Robotics and Computer Science:

toward continued collaboration between CCNY and Kyutech

September 8, 2017 (9am – 5:50pm)

Steinman Hall, Room ST161 (Lecture Hall)
The Grove School of Engineering
The City College of New York

Jointly hosted by
The Department of Computer Science in the Grove School of Engineering at the City College of New York
and
School of Computer Science and Systems Engineering at Kyushu Institute of Technology (Kyutech), Japan

The City College of New York | The Grove School of Engineering

Kyutech
Kyushu Institute of Technology

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(160 Convent Avenue, Corner of 140th Street, New York)

Time	Program	
9:00-9:10	**Welcoming remarks**	Associate Dean for Research Dr. Rosemarie Wesson (CCNY) President Yuji OIE (Kyutech)
9:10-9:40	**Keynote talk** (CCNY)	**Learning with Sociable Artifacts** Speaker: Prof. Sandra Okita (Columbia University)
9:40-10:10	**Keynote talk** (Kyutech)	**Looking forward to future robots** **–Automated to Autonomous –** Speaker: Prof. Eiji HAYASHI (Kyutech)
10:10-10:25	Break	*Posters on display in exhibition room
10:25-10:50	**4 contributed talks** *20 minutes plus 5 minutes for questions and discussion	Session 1 **Efficient algorithm design for combinatorial optimization problems** Speaker: Prof. Eiji MIYANO (Kyutech)
10:50-11:15		Session 2 **Verifiable Outsourced Computation: A Survey** Speaker: Prof. Rosario Gennaro (CCNY)
11:15-11:40		Session 3 **Elimination of numerical difficulties in H-infinity control problem** Speaker: Prof. Noboru Sebe (Kyutech)
11:40-12:05		Session 4 **Human-Machine Perception and Assistive Technology** Speaker: Prof. Zhigang Zhu (CCNY)
12:05-2:00	Lunch	*Posters on display in exhibition room

2:00-2:15	**Guest talk** *15 minutes including Q&A	**Optimizing SAT Encodings for Arithmetic Constraints** Speaker: Prof. Neng-Fa Zhou (CUNY Brooklyn)
2:15-2:40	**3 contributed talks** *20 minutes plus 5 minutes for questions and discussion	Session 5 **Subgraph Enumeration Algorithms by ZDDs and Its Applications** Speaker: Assoc. Prof. Toshiki SAITOH (Kyutech)
2:40-3:05		Session 6 **Multi-Modal Sensing and Computing in Medical, Civil and Military Applications** Speaker: Prof. Jie Wei (CCNY)
3:05-3:30		Session 7 **Challenges for Connecting Universal Things to Network** Speaker: Assist. Prof. Daiki NOBAYASHI (Kyutech)
3:30-3:55	Break	*Posters on display in exhibition room
3:55-4:20	**3 contributed talks** *20 minutes plus 5 minutes for questions and discussion	Session 8 **Toward an Interactive Framework for Visual Exploration of Big Urban Data Sets** Speaker: Prof. Huy Vo (CCNY)
4:20-4:45		Session 9 **Sample Return from Deep Ocean** Speaker: Prof. Kazuo ISHII (Kyutech)
4:45-5:10		Session 10 **Underwater Autonomous Vehicle Localization** Speaker: Prof. Zheng Peng (CCNY)
5:10-5:40	**Poster session**	*Workshop attendees will have an opportunity to view the posters and discuss the work with students.
5:40-5:50	**Closing remarks**	Prof. Kawaguchi (CCNY)

Abstract

Learning with Sociable Artifacts

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Abstract

People often turn to others to improve their own learning. Technological artifacts (e.g. humanoid robots, pedagogical agents/avatars) often consist of human-like qualities that create unique situations and interesting implications for peer learning and social behavior. The talk explores possible ways to capitalize on the strong social components of technology that enables students to develop peer-learning relationships (e.g., recursive feedback during learning-by-teaching, self-other monitoring).

Technological artifacts also present an array of interesting design choices (e.g., customization, creating look-alikes, adopting personas) when modeling interactions with human learners, and how identifying cause-and-effect relationships enables us to more effectively design interventions. I will introduce some ongoing research that uses technological artifacts (robots, pedagogical agents/avatars) as a threshold to learning, instruction, and assessment in formal (e.g., classrooms) and a brief overview of the IEEE RO-MAN conference.

