electricity saving with a target of 15% was carried out in the service areas of Tokyo Electric Power Company and Tohoku Electric Power Company. In the summer of 2012, efforts were made to save the electricity throughout Japan, particularly with a 10% target in the Kansai Electric Power Company 's service area. This study aims to examine changes from 2011 to 2012 in terms of the electricity conservation rate, implementation rates of measures to save electricity, and awareness of electricity conservation. We conduct a follow-up survey of about 1500 households in Tokyo who participated in our previous survey, and a new survey was conducted to about 1100 households in Kansai. Excluding the effects of weather, the electricity consumption during the months of July-September 2012 was lower by an average of 11% than the 2010 level in Tokyo, and by an average of 9% in Kansai. The implementation rate was slightly lower than the level of the previous year in Tokyo. In Kansai, the implementation rate increased in 2012, although not to the extent of Tokyo households in the summer of 2011. In Tokyo, normative incentive and informational incentive became weaker, while economic incentive was stronger partly stimulated by the electricity rate increases in September 2012. Available at: <http://www.eedal-2013.eu/?q=node/21>

- [paikic-04:2013] T. Tanaka B. Kumara W. Chen, I. Paik. Awareness of So-

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cial Influence on Linked Social Service. In IEEE SMC, editor, *Proceedings of IEEE International Conference on Cybernetics*, pages 32 – 39, Lausanne Switzerland, June 2013. IEEE SMC, IEEE CPS.

Linked social service considers not only the functionality and QoS of service but also the service's sociability, so that it knows not only about itself, but also the peers that they would like to work with in case of composition or they would have to compete against in case of service selection. Global social service network was constructed by connecting linked social services, to describe service societies' features such as social relations and social states, and provide a basis for inferring, planning, and coordinating social activities. Therefore, awareness of the social relationship between linked social services can help many mining applications such as representative node identification and service recommendation. In this paper, we propose a flexible model for effective awareness of social influence to provide a quantitative measure of the influential strength. First, we formally formulate the problem of awareness of social influence in general domains; next, we observe some fundamental social factors which impact the social influence strength between Linked social services in global social service network; and then, a flexible model is proposed for awareness of social influence on Linked social service to provide a quantitative measure of social influence strength. Finally, an application examples, such as representative service identification is provided.

[paikic-05:2013] W. Chen I. Paik V.W. Chu, R.K. Wong and C. H. Chi. Service Discovery Based on Objective and Subjective Measures. In IEEE SCC Committee, editor, *Proceedings of IEEE International Conference on Service Computing*, pages 360 – 367, Santa Clara, CA, USA, July 2013. IEEE SCC Organizing Committee, IEEE CPS.

Web services have become a primary mechanism for consuming resources available on the Internet. As more and more services are published on the Web, automated service discovery is critical to consumers to identify relevant and reliable services efficiently. In this paper, we enhance the Web Service Crawler Engine (WSCE) framework by introducing comparison measures to allow for more accurate identification, discovery and ranking of relevant Web ser-

vices. To discover services effectively, we need to be able to measure and compare the similarity among services. Most ontology-based and IR-based discovery techniques assume that service input/output are simple data types when calculating service similarity. However, real-world services published on the Web usually have complex data types input/output parameters. Furthermore, a good match of parameters does not guarantee good usability and good reliability. The relevant services must be further evaluated by users' past experiences, based on both objective and subjective measures, to make optimal solution selection possible. This paper proposes a service matchmaking algorithm that considers the complex data types of service input/output parameters, as well as experience-based objective and subjective measures for ranking. Experiments show that our approach performs better than previous works that only consider simple data types.

- [paikic-06:2013] Incheon Paik. Domain Independent Active Situation Awareness Framework on Big Data Infrastructure. In ACS-14 Publication Committee, editor, *Proceedings of the 2014 FTRA International Conference on Advanced Computing and Services (ACS-14)*, pages 11–13, Jeju, Korea, February 2014. ACS-14 Organization Committee, ACS Publication Committee.

