

# Addressing Sustainability via AI

— Report from the 23<sup>rd</sup> International Joint Conference on Artificial Intelligence

By SONG Jianlan (Staff Reporter)

The 23<sup>rd</sup> International Joint Conference on Artificial Intelligence (IJCAI-13), the premier international conference for scientists presenting their research in the field of artificial intelligence (AI), convened from August 3 to 9 in Beijing. This marked the first time ever for this 44-year-old conference to be hosted in China.

Jointly organized by the International Joint Conferences on Artificial Intelligence Organization, the

CAS Institute of Automation, the Chinese Association of Automation, Chinese Academy of Sciences (CAS), Tsinghua University, State Key Laboratory of Management and Control for Complex Systems and the Chinese Association for Artificial Intelligence, this conference also signaled the welcoming of a “strong and quickly growing Chinese AI community” to join the international AI family, according to organizers.

An overview of the conference.



## Celebrating Excellence in AI

The conference featured a technical program, a social program and numerous events including AI-related competitions and an exhibition program. Immediately prior to the technical program occurring from August 6 to 9, workshops and tutorials were held from August 3 to 5, to allow opportunities for participants to exchange innovative ideas on certain issues in AI area. To celebrate excellence in AI, 30 presentations of award-winning papers from sister AI conferences, plus 6 presentations of distinguished doctoral dissertations were also hosted at the Conference.

For its technical program, the Conference received 413 posters and 195 oral presentations on the regular track and especially 26 posters and 12 oral presentations on the “Computational Sustainability Track”, which echoed the theme of the Conference. Oral presentations on the regular track were organized along more specialized AI areas, including “Constraints, Satisfiability and Search”, “Agent-based and Multi-agent Systems”, “Planning and Scheduling”, “Machine Learning”, “Computation and Logic”, and “Natural Language Processing”.

Eight outstanding scientists were invited to give plenary talks during the session of the technical program, addressing some general issues of AI, including AI’s application in environment preservation and resources allocation, symbiotic AI, and future-generation smart machines.

To highlight AI’s impact on human society and deal with some issues of common concern between AI and humans, the Conference included a special social program of two debates, one on banning autonomous weapons and another on the future of AI.

Of particular interest to the participants was a series of awards granted at the Conference, in particular the “IJCAI-13 Award for Research Excellence” and the “Computers and Thought Award”.

The IJCAI Award for Research Excellence is established to recognize consistently excellent work by a scientist that yields several substantial results. The winner of the 2013 Award for Research Excellence was Hector



Kristen Grauman, winner of the 2013 Computers and Thought Award, gives a plenary talk titled “Teaching Computers about Visual Categories”.

Levesque, Professor of Computer Science at the Department of Computer Science of the University of Toronto.

Established with the royalties received from the book *Computers and Thought* edited by Edward Feigenbaum and Julian Feldman, the Computers and Thought Award aims to honor outstanding young scientists in AI. The Award for 2013 went to a young woman scientist, Kristen Grauman, Associate Professor at the Department of Computer Science, University of Texas at Austin. She gave a plenary presentation titled “Teaching Computers about Visual Categories”. Looking towards large-scale visual recognition and search, she analyzed the underlying mechanism of human visual recognition and classifications, including those involved with certain emotional and aesthetic judgment, and explored methods and strategies for large-scale visual recognition, classification and search.

WANG Ziyu, on behalf of his team, gives a talk on their winner paper “Bayesian Optimization in High Dimensions via Random Embeddings”.



Awarded at the Conference were also IJCAI 2013 Distinguished Papers and Outstanding Papers for the special track focused on computational sustainability. The “IJCAI 2013 Distinguished Papers” were awarded to “Bayesian Optimization in High Dimensions via Random Embeddings” by WANG Ziyu and his cooperators, and “Maximizing Flexibility in Simple Temporal Networks” by Bob Huisman *et. al.* On the special track for the theme of “AI and Computational Sustainability”, an “Outstanding Paper” was awarded to “Semi-Supervised Learning for

Integration of Aerosol Predictions from Multiple Satellite Instruments” by Nemanja Djuric and his cooperators, and an “Outstanding Student Paper” was awarded to “A Hidden Markov Model-Based Cicada Detector for Crowdsourced Smartphone Biodiversity Monitoring” by a team led by Davide Zilli.

Other awards granted at the Conference included the Donald E. Walker Distinguished Service Award, the IJCAI-JAIR Best Paper Prize, ECCAI Thesis Award and the AI Journal Awards.

