Embassy of Japan in the UK

JETRO Japan External Trade Organization

JST

UK-RAS NETWORK ROBOTICS & AUTONOMOUS SYSTEMS

British Embassy Tokyo

# ***Japan-UK Robotics and Artificial Intelligence Seminar 2016***

# Summary Report

18th February 2016

Embassy of Japan in the UK

# Programme

15:00 Doors Open

**15:30 Opening Remarks**

- H.E. Keiichi Hayashi, Ambassador of Japan
- Professor Robin Grimes, Chief Scientific Adviser to the Foreign and Commonwealth Office

## Session 1 Overview of policy setting and funding arrangements in Japan and the UK

15:40 Brief introduction to recent policy trends in Japan

*- Ms Kanae Kurata, First Secretary (Science and Technology), Embassy of Japan in the UK*

15:50 Brief introduction to recent trends in the UK

*- Dr Kedar Pandya, Head of the Engineering Theme for the Engineering and Physical Sciences Research Council*

*- Professor Guang-Zhong Yang, Imperial College London, UK-RAS Network*

16:10 Q&A

## Session 2 Cutting-edge research projects in Japan and the UK

16:15 Introduction *Dr Fumiya Iida, Department of Engineering, University of Cambridge* (Facilitator)

16:20 *Professor Hiroshi Ishiguro, Intelligent Robotics Laboratory, University of Osaka*

16:30 *Professor Kerstin Dautenhahn, School of Computer Science, University of Hertfordshire*

16:40 *Dr Komei Sugiura, Senior Researcher, National Institute of Information and Communications Technology*

16:50 *Professor Tadahiro Taniguchi, Department of Human & Computer Intelligence College, Ritsumeikan University*

17:00 *Professor Sethu Vijayakumar FRSE; Director, Edinburgh Centre for Robotics, University of Edinburgh*

17:10 *Professor Tetsuya Ogata, Laboratory for Intelligent Dynamics and Representation, Waseda University*

17:20 *Professor Roberto Cipolla FREng, Department of Engineering, University of Cambridge*

17:30 *Professor Yoshihiko Nakamura, Department of Mechano Informatics, University of Tokyo*

## Session 3 Socio-economic impact

17:40 New business innovations

- *Mr Llewelyn Morgan, Service Manager, Localities Policies and Innovation, Oxfordshire County Council*
- *Mr Shohei Hido, Chief Research Officer, Preferred Networks*

18:00 Future social impact

- *Dr. Anders Sandberg, James Martin Research Fellow, Future of Humanity Institute, Oxford Martin School, University of Oxford*

**18:10 Q&A**

**18:30 Closing**

**Networking Reception**

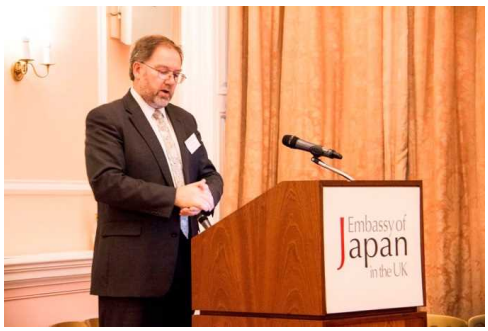
## Summary

On 18 February 2016, the Japanese Embassy hosted the Japan-UK Robotics and AI seminar which brought together experts from both countries to share knowledge and foster collaboration. This event was co-hosted by JETRO, JST, the UK-RAS Network and the British Embassy Tokyo. The afternoon was divided into three sessions: government policy and funding, cutting-edge research projects, and an analysis of the socio-economic impact of these developments.

The event was introduced by H.E. Keiichi Hayashi, the Ambassador of Japan, who highlighted the significant contribution of UK and Japanese expertise to recent breakthroughs in robotics and artificial intelligence (AI) and the collaborative efforts supported by the governments of both countries. He referred to the possibility that some current jobs may be replaced by robots in the near future and commented that a key question for the Japanese and UK governments is how to address that societal shift and respond to the opportunities and challenges. In order to do that, it was important to understand the latest research and achievements.


The ambassador's remarks were echoed by Professor Robin Grimes, Chief Scientific Adviser to the Foreign and Commonwealth Office (FCO) who represented the UK Government who focused on the strategic partnership between the Japan and the UK. Japan is the world leader in robotics and the UK has complementary strengths in sensing, imaging, software and processing and a strong track record in the complex systems integration that underpins advanced robotics. The UK is investing £200 million in research into robotics and autonomous systems by 2020 and £42 million in the Alan Turing Institute of Data Science.

