

IEICE Global Plaza

—Monthly community plaza in English for students, faculties and engineers—

Essay

Research on Complex Systems and Networks at Binghamton University, State University of New York



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Prologue

The emerging science of complex systems and networks investigates various systems made of a large number of components that interact with each other, which may collectively generate non-trivial emergent behavior at macroscopic scales (see the organizational map of complex systems created by the author at https://en.wikipedia.org/wiki/Complex_systems#/media/File:Complex_systems#/media/File:Complex_systems_organizational_map.jpg). Many important real-world systems, such as information communication networks, social media, financial markets, supply chains, and global trade relationships, as well as biological/ecological networks such as gene regulatory networks and food webs, can be modeled and studied as complex systems. Understanding such complex systems and developing novel ways to control (or at least influence) their behaviors has rapidly increased its relevance and currency for solving various problems that our society is facing today. This observation can be well illustrated in the recent rise of scientific communities and academic programs on these topics, such as the Complex Systems Society (<http://cssociety.org/home>), the Network Science Society (<http://www.netscisociety.net/>) and many research centers, institutes, academic programs and online resources (<http://www.complexityexplorer.org/>).

At Binghamton University, one of the four PhD-granting University Centers of the State University of New York (SUNY) system located near Binghamton, NY, we have been taking unique actions to respond to this increasing societal demand for research and education in complex systems and networks. This includes creating a new interdisciplinary research center and developing a new academic program, which are both the first establishment in the SUNY system.

Innovation of Research Activities

The Center for Collective Dynamics of Complex Systems (CoCo; <http://coco.binghamton.edu>) is an interdisciplinary research center that has officially established as a new Organized Research Center of the University in 2015 (but it has existed informally since 2007). This Center, which consists of more than 30 faculty participants and other graduate students coming from all over the campus with a wide variety of disciplinary backgrounds (Fig.1), takes the initiative to develop interdisciplinary research projects that would be hard to accomplish with a single-disciplinary approach. We organize biweekly research seminar series each semester, facilitate collaborative proposal development and publications, and invite and host external visitors to establish international collaborative relationships. We have been successful in acquiring external research funding for more than \$1.6 million since 2008. We have held 9 seminar talks during the Fall 2015 semester, 6 of which were given



Fig. 1 Members of CoCo Center who joined the 2015 End-of-the-Year Party

by external speakers (including 3 international ones). We would be more than happy to host visitors from Japan and other Asian countries if there is any interest.

Evolving Educational Program

We also have been quite active in education on complex systems and networks. We have developed the Advanced Graduate Certificate Program in Complex Systems Science and Engineering (<http://binghamton.edu/cx>), the SUNY's first academic program in complex systems. This program is designed so that graduate students in any major can take it as an "add-on" to their primary degree program, to improve their knowledge and skills about complex systems and thereby enhance their marketability in today's competitive job market (in both academia and private sectors that require scientific knowledge and skills). This program is designed as a four-course curriculum made of one core seminar course, one core modeling course, and two electives (one with a greater focus on theories and another with a greater focus on applications). This program has been receiving constant enrollments since its establishment in 2013 even though we have not spent any significant marketing effort, and it is expected to attract more enrollments in the coming years.

Outreach Activities for Knowledge Sharing

In addition, I have been personally involved in several other educational outreach activities to promote concepts and lessons of complex systems and networks to a broader audience. I have written Binghamton University's first Open SUNY Textbook "Introduction to the Modeling and Analysis of Complex Systems" (<http://textbooks.opensuny.org/introduction-to-the-modeling-and-analysis-of-complex-systems/>), which is an open-access textbook freely available online. The Open SUNY Textbook is the SUNY's unique initiative to reduce the costs of higher education by producing and e-publishing quality college textbooks. My book has been adopted by a number of instructors in several different countries, and has been downloaded more than 14,500 times since its publication in August 2015.