## AI-Aided Sustainability and Human Life

Under the theme of “AI and Computational Sustainability”, the IJCAI-13 highlighted the increasingly important role played by AI in addressing environmental, economic, and societal challenges concerning sustainable development and a sustainable future. An invited talk on “computational disaster management” demonstrated AI’s effectiveness and efficiency in optimized managing and allocating natural and societal resources in different phases of disaster management, including optimization in strategic and tactical planning before disasters, and post-disaster response and recovery. The talk given by Pascal Van Hentenryck from NICTA and the University of Melbourne reported a fast-response analysis and decision support system built by his team to perform tasks in disaster mitigation, like planning the evacuation, distributing relief and optimal routing and scheduling in power restoration. Though this “agent” still needed further improvement, encouraging results from its experimental applications in recent natural disasters heralded a bright future concerning AI’s application in this field.



Pascal Van Hentenryck gives an invited talk on “computational disaster management”, introducing his team’s work on a quick-response analysis and decision-support tool for autonomous tasks in disaster mitigation, including evacuation, relief distribution and optimized restoration of power.

Titled “Algorithmic Method for Conserving Biodiversity”, another invited talk gave a glance at potential uses of AI in environment preservation. This talk, given by Steven Phillips from AT&T Labs, showed the audience what AI could do in terms of natural conservation, including reconstructing models of species distribution, designing protected areas, guiding field surveys, and reserve planning amid climate change and the sixth extinction in geological history.



Steven Phillips from AT&T Labs talks about AI’s application in conserving biodiversity.

Some of the other invited talks focused on deciphering human activities and cognitive processes, as well as applications of the results in different fields, including aiding the handicapped. Those most engaging included the talk on symbiotic AI given by Thad Starner from the Georgia Institute of Technology. Drawing on his long-term efforts to “discover” and reconstruct human activities from a computational view via data of human motions collected by a wearable camera and a group of wearable sensors, Starner reported the latest results from his team’s work, placing emphasis on potential applications of this technology, such as providing help to the handicapped. He demonstrated





The talk "Symbiotic AI: An Approach to Artificial Intelligence through First-Person Sensing" given by Thad Starner, who is wearing a camera on the glasses and a group of sensors on the fingers, fascinates the audience.



Joshua Tenenbaum from Massachusetts Institute of Technology gives a talk "Learning as Program Induction".

this technique's future use in a video, where an AI system could recognize and predict the actions of a vision-impaired person based on the data collected from his movements, tell him his own position, describe the objects around him, give alerts of possible dangers, and send out calls for further help online if necessary.

Another invited talk given by Joshua Tenenbaum from the Massachusetts Institute of Technology titled "Learning as Program Induction" also represented attempts in this direction, exploring the mystery of how human beings learn from a very limited amount of data.

What will the next generation of intelligent machines look like? Prof. Rolf Pfeifer from the Artificial Intelligence Laboratory, University of Zurich, and the Switzerland National Competence Center Research in Robotics, argues that they will look "softer", more like biological organisms.

Prof. Pfeifer and his team has been working on "soft robotics", a special robotics area where scientists render robots ability to function in the real world via "soft" designs, for example soft surface (skin), soft movement mechanisms (muscles, tendons), and soft interaction with other agents (smooth, friendly interaction). In his invited talk Pfeifer introduced the evolution of robotics research and simulation strategies, reviewed the design of Roboy, a research platform for anthropomorphic robotics as well as a tendon-driven soft humanoid, and suggested that these future-generation smart machines would arouse softer emotions in humans.

Prof. Rolf Pfeifer explains the mechanism of human walking and the evolution of AI strategies to mimic this process, beside the "Roboy", a most human-like robot, which is also a platform for anthropomorphic robotics research.





Program Chair of IJCAI-13, Francesca Rossi (first left) from University of Padova of Italy, Local Arrangement Chair, Prof. WANG Feiyue (center) from the Institute of Automation, CAS pose with the Roboy team led by Prof. Rolf Pfeifer together with the robot after the invited talk "Soft Robotics: Next Generation of Intelligent Machines".

## Impact of AI on Society in Dispute

To address some general issues that have raised common concerns in the AI community and beyond, a special social program was arranged during the Conference, comprising with two events, namely the debate on banning autonomous weapons, and the panel discussion on the future of AI.

Anxiety about the use of autonomous weapons has been gaining momentum, against the backdrop that some weapons have been endowed with high-level intelligence, equipped with advanced AI programming and can decide on themselves during a battle whether or not to fire. Should we ban autonomous weapons? The answer might seem intuitively obvious, as it is appalling

to leave the right to fire to a machine. Things might not be so simple, however, on closer inspection. At the debate "Should We Ban Autonomous Weapons", Noel Sharkey from University of Sheffield, UK described the current situation concerning developments and proliferation of such military robots, limitations of AI compared with humans in deciding on appropriate targets in a war, and reviewed recent international regulations/policies on this issue, while welcoming opinions from the attendees.