Professor Grimes highlighted common challenges between the UK and Japan including an aging infrastructure and population, and shared synergies around innovation, which have been strengthened by partnership agreements between Japanese companies and UK universities, notably the £300,000 multi-year contract between Kawasaki and Herriot-Watt University and the agreement between Hitachi and Edinburgh University. Finally, he emphasised that Japan's Science and Innovation Network and UKTI are keen to explore further options for collaboration and partnership.



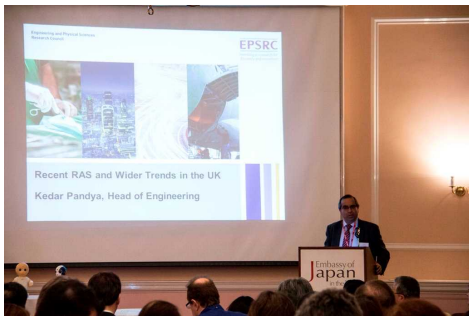
**Session1: Government policy and funding for robotics and AI**

The first session provided an overview of policy setting and funding arrangements in Japan and the UK.

Ms Kanae Kurata, First Secretary, Science and Technology Embassy of Japan in the UK, gave a brief overview of the Japanese government's recent policy on Robotics and AI.

The Japanese government published its New Robot Strategy in January 2015 and established the Artificial Intelligence Research Centre in May that year. This reflects the 5th Science and Technology Basic Plan, which runs from April 2016 until March 2020 and focuses on the promotion of research and development to realise a super smart society. It has a total budget of ¥26 trillion (or £161 billion) which is significantly more than the UK figures quoted by Professor Grimes.

In 2016 it will launch the Advanced Integrated Intelligence Platform Project (AIP), which addresses global trends in AI, big data, sensors and the Internet of Things (IoT) and cybersecurity. The Ministry of Education, Culture, Sports, Science and Technology (MEXT) is collaborating with METI (Ministry of Economy, Trade and Industry) and MIA (Ministry of Internal Affairs and Communications) to establish an integrated system to support research into next generation AI technology and its social application.

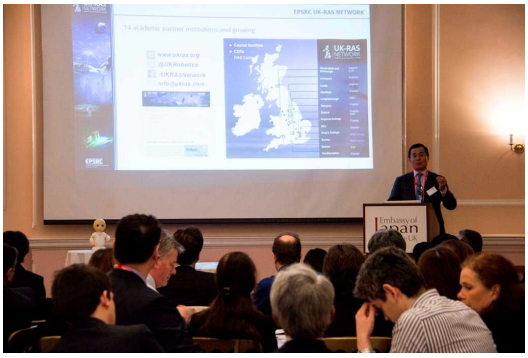



Dr Kedar Pandya, Head of Engineering at the Engineering and Physical Sciences Research Council (EPSRC), is a key policymaker in the UK Strategy for Robotics and Autonomous Systems (RAS), which was developed in 2012 and focuses on five key areas: grand challenges that stimulate collaboration; clusters of emerging growth that stimulate innovation; developing multidisciplinary skills, building tangible assets for the RAS community and ensuring coordination across research, business and regulation.

Dr Pandya outlined the EPSRC's framework for supporting UK prosperity and the role of intelligent technology across productivity, connectivity, resilience and health through eight capital centres of excellence and four centres for doctoral training (CDTs).

Current and planned research is applying IoT in ways that will transform infrastructure, products and services. Topics included autonomous vehicles, intelligent automation in manufacturing, and projects creating the cities of tomorrow – including a plan for robots to replace diggers in Leeds and turn it into the world's first self-repairing city. RAS target areas include health and social care, transport and intelligent mobility, including in extreme and challenging environments. Dr Pandya highlighted opportunities for Japan

and the UK to collaborate on research challenges and accelerate pathways from lab research to real-life applications while addressing the social and ethical considerations.



Professor Guang-Zhong Yang is Director and co-founder of the Hamlyn Centre for Robotic Surgery at Imperial College, London and chairman of the UK RAS network, which is working to harmonise developments and foster collaboration between academic institutions and industry as well as international partnerships highlighted the active collaboration between UK and Japanese institutions.