Another educational outreach activity I have been heavily involved in is the "Network Science in Education" movement (NetSciEd; <http://tinyurl.com/netscied>), in which we have been introducing the concepts and tools of "networks" to K-12 education. As all of us know too well, our primary and secondary educational system has been structured into several disconnected disciplines ("language", "math", "science" and "social studies" in many countries) without any interactions across these disciplines. However, by paying more attention to the connections between things, facts, concepts and ideas, students can develop a higher-level understanding of various topics discussed in these subjects as "networks", which helps them develop the critical ability to think about various things as "systems" and analyze their unique properties and common features across disciplines. To promote this NetSciEd movement, we have been running NetSci High, a high school research program in network science since 2010 (<http://tinyurl.com/netscihigh>) with very successful outcomes over the last several years. We have also edited and published a free e-booklet "Network Literacy: Essential Concepts and Core Ideas" (<http://tinyurl.com/networkliteracy>, <http://comnet.oxfordjournals.org/cgi/content/short/cnv028v1>) which has been translated into 14 different languages (including Japanese) by volunteers so far. Feedback from the participants and users of these programs and resources has shown that learning concepts and tools about complex networks is a very powerful method to develop students' "systems" perspective. This is a crucial intellectual skill that is needed by all of our next generation who are living in this highly interconnected world since the day they were born.

For Young Researchers and Students

Here, I have reviewed some of our research and educational activities going on at Binghamton University where I have been working for the last decade. Being someone who used to work at a university in Japan, I believe I am at a unique position by being able to understand how academic systems function in two different cultures and by bridging them together. As an example, I have been facilitating the establishment of a formal partnership and various collaborative activities between Binghamton University and the University of Electro-Communications (UEC) in Japan since 2013. Such international collaborative activities are highly beneficial for both parties, and especially for young researchers and students who can gain valuable international experiences and perspectives. We are always open to any future collaborations and partnerships;

should you have any interest in potential international collaboration, please don't hesitate to contact me at sayama@binghamton.edu.

Note by the Editor

Dr. Sayama also serves Binghamton University as Directors of the Graduate Program in Systems Science and the Advanced Graduate Certificate Program in Complex Systems Science and Engineering. He received his B.S., M.S., and Ph.D. degrees from the University of Tokyo, Japan in 1994, 1996 and 1999, respectively. He was with New England Complex Systems Institute, USA, in 1999-2002, UEC, Japan in 2002-2005 and joined Binghamton University in 2006. He also holds a visiting faculty position at Northeastern University, USA since 2014. His article will encourage general readers, above all, the young generation in the world through his excellent academic activities and brave experience.

Hot Topics

Introduction of New Representatives of IEICE International Sections, no. 7 (Last)

IEICE International Affairs Committee

The former issues of IEICE Global Plaza have introduced eleven of twelve current IEICE International Section Representatives. This issue refers to the Representative of IEICE Vietnam Section.

IEICE Vietnam Section



Nguyen Ngoc Binh, Prof. Dr.,
Director, International Francophone Institute,
Vietnam National University, S.R.V.,
President, The Radio & Electronics Association
of Vietnam,
Representative, IEICE Vietnam Section
Member, IEICE

Vision

IEICE Vietnam Section has organized international conferences and IEICE sponsored lectures since it was established in the beginning of 2013. The scheme and main activities of the Section is summarized as follows:

1. Knowledge sharing of ICT R&D through the Section: (1) To provide regular and potential members with good forum for idea exchange. (2) To connect members in email at ieicevn@vnu.edu.vn and on Website at <http://www.uet.vnu.edu.vn/ieicevn>. (3) To manage the rolls of the Section and introduce IEICE and IEICE-VN to researchers and lecturers. (4) To enlarge the membership.
2. IEICE based academic activities: (1) To organize international events like ICDV or VJMW. (2) To collaborate with regional academic societies like REV, VAIP.
3. IEICE Sponsored Lecture: (1) To provide the lecture on hot topics covering LSI Design, Communications, IoTs, Big Data. (2) To enhance the knowledge collaborating with EDA/VDEC in Japan
4. Collaboration with the other IEICE Sections:
 - Japan: EDA, Photonic Network, Microwave, Embedded Systems, Multilingual Processing and NLP
 - China: Information Security, Photonic Network, Chinese Character based Language Processing
 - Thailand: Multilingual Processing and NLP, Microwave
 - Korea: Cloud Computing, ICT Services
 - Others: Computer Science and Communications, Electronics, VLSI design for multimedia applications
- (5) Proposals to the IEICE Headquarter: (1) To strengthen ICDV with the support of IEICE. (2) To yearly or biyearly publish Special Issue on ICDV through IEICE Transactions A.