Looking forward to future robots –Automated to Autonomous –

Eiji Hayashi
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Abstract

First of all our Kyushu Institute of Technology (Kyutech) in Japan is introduced with our approach. Kyutech is traditionally known for its research and education in the engineering, and more recently in Robotics, Spacecraft Environment, Network as well. Kyutech has 2 schools (Tobata and Iizuka Campus) , 3 graduate schools and 17 research and education centers.
Nowadays, robot will be necessary to use in the work or life place since the decline of Japanese population, and robots have to improve how to recognize and express more and more of the things that we have various desires. And, an automatic piano, a conscious behavior robot called Conbe-I, and a rough-terrain robot called SOMA, are described. And then, it is considered what we need in the progress of robotic technology through our developments from automated to autonomous.

Efficient algorithm design for combinatorial optimization problems

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Abstract

Many interesting combinatorial optimization problems are computationally intractable (NP-hard), i.e., there are no algorithms to find optimal solutions to such problems in polynomial time unless P = NP. In some situations, the complete input is not known in advance, for example, the input is a request sequence that is revealed gradually over time. Under the lack of information on future requests, the algorithm has to perform well only by using the known partial information. For such two types of hard combinatorial optimization problems, the goal of this research is to design efficient algorithms which are theoretically evaluated by the worst case possible relative errors over all possible instances of the problems.

Keywords: combinatorial optimization problems, approximation algorithms, online algorithms

Verifiable Outsourced Computation: A Survey

Professor Rosario Gennaro
Department of Computer Science
The City College of New York

Abstract

In this talk I will review recent (and not so recent) research on the topic of Verifiable Outsourced Computation. The problem of verifying the correctness of computations done by untrusted parties was a driving motivation behind some of the most celebrated results in Complexity Theory in the 90's, from Interactive Proofs to the PCP Theorem. More recently this problem has received renewed attention from more applied corners of Computer Science, due to the rise of the Cloud Computing paradigm, where data and computation is outsourced to external "providers" who may not be necessarily trusted. Current research is focused on making some of those "old" theoretical results applicable in practice, a task that ultimately will require both theoretical and more applied systems breakthroughs.

Elimination of numerical difficulties in H-infinity control problem

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Abstract

Semidefinite Programming (SDP) has ability to model or approximate many practical optimization problems and is of growing interest. Especially, in the field of control system design, SDP is widely used in the context of Linear Matrix Inequality (LMI). However, we often encounter numerical difficulties in solving SDP problems obtained from H-infinity and other related control problems. In this study, we clarify the relation between the invariant zeros of the system and the strong feasibility of the dual of the H-infinity control problem. Furthermore, we show that applying Facial Reduction method recovers the strong feasibility of the dual of H-infinity control problem and eliminates the numerical difficulties.

Human-Machine Perception and Assistive Technology

Professor Zhigang Zhu
Department of Computer Science
The City College of New York

Abstract

NSF Emerging Frontier in Research & Innovation (EFRI), includes Man, Machine and Motor Control (M3C); Multimodal perception is the key, and mobile/cloud computing is the backbone.
Both virtual reality and gaming can be more positive and beneficial; And if we are not constrained by conventional wisdom, substitute perception can be developed. Location-based services go indoors, deep learning can also be here found; Public transportation needs to be improved, to be both smart and accessible.

Binocular vision is made smart, and monocular vision can better estimate distances; Omnidirectional vision sees everything, and 3D vision is more direct and effective. Full-body eyes have been designed, and crowd-sourcing human sensors are tried; EMG can be used to recognize speakers, even tongues may be able to read images. Smart machines read facial expressions, so the blind can see emotion of others; The mystery of the human brain, now may be explored to some extent.

Optimizing SAT Encodings for Arithmetic Constraints

Neng-Fa Zhou and Hakan Kjellerstrand

Abstract

The log encoding has been perceived to be unsuited to arithmetic constraints due to its hindrance to propagation. The surprising performance of PicatSAT, which is a pure eager SAT compiler based on the log encoding, in the MiniZinc Challenge 2016 has revived interest in the log encoding. This paper details the optimizations used in PicatSAT for encoding arithmetic constraints. PicatSAT adopts some well-known optimizations from CP systems, language compilers, and hardware design systems for encoding constraints into compact and efficient SAT code. PicatSAT is also empowered by a novel optimization, called equivalence reasoning, for arithmetic constraints, which leads to reduction of code size and execution time. In a nutshell, this paper demonstrates that the optimized log encoding is competitive for encoding arithmetic constraints.

Subgraph Enumeration Algorithms by ZDDs and Its Applications

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Abstract

Subgraph enumeration algorithms are to enumerate all subgraphs satisfying some property from a given graph and are studied in the areas of data mining, bioinformatics, etc. Zero-suppressed binary decision diagrams, ZDDs for short, are useful and compact data structures to represent a set of subgraphs. By representing the subgraphs in ZDDs, we can compute a solution with the maximum/minimum weight, count the number of solutions, and generate a solution uniformly at random in the time proportional to the size of the ZDDs. Recently, the algorithms constructing a ZDD which represents desired subgraphs has been proposed for some graph problems, called frontier based-search method. In this presentation, we introduce the power of ZDDs and construction algorithms by the frontier based-search and discuss the applications of the algorithms.