Professor Yang highlighted the breadth of the UK research landscape which ranges from deep sea and space exploration to assistive technology and autonomous cars. RAS has 14 partners and a growing network. Robotics research is concentrated in five areas: manufacturing, transport, healthcare, autonomous systems and machine learning technology.

Professor Yang is working on surgical robotics that integrate data and calculate in real time to improve the accuracy of medical procedures and patients' quality of life post-surgery. These include 'smart' surgical instruments that enable human surgeons to carry out ultra-precision surgery and could potentially transform cancer surgery.

**Session2: Cutting-edge research projects**

Dr Fumiya Iida, of the Department of Engineering, University of Cambridge, who facilitated the session explained that although AI's performance can go beyond that of humans, there is still a long way to go in terms of embodied intelligence, where robots that learn to assemble other robots learn to be more creative, adaptive and responsive to human needs. This requires enabling technology.

Professor Hiroshi Ishiguro, of the Intelligent Robotics Laboratory, University of Osaka became a global robotics icon by creating the Geminoid, an android replica of himself. Professor Ishiguro's work focuses on robots' role in society. He believes that robotic research is about understanding humans and human interactions better and that in order to design robots that can function like humans, it is necessary to understand the relationship between desire, intention and behaviour. To that end, his current project, Erica, is an advanced humanoid android that can have natural conversations with humans using non-verbal clues and body language. She has two desires: to do her job,

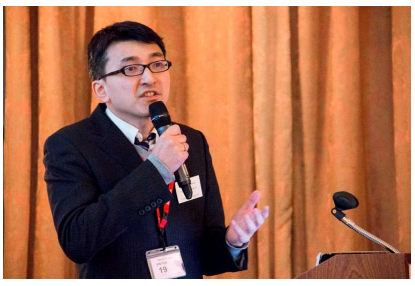
and to be recognised. However, Erica's AI is not fully autonomous – she is supported and controlled by ten computers.

Professor Ishiguro discussed how humans communicate with different types of robot, and how they can be used to support human needs. Finally, he gave us a demonstration of CommU, a small humanoid robot (currently on the market) that has translation capability. He showed us Sota a conversational companion robot.

Finally, he observed that human communication is bringing us closer to technology as we use smartphones to text and chat. Nor do we consider people with disabilities who rely on communication devices and replacement limbs as being any less human.

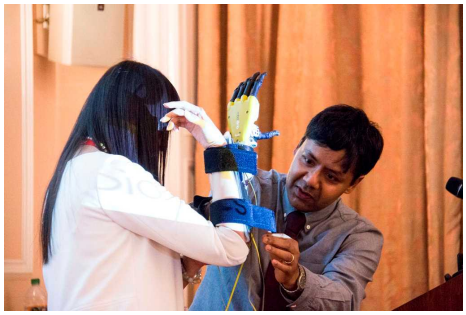
Professor Kerstin Dautenhahn, from the School of Computer Science, University of Hertfordshire has developed robotic physical assistants, supporting elderly people in their homes, including by identifying and carrying objects, and adding reminders to take medicines. She demonstrated the use of robots as a therapeutic and educational tool for children with special needs. Her video of a robot helping an autistic child to learn about self-expression showed the value of robot-human interaction in a practical and valuable way.


Dr Komei Sugiura, Senior Researcher at Japan's National Institute of Communications Technology (NICT), presented robotics as on-demand cloud services for language processing. He introduced Rospeex which combines speech synthesis and speech recognition to facilitate multilingual human-robot dialogue. Rospeex has been applied to humanoids, but also to web agents, automotive navigation systems and smart home interfaces.



However, Professor Tadahiro Taniguchi, Associate Professor at the College of Information Science and Engineering, at Japan's Ritsumeikan University demonstrated the practical challenges of natural

language processing – replicating the way we instantly recognise words and understand what they mean. Professor Taniguchi is working on a robotics machine learning system that can acquire language through embodied multimodal interaction. As a Visiting Associate Professor at Imperial College in London, Professor Taniguchi is an example of Japan-UK collaboration.