Goal of situation awareness aims to simulate human's intelligent awareness of situations. There have been several frameworks for the situation awareness, however, the frameworks have been fallen into single domain and situation of limited context. Our previous study about customizable active situation awareness framework provides domain independent inter-layers reasoning through meta-ontology and ontologies of temporal or spatial relations. The framework can expand range of rule set to infer new situation and projection, and makes it possible to give higher level of awareness ability. Recently many useful data of human activities about events at a specific time and location on social network services (SNS) has been stored on big data infrastructure. The research interest in this paper is focus on how to involve time, space and events on the SNS into big data infrastructure to be aware of new situation and projection. In the proposed framework, big data of event information with time and location is saved through SNS API and can be retrieved by MapReduce operation to be used at the perception layer. The data is mined to be the information that will be used at the comprehension layer.

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Through the three layers of the framework, rules that had been created to infer higher level's situation awareness on time and space for streamlining awareness sequence are used together with meta-event ontology for defining terms and process between different domains. The proposed framework shows a representative example streamlining domain independent situation awareness from big data infrastructure to projection of new situation.

- [paikic-07:2013] B.T.G.S. Kumara T. Tanaka Z. Li Y. Yaguchi I. Paik, W. Chen. Linked data-based Service publication for Service Clustering. In FTRA-CSA 2103 Committee, editor, *Proceedings of the 5th FTRA International Conference on Computer Science and its Applications (CSA-13)*, pages 1429–1435, Danang, Vietnam, December 2013. FTRA-CSA 2103 Organizing Committee, FTRA.

In this paper, we propose an approach to publish services based on Linked data principles and discover services by service cluster with visualization for reducing the using thresholds. First, we propose Linked social service which is published on the open web by following Linked data principles with social link, then, a spatial clustering algorithm is proposed to enable visualization for reducing the using thresholds. Finally, experiment is conducted to show the effectiveness of our proposed approach.

- [paikic-08:2013] K. Ryu I. Paik, R. Komiya. Customizable Active Situation Awareness Framework Based on Meta-Process in Ontology. In IEEE iCAST 2013 Publication Committee, editor, *Proceedings of International Conference on Awareness Science and Technology (iCAST) 2013*, pages 114–120, Aizu, Fukushima, Japan, November 2013. IEEE iCAST 2013 Organizing Committee, iCAST 2013 Publication Committee.

Situation awareness aims to simulate human's awareness. There have been several frameworks for the situation awareness. However, the existing frameworks have some problems for reasoning relations between multiple domain situations. The framework provides an entire sequence for situation awareness for the domain, but not how to streamline the sequence at different domains. We created rules to infer higher level's situation awareness on time and space for streamlining the aware sequence, devised meta event ontology for defining terms and process between different domains. There are common

concepts (e.g. actor, object, relation) and properties (e.g. time and space) in almost situations, crossing multiple domains. These concepts and properties enable to infer relations between situations at different domains. Our meta-event ontology and rules are designed for abstraction of inference concept and process. Customizable active situation awareness (ASA) framework takes these concepts in the existing ASA framework then it contributes to situation awareness for multiple domains. We explained the ontologies and principles of the rules and a prototype of the customizable ASA framework.

- [paikic-09:2013] B.T.G.S. Kumara H. Ohashi, I. Paik. Calculating Word Similarity for Context Aware Web Service Clustering. In IEEE iCAST 2013 Publication Committee, editor, *Proceedings of International Conference on Awareness Science and Technology (iCAST) 2013*, pages 216 – 220, Aizu, Fukushima, Japan, November 2013. IEEE iCAST 2013 Organizing Committee, iCAST 2013 Publication Committee.

Web service discovery is becoming difficult task because of increasing Web services available on the Internet. Therefore, organizing the Web services into functionally similar clusters is very efficient approach now. In order to cluster web service, each context are need to categorized own domain. Current works for service clustering have not considered the context. To make clustering of web services by domain context, we need calculation of terms similarity under a specific context. We first use support vector machine to learn context in a domain and web search engine to classify terms to domain. In this paper, we suggest a novel method to measure terms similarity consider the specific domain context using machine learning for efficient clustering.

- [paikic-10:2013] Y. Yaguchi H. Ohashi B.T.G.S. Kumara, I. Paik. Web Service Filtering and Visualization with Context Aware Similarity to Bootstrap Clustering. In IEEE iCAST 2013 Publication Committee, editor, *Proceedings of International Conference Awareness Science and Technology (iCAST 2013)*, pages 220 – 226, Aizu, Fukushima, Japan, November 2013. IEEE iCAST 2013 Organizing Committee, iCAST 2013 Publication Committee.