Multi-Modal Sensing and Computing in Medical, Civil and Military Applications

Professor Jie Wei
Department of Computer Science
The City College of New York

Abstract

In recent years, the great advances made in sensors, computer hardware and algorithm designs have made the power of computing felt universally. With support from NSF, NIH, Army Research Office and Air Force, and collaborating side by side with domain experts, I have been able to apply my work in computer vision, signal processing and machine learning, esp. deep learning, to several different areas, such as automatic cancer treatment planning and delivery through collaboration with MSKCC and Mt. Sinai researchers and physicians; automatic analysis and processing of brain blood vessels by joint work with in biomedical engineers and biologists; nano-particle detection with chemical engineers; bridge and tunnel surveillance and monitoring with NYC DoT engineers; un-cooperative vehicle classification using laser sensors, and threat detection in electronic warfare through collaborations with Air Force research laboratory researchers. Effective data representations, feature engineering and learning, shallow and deep learning corresponding to different data and problems are of utmost importance to attaining desirable detection and classification accuracy. In this talk the different phenomenology and modality that have been addressed in my recent and on-going research and developments will be introduced. The corresponding mathematics and algorithmic ideas behind these applications will also be discussed.

Challenges for Connecting Universal Things to Network

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Abstract

Information and Communication Technology (ICT) has become an indispensable infrastructure for human society. In recent years, technologies related to ICT, including Internet of Things, have created new services for every filed, and ICT has made a great contribution to us.

In this paper, we will introduce several studies about ICT which is being executed at a network research group in Kyushu Institute of Technology. First, we will present the Radio-On-Demand Sensor and Actuator Network (ROD-SAN) that achieve both power saving and high response performance for wireless sensor and actuator networks. Second, we will show research on Multi-Path Transmission Control Protocols (MPTCP) to leverage effectively available network resources. Finally, we will introduce a novel network architecture using vehicles aiming for “locally produced and consumed” of data.

Toward an Interactive Framework for Visual Exploration of Big Urban Data Sets

Professor Huy Vo
Department of Computer Science
The City College of New York

Abstract

The ubiquity of sensors, mobile devices and crowdsourced services, notably in urban environments, has led to an explosion in the volume of data sets that have both spatial and temporal components. These data are also a rich source for domain scientists who aim to better understand cities and their populations. If properly acquired, integrated, and analyzed, “big data” can enable better operations, informed planning, and improved policy in cities. In this talk, I will discuss the challenges in visual exploration of big urban data sets through technological advances in large-scale data management and visualization. I will demonstrate our key contributions in two practical use cases in New York City.

Sample Return from Deep Ocean

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Abstract

Underwater robot is one of the important research tools to explore deep-sea where high pressure, darkness, radio attenuation prevent humans from direct access. In particular, Autonomous Underwater Vehicles (AUVs) attract attentions because of their possibility.

As the next generation AUV, we have been developing a Sampling-AUV that can dive into deep-sea and bring back marine creatures to understand marine ecosystem. In the mission scenario of the Sampling-AUV, the AUV is required to transmit the deep-sea floor images to the scientists on the research ship using acoustic communication, and the scientists select the marine creatures to pick up, and ask the AUV to sample them. Then the AUV returns to the area where the interesting marine creatures are observed, and collects and bring back the samples. In order to realize the mission scenario, the sea-floor images should be enhanced to assist the judgment of scientist. Moreover, the underwater acoustic communication is slow and inaccurate, the AUV has to select interesting images that will include marine lives. We show the results of sea trials and discuss the issues still there.

Underwater Autonomous Vehicle Localization

Professor Zheng Peng
Department of Computer Science
The City College of New York

Abstract

In recent years, there is a surge in the research and development of autonomous underwater vehicles (AUVs) as they facilitate a wide variety of marine applications. To achieve accurate navigation, AUVs must have a good knowledge of their locations. In this talk, the speaker will discuss a method to localize a swarm of AUVs operating in rough waters. The purpose is to ensure that all AUVs can be localized throughout their entire mission. The algorithm can lower the probability that an AUV swarm is detected by reducing the number of occasions that the vehicles must surface. It also achieves good energy efficiency through improved control of localization message exchanges. Simulation results will be shown and discussed. The data shows that our method can obtain good localization accuracy, reduce energy consumption, as well as lower the probability of detection.