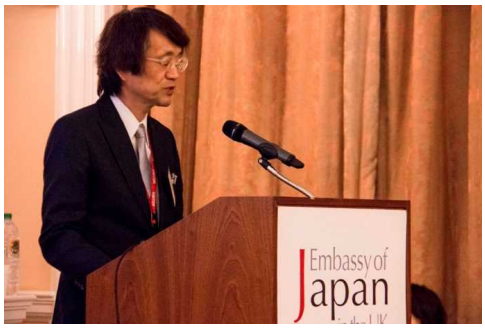


Professor Sethu Vijayakumar, Director of the Centre for Robotics at Edinburgh University, believes that the biggest robotics challenge is shared autonomous systems – robots whose interaction with humans is based on their acquired knowledge. He emphasised that the balance of power should always remain with humans. This means integrating human language into robot instructions and dealing with uncertainty through compliant actuation, which is crucial for safe, precise human-robot interactions. Professor Vijayakumar gave a demonstration of a prosthetic arm that responded to sensors placed on a (separate) human arm to replicate its movement. This type of technology can be used in manufacturing, self-driving cars and rehabilitation, as well as active prosthetics.


Professor Tetsuya Ogata from the Laboratory for Intelligent Dynamics and Representation at Waseda University in Japan explained the complex and detailed neuro-dynamic models that he has developed to 'teach' robots to integrate language and behaviour so that they can carry out tasks in response to natural language instructions.


Professor Roberto Cipolla from the Department of Engineering at the University of Cambridge presented his work on robotic vision, which is based in reconstruction, registration and recognition. Although vision itself is based on geometry, registration and recognition require deep learning. Professor Cipolla's work on machine learning also includes AI technology that recognises and reproduces voices and expressions/emotions.

Finally, Professor Yoshiko Nakamura from the Department of Mechano Informatics at the University of Tokyo presented his work on supercomputing for robotics, biomechanics and neuroscience. Professor Nakamura is developing motion and language association




software to enable robots to associate instructions with activities. This involves creating a computational model of the human neuro musculoskeletal system in order to gain a deeper understanding of human movement and behaviour. This methodology is being used for research into Parkinson's disease and can be applied to sports training in the build-up to the 2020 Olympics as well as rehabilitation.

**Session 3: The socio-economic impact**

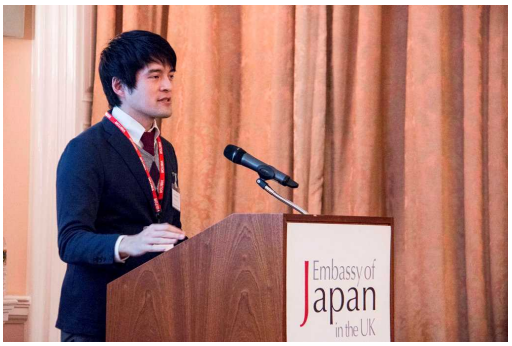
Session 3 discussed the application of robotics and AI to solving practical problems, and its impact on society and the way we live and work.


Mr Llewelyn Morgan is Services Manager for Localities, Policies, and Innovation at Oxfordshire County Council, which is the only council in the UK to have a local transit policy which includes autonomous vehicles.

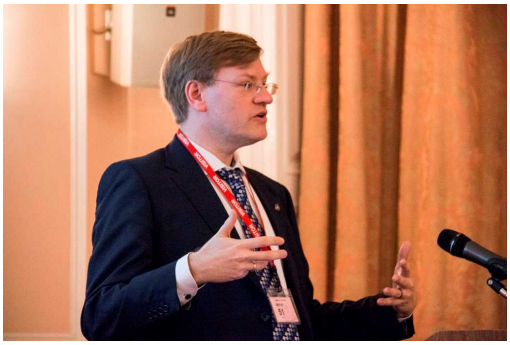
The council's key challenge is finding the most efficient way to manage Oxfordshire's overstretched and congested highway network. This led to the establishment of MobOx, a community interest company that taking an open, collaborative approach to transforming transport technology and infrastructure. It has a link to Japan as one of its founding partners is Japanese motor racing team, Team Aguri.

MobOx is using a combination of floating data (from mobile devices), machine learning, AI and predictive analytics to provide timely travel information and early warnings of problems.

Oxfordshire is the first place in the UK to operate an autonomous vehicle on a public highway. Oxbotica software enables highway inspection vehicles to use real-time visual information to help monitor and maintain the highway network.




Mr Shoehei Hido, Chief Research Officer at Preferred Networks outlined how AI is revolutionising industrial IoT. Preferred Networks is partnering with Toyota Motors on deep learning technology that trains autonomous cars to avoid collisions – even with human-controlled vehicles. It is working with factories to optimise production processes by training machines to learn to find the most efficient way of completing a task.