Web service clustering is an efficient approach to address some challenges in service computing area such as discovering and recommend-

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ing. To cluster the Web services, we need to filter the similar services. Key operation of filtering process is measuring the similarity of services. There are several methods used in current similarity calculation approaches such as keyword, information retrieval, ontology and hybrid methods. However, these approaches do not consider the context when measuring the similarity. So these approaches failed to capture the semantic of terms, which exist under a certain domain. In this paper, we propose context aware similarity method, which uses search results from search engines and support vector machine. Then, we apply Associated Keyword Space (ASKS) algorithm which is effective for noisy data and projected results from a three-dimensional (3D) sphere to a two dimensional (2D) spherical surface for 2D visualization to filter the services. Experimental results show our filtering approach is able to filter services based on domain and plot the result on sphere. Also our approach performs better than the existing approaches. Further, our approach aids to search Web services by visualization of the service data on a spherical surface.

[paikic-11:2013] H. Ohashi W.Chen I. Paik, T. Takazumi. Big Data Infrastructure for Active Situation Awareness on Social Network Services. In IEEE Big Data Congress Publication Committee, editor, *Proceedings of IEEE 2nd International Congress on Big Data*, pages 411–412, Santa Clara, CA, USA, July 2013. IEEE Big Data Congress 2013 Organizing Committee, IEEE CPS. Awareness computing aims at our final goal in computer science to simulate human 's awareness and cognition. Awareness of social network knowledge in everyday life is actively enabled by big data society. In this paper, we investigate infrastructure for big data analytics for social network services, and propose TF-IDF calculation on big data infrastructure to be aware of social relations on social network

[paikic-12:2013] I. Paik B. T. G. S. Kumara, Y. Yaguchi. Clustering and Spherical Visualization of Web Services. In IEEE SCC Committee, editor, *Proceedings of IEEE International Conference on Service Computing*, pages 89 – 96, Santa Clara, CA, USA, July 2013. IEEE SCC 2013 Organizing Committee, IEEE CPS. Web service clustering is one of a very efficient approach to discover Web services efficiently. Current clustering approaches use tradi-

tional clustering algorithms such as agglomerative as the clustering algorithm. The algorithms have not provided visualization of service clusters that gives inspiration for a specific domain from visual feedback and failed to achieve higher noise isolation. Furthermore iterative steps of algorithms consider about the similarity of limited number of services such as similarity of cluster centers. This leads to reduce the cluster performance. In this paper we apply a spatial clustering technique called the Associated Keyword Space(ASKS) which is effective for noisy data and projected clustering result from a three-dimensional (3D) sphere to a two dimensional(2D) spherical surface for 2D visualization. One main issue, which affects to the performance of ASKS algorithm is creating the affinity matrix. We use semantic similarity values between services as the affinity values. Most of the current clustering approaches use similarity distance measurement such as keyword, ontology and information-retrieval-based methods. These approaches have problem of short of high quality ontology and loss of semantic information. In this paper, we calculate the service similarity by using hybrid term similarity method which uses ontology learning and information retrieval. Experimental results show our clustering approach is able to plot similar services into same area and aid to search Web services by visualization of the service data on a spherical surface.

- [paikic-13:2013] W. Chen B. T. G. S. Kumara, I. Paik. Web-service Clustering with a Hybrid of Ontology Learning and Information-retrieval-based Term Similarity. In IEEE ICWS Committee, editor, *Proceedings of IEEE International Conference on Web Services*, pages 340 – 347, Santa Clara, CA, USA, July 2013. IEEE ICWS Committee, IEEE CPS.

Organizing Web services into functionally similar clusters, is an efficient approach to discovering Web services efficiently. An important aspect of the clustering process is calculating the semantic similarity of Web services. Most current clustering approaches are based on similarity-distance measurement, including keyword, ontology and information-retrieval-based methods. Problems with these approaches include a shortage of high quality ontologies and a loss of semantic information. In addition, there has been little fine-grained improvement in existing approaches to service clustering. In this paper, we present a new approach to grouping Web services into func-

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tionally similar clusters by mining Web service documents and generating an ontology via hidden semantic patterns present within the complex terms used in service features to measure similarity. If calculating the similarity using the generated ontology fails, the similarity is calculated by using an information-retrieval-based term-similarity method that adopts term-similarity measuring techniques used by thesaurus and search engines. Another important aspect of high performance in clustering is identifying the most suitable cluster center. To improve the utility of clusters, we propose an approach to identifying the cluster center that combines service similarity with the term frequency-inverse document frequency values of service names. Experimental results show that our clustering approach performs better than existing approaches.