Profile

He received his B.S. degree from Kishinev National University, Moldova, USSR in 1981, his M.E. degree from Toyohashi University of Technology (TUT), Japan in 1995 and his Ph. D. degree from Osaka University, Japan in 1998. He also received the first Honorary Doctorate degree from TUT in 2011. He served School of Knowledge Science, Japan Advanced Institute of Science and Technology (JAIST) in 1998-2000, Hanoi University of Technology (current HUST) in 2000-2006, Vietnam National University (VNU) College of Technology as Vice Rector in 2006-2009 and VNU University of Engineering and Technology as Rector in 2009-2014, and he has been serving VNU International Francophone Institute as Director since 2014. He also served Asia Japan Alumni (ASJA) International as Director and ASEAN Council of Japan Alumni as Governor, respectively in 2007-2013. Currently, he serves Radio and Electronics Association of Vietnam as President in 2014-2019, Vietnam-Japan Friendship Association as Vice President in 2011-present. He was awarded by the Minister of Foreign Affairs of Japan in 2014, for his excellent contributions to the relations between Vietnam and Japan.

Announcement

Interruption of IEICE Global Plaza



Kenzo Takahashi, Prof. Dr., Int'l Relations,
University of Electro-Communications, Tokyo,
Member, IEICE International Affairs Committee,
Editor-in-Chief, IEICE Global Plaza

Seven years have passed since the first issue of IEICE Global Plaza (GP) was published as a part of monthly IEICE Journal in February 2009. It was published for the purpose of providing International members and potential members covering international students, faculties and engineers with a forum where any one could join and frankly exchange opinions so that it would be easier for them to participate in paper publication, Technical Committees or various events. Indeed, quite many articles have been contributed to GP so far. Any article was valuable and encouraging for general readers, especially young generation according to their opinions.

As the Editor-in-Chief, I would like to thank all the authors over the world covering Asia, Oceania, Europe, Africa, North and South Americas for their kind and generous contribution and general readers over the world who gave us a lot of opinions and constructive proposals. I also would like to thank each of the editors representing the four Societies and Group who have been selected every fiscal year, members of IEICE International Affairs Committee (IAC) and members of IEICE Task Force for International Policy and Planning (TFIPP), for their coordination to the edition of GP.

TFIPP was set up to find solutions of globalization through discussion by experts, indefinite unless noted, in IEICE Strategic Planning Committee in May 2008 and transferred to IEICE IAC in July 2008, taking in the prior IEICE Working Group for Globalization Promotion. The members who have been registered are listed below in alphabetical order of family name, without title:

- Makoto Ando, Tokyo Institute of Technology
- Katsumi Emura, NEC Corporation
- Yuji Inoue, TOYOTA Info Technology Center
- Yukou Mochida, German Babaria's Representative in Japan
- Iwao Sasase, Keio University
- Kenzo Takahashi, University of Electro-Communications
- Yoshiaki Tanaka, Waseda University
- Masahiko Tominaga, Min. of Internal Affairs and Communications
- Toshitaka Tsuda, Waseda University
- and the former and current Directors for Int'l Coordination and Publicity, IEICE, in chronological order,
- Keiji Yamada, NEC Corporation
- Fumiyuki Adachi, Tohoku University
- Kaoru Arakawa, Meiji University
- Shigeru Sasaki, Fujitsu Laboratories
- Kazue Sako, NEC Corporation
- Miki Haseyama, Hokkaido University
- Ryutaro Kawamura, NTT Network Innovation Laboratory

One of the outputs by TFIPP is the publication of GP and it started through mail magazine in December 2008, Web archive and publication in the monthly IEICE Journal in February 2009. The number of issues reached 85 now. The publication of GP accelerated to regenerate IEICE Indonesia Section at first and to set up new IEICE International Sections covering Europe, Vietnam and Malaysia Sections and increase the membership of International Sections through frequent discussion with them in editorial works of GP by international telephone, email, Skype and Facebook.

Meanwhile, English publications in each Society have been evolved over the past eight years since 2009 so that it is expected to reform the relations between Society based publications and IEICE Global Plaza. IEICE IAC has decided to once interrupt the publication of GP and restart it after the review and reconstruction of editorial scheme using the effect of Web application. Please look forward to the publication of the new GP.

Message from TFIPP Secretariat

Please contact Prof. Takahashi, TFIPP (Task Force for International Policy and Planning) at global@ieice.org, if you need. Back numbers are available in archives at: http://www.ieice.org/eng/activities/ieice_global_plaza.html.

Editorial Committee of IEICE Global Plaza

Editor-in-Chief	Kenzo Takahashi	Chair, IEICE-TFIPP
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