The final presentation by Dr Anders Sandberg, James Martin Research Fellow at Oxford University's Future of Humanity Institute focused on AI's socio-economic challenges. There have been predictions that AI will lead to 47% of all jobs being automated – the indications are that a job that is easy to define is easy to automate.

However, Dr Sandberg observed that even AI experts – who create a lot of data – are bad at making predictions – because it is impossible to predict when someone will have an idea that will change the future. So we should expect surprises and incorporate that into our policies and plans.

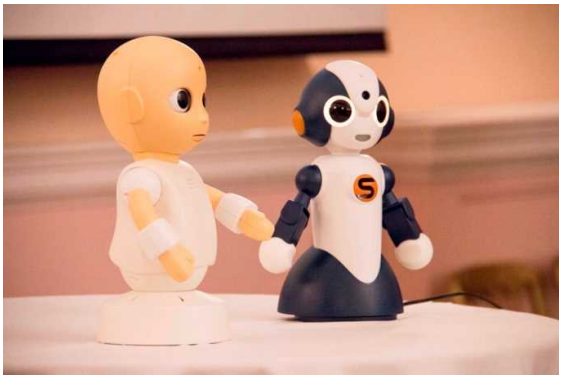
There are also ethical and moral considerations. Robots have to navigate a human-shaped world and interpret human intentions. There are also safety issues and ethical considerations – Dr Sandberg flags up search engine misclassification and fake products for sale on websites.

It is critical to distinguish between intelligence and values. Dr Sandberg observes that people are bad at explaining to machines what matters and this creates orthogonality between intelligence and goals. Leaving out something small, but critical, can make an enormous difference. For example, a medical robot that did not take into account patients' privacy and comfort would be a bad robot (even if it was effective).

As AI systems become more intelligent and powerful they also become more dangerous in this regard. Dr Sandberg believes that a new approach is needed – one that reflects the confluency between cognitive science, computer science, philosophy and economics in figuring out better motivation systems for humans and AI. We need to work together to instil our values into our machines so that they become part of society, he says.

The presentations were followed by a brief Q&A session and networking. [ENDS]

*Written by Joanna Goodman MBA*



## 概要

産業用ロボットで世界をリードしてきた「ロボット大国」日本と、サイエンスの裾野が広い英国の強みを合わせようと、2016 年 2 月 18 日、在英日本国大使館が、「日英ロボット・人工知能（AI）セミナー2016」を、駐日英国大使館、JST、JETRO、英ロボティクスネットワーク（UK-RAS）と共催して、大使館で開催した。自動運転車など、人の関与を必要としない自律的なロボットの実用化が夢ではなくなる中、ロボットや AI の分野の両国の第一人者からの講演に、日英の産学官関係者が 120 名近く集まった。

日本の産業用ロボットの年間出荷額、国内稼働台数はいずれも世界一。安倍政権は 2015 年 1 月に「ロボット新戦略」を発表。（1）世界のロボットイノベーション拠点（2）世界一、ロボットを利用・活用する社会（3）IT（情報技術）と融合してビッグデータや AI を使いこなせるロボットで世界をリードすることを目標に、経済産業省だけでなく、文部科学省も取り組みを強化している。

一方、英国政府は、ビッグデータ、ロボット工学と自律システム（RAS）など 8 優先技術分野（Eight Great Technologies）を指定し、15 年 3 月に RAS への支援を表明。林景一・駐英国特命全権大使が「日英両国は技術と社会への影響を研究する上で非常に多くの共通点を抱えている」と呼びかけると、英国側のロビン・グライムス外務省首席科学顧問は「今日は日本の研究活動を見聞きできることを楽しみにしています」と応じた。

ロボット・AI 分野における両国の最新政策を紹介する第 1 部で、在英日本大使館の倉田書記官は文部科学省に代わり、2016 年度から新たに整備される「AIP（Advanced Integrated Intelligence Platform）プロジェクト」を紹介。また英国工学物理科学研究会議（EPSRC）のケダル・パンディヤ博士は「ロボットと AI の研究が高齢化や介護の問題にどのように役立つのか関心がある」と日英両国の協力に大きな期待を示した。患者への負担が少ない低侵襲手術器具を開発しているインペリアル・カレッジ・ロンドンのガン・ゾン・ヤン教授は、研究者主導で産業界・国際組織・研究者養成センター・大学の連携を図る RAS ネットワークの枠組みについて説明した。