- [paikic-14:2013] T. Tanaka B. T. G. S. Kumara W. Chen, I. Paik. Awareness of Social Influence for Service Recommendation. In IEEE ICWS Committee, editor, *Proceedings of IEEE International Conference on Service Computing*, pages 767 – 768, Santa Clara, CA, USA, July 2013. IEEE ICWS Organizing Committee, IEEE CPS.

With increasing presence and adoption of Web Services on the World Wide Web, to recommend suitable services to users has become an important issue. However, existing personalization approaches, such as collaborative filtering or content based recommendations, are ignoring services' sociability because of the isolation of services without social relationships among them, and lacking of consideration of social influence. Therefore, there is a need for more accurate means to interlink them in a social-enhanced interest network, and to analyze and quantify the social influence. In this paper, we propose a methodology to connect distributed services into a global social service network for social influence-aware service recommendation, called recommend-as-you-go. First, we propose a novel platform to construct a global social service network by linking distributed services with social link using quality of social link, and then we propose a flexible model for effective awareness of social influence to provide a quantitative measure of the influential strength, Next, a novel social influence-aware service recommendation approach is presented based on global social service network, and finally, the experiment results show that our new approach can solve the quality of service

recommendation problem well with quick query response, low usage threshold and high accuracy with user preferences by recommend-as-you-go.

Grants

[o-fu-09:2013] Kenta Ofuji. Central Research Institute of Electric Power Industry, 2009-2013.

Academic Activities

[o-fu-10:2013] K. Ofuji, September 2013-.
member, editorial committee

[paikic-15:2013] Incheon Paik, July 2013.
Program Committee Member

[paikic-16:2013] Incheon Paik, July 2013.
WIP Track Chair

[paikic-17:2013] Incheon Paik, Nov. 2013.
PC Chair

[paikic-18:2013] Incheon Paik, May 2012.
Editorial Borad

[paikic-19:2013] Incheon Paik, November 2012.
Expert Committee Member

[paikic-20:2013] Incheon Paik, January 2013.
Chair

Ph.D and Others Theses

[o-fu-11:2013] Shigeki Hayashi. Graduation Thesis: Economic impact of renewable energy policy in Fukushima, University of Aizu, 2013.
Thesis Advisor: K. Ofuji

Summary of Achievement

- [o-fu-12:2013] Takayuki Miyasaka. Graduation Thesis: Association analysis of power conservation behaviours in households in Kanto, University of Aizu, 2013.
Thesis Advisor: K. Ofuji
- [o-fu-13:2013] Haruka Imai. Graduation Thesis: Review of calculation methods of CO2 emissions from food, University of Aizu, 2013.
Thesis Advisor: K. Ofuji
- [o-fu-14:2013] Yasuyuki Inoue. Graduation Thesis: Association analysis of power conservation behaviours in households in Kansai, University of Aizu, 2013.
Thesis Advisor: K. Ofuji
- [paikic-21:2013] Hiroki Ohashi. Calculating Word Similarity for Context Aware Web Service Clustering, Graduate School, University of Aizu, 2013.
Thesis Advisor: I. Paik
- [paikic-22:2013] Tetsuya Tashiro. Constructing Web-Scale Functional Map on Global Social Service Network for Workflow-as-a-Service, Graduate School, University of Aizu, 2013.
Thesis Advisor: I. Paik
- [paikic-23:2013] Leo Saito. Evaluation of Hierarchical Categorization of SNS Information by SVM, University of Aizu, 2013.
Thesis Advisor: I. Paik

Others

- [o-fu-15:2013] Kenta Ofuji.
Invited Speech: Consumer behavior analysis in the pre-big data era, prepared for Aizu Sangaku Konwakai, Aizu Wakamatsu, June 5, 2013
- [o-fu-16:2013] Kenta Ofuji.
Invited Speech: Energy efficiency tips, prepared for 1st graders in Sendai Ikuei High School, UoA, May 23, 2013
- [o-fu-17:2013] Kenta Ofuji.
Invited Speech: Getting to know the world of research, prepared for 2nd graders in Aizu High School, UoA, June 15, 2013

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[o-fu-18:2013] Kenta Ofuji.

Invited Speech: Future of Smart Grid and Smart Homes, Aizu Wakamatsu,
Jan. 20, 2014