日英両国の最先端研究を紹介する第 2 部で司会を務めたケンブリッジ大学の飯田史也博士のテーマは「進化するロボット」。「マザー」と呼ばれるロボットアームが小さなモーター付き立方体を組み合わせて「ベビー」を作る。「マザー」は人の力を借りずに、さらに広い範囲を行動できるベビーを組み立てる。10 代目ベビーは初代より 2 倍の距離を動くようになった。飯田博士は「ロボットと AI は手を携えて進むべき」と強調した。

日本側発表者のトップバッターは、人に近いロボット（アンドロイド）を用いた人間調和型コミュニケーションメディアの研究で世界的にも有名な大阪大学の石黒浩教授。人そっくりのアンドロイドの外観や動作が、人が人にだけ示す心理的反応を引き出す点に注目した研究を進めている。認知症の高齢者や子供とコミュニケーションを取るツールとしてアンドロイドの可能性に海外メディアの強い関心が寄せられた。

ハートフォードシャー大学のケルスティン・ダウテンハン教授は、自閉症児が「キャスパー」と名付けられたロボットを相手に築く関係を研究。キャスパーは幼児と同じ大きさで、単純化された人の顔を持っている。くすぐるとうれしそうな表情と仕草を見せ、叩くと悲しそうな素振りをする。自閉症児はこうした遊びを通じて人の感情を学ぶことができる。「高齢者へのサポート、自閉症児のセラピーや教育にロボットは役立つ可能性は大きい」と指摘した。

今回のセミナーでは日本から若手研究者数名も参加。情報通信研究機構（NICT）の杉浦孔明・上級研究員は多言語に対応するクラウド型音声認識・音声合成を行うツール「rospeex」の開発などについて発表した。「記号創発ロボティックス」という新しいキーワードを提唱している立命館大学の谷口忠大准教授は言語を自ら獲得するようなロボットやアルゴリズム、数理モデルを作り、知能を理解しようとする研究について紹介した。

エジンバラ大学のセス・ヴィジャヤクマー教授は火星への無人探査につながる米航空宇宙局（NASA）のロボット開発にも参加していることを説明し、早稲田大学の尾形哲也教授は人の認知的能力をロボットに持たせることを目指す「神経回路モデル」やそのロボットとのコミュニケーションなどに関する研究内容を発表した。ケンブリッジ大学のロベルト・チポラ教授は自動運転車にも利用されている「SegNet」を紹介。道路の映像をリアルタイムで読み込んで、瞬時に空や建物、柱、標示、標識、道路、車、歩行者、バイクなど 12 のカテゴリーに分類できることを発表した。

第2部の締めくくりは、日本のロボット研究を引っ張ってきた東京大学の中村仁彦教授。力強く繊細なオペレーションを油圧アクチュエータで可能にした人型ロボット「Hydra」や、スーパーコンピューターを使って筋骨格モデルの運動をシミュレーションする研究を発表した。中村教授は「ビッグデータや複雑なシステムをコンピューターで分析することは、人型ロボットの相互作用や人のシミュレーションを大きく変えるだろう」と解説した。

ロボットや AI が将来、社会や経済への影響を考える第 3 部では、オックスフォードシャー州政府のルーウェリン・モーガン部長がロボットと AI の研究・開発を支援する地域の取り組みを紹介。また日本発のベンチャー企業プリファード・ネットワークス社の比戸将平・首席研究員は、プリファード・ネットワークス社のこれまでの経緯や事業内容等を紹介するとともに、人が遠隔操作するモデルカーが柱にぶつかるのに自ら学習するロボットカーが他の車と衝突せずにスムーズに走る様子を動画で紹介すると会場から笑みがこぼれた。

オックスフォード大学のアンダーズ・サンドバーグ博士は「ロボットと AI の進化が人間社会に与える影響についてはまだよく分かっていない」と説明。ロボットや AI は人の仕事を奪うのか、それとも可能性を広げていくのかについては意見が大きく 2 つに分かれている。

セミナーでは研究・開発の課題、実用化の可能性が示され、参加者から「もっと詳しく知りたい」という要望が寄せられるなど、好評を博しながら幕を閉じ、引き続き行われたネットレセプションでは大盛況の中、日英関係者間で積極的なネットワーキングが行われた。

*Written by Masato Kimura*