Some attendees echoed the worries about the proliferation of highly smart weapons, but at the same time some voices opposed banning research on related AI, while



"We are concerned": At the debate "Should We Ban Autonomous Weapons", Noel Sharkey from University of Sheffield, UK, who is also the Chair of the International Committee for Robot Arms Control, talks about the current situation concerning developments and proliferation of such military robots.

advocating the necessity of humans having the final say so as to limit the abuse of such techniques — or in other words, to maintain a balance.

It seems that the controversy will continue to rage, possibly with greater intensity outside the confines of the conference halls.

Scientists have endeavored to develop AI to a more advanced level where machines can be highly smart — say, as smart as humans. Some believe that it is only limited by ingenuity and physics, and progress seems to be accelerating, according to Stuart Russell, chair of the panel discussion, and scientists may soon have a roadmap towards this objective, though we are still far from achieving real success. So, what would happen if we do succeed in making an ultra-intelligent machine? Opinions on this issue are highly polarized. One of the two ends, represented by I. J. Good (1965), says "The first ultra-intelligent machine is the last invention that man needs ever make", while the

other argues that "Success would be the biggest event of human history". Four panelists each gave their opinions concerning the evolutionary path of AI, what would be the plausibly reachable best and worst cases, and technical/societal solutions to this issue if human beings were capable of affecting this evolution. Ethical issues arising from the relationship between smart machines and humans were also addressed. Subsequently the panelists joined the audiences in a Q & A session to further discuss this issue. Given the "very, very risky, potentially terminal" subsequence of losing control — "even near human-level AI could be a game-changer" — Anders Sandberg urged that actions were needed to be taken to strengthen research on safety and trustworthiness of machine intelligence at an early stage.



Panelists of the discussion on "What If We Succeed?": (From left to right) President of AAAI, Prof. Henry Kautz from University of Rochester; Developer of Google driverless car, Sebastian Thrun from Udacity/Google/Stanford University, who is also the Conference Chair of IJCAI-13; Fellow of the Future of Humanity Institute, Anders Sandberg from University of Oxford; and Co-author of the book *EPSRC Principles of Robotics*, Joanna Bryson from University of Bath.

## Agents vs Humans

Aside from advanced AI techniques that seem to be too abstruse to engage non-experts, three competitions held under the framework of the Conference, represented by the "Angry Bird AI Competition" attracted a lot of attention from the public due to their great enjoyment.

In the popular video game "Angry Birds", human players are required to destroy a certain mechanical structure to solve a level. Competitors in the Angry Birds AI Competition, interestingly, were invited to develop a programmed agent as a surrogate player to destroy the structures without any human interference. On the final day of IJCAI-13, challengers recruited earlier confronted the

Top3 winner agents, and eventually human challengers won the "Man vs Machine Challenge".

"It is good to see that we are still better at playing Angry Birds than AI and Angry Birds remains a very challenging problem for Artificial Intelligence. It seems that AI at the moment is clearly better than beginners, but cannot yet match the experience of the best human players," the organizer commented on the results.

Apart from the Angry Bird AI Competition, the IJCAI-13 Robot Competition and Exhibition and the AI Video Competition also attracted a lot of spectators.

For the AI Video Competition, a total of 17 submissions





At the closing ceremony of IJCAI-13, awarded are the winners of both the Angry Bird AI Competition and the Man vs Machine Challenge between the human challengers and winner agents for the Angry Bird AI Competition.

were shortlisted and showed in common areas during the Conference. At a ceremony held on the morning of August 8, awards were respectively given to AI teams for the best video, the most educational video, the best autonomous robotics video, the best application, the most entertaining video, and the most entertaining autonomous robotics video. The team from the University of Science and Technology of China (USTC) led by CHEN Xiaoping won the “Best Autonomous Robotics Video” with their work “Utilize External Knowledge to Solve New Problems”. The video

demonstrated how a general-purpose service robot “Kejia” can solve problems for which solutions were not taught by the inbuilt program, like heating food with a microwave oven, by referring to knowledge from an external source — after hearing the order, it follows the master’s requirements to download a manual of the microwave oven and successfully heats the food after reading the manual. The robot “Kejia” also reaped the Prize for the Best General-Purpose Service Robot in the Robot Competition and Exhibition.

The Robot Competition and Exhibition was the first



Representative of the USTC team receives the IJCAI-13 Video Award for the Best Autonomous Robotics Video.



The same team who won the “Best Autonomous Robotics Video” is also awarded at the closing ceremony with the Prize for the Best General-Purpose Service Robot for the Robot Competition.



Leader of the team PKU-MLR from Peking University, China receives the Prize for the Best Technical Skills for the Robot Competition from Sebastian Thrun, Chair of the Conference.



of its kind held during an IJCAI. For this competition, performance of robot attendees were examined and assessed in terms of innovation, significance, technical quality and understandability. Finally four prizes were offered for

physical skills, social skills, service tasks and awesome application. The team “PKU-MLR” from Peking University, China won the Prize for the Best Technical Skills in the Robot Competition.

## AI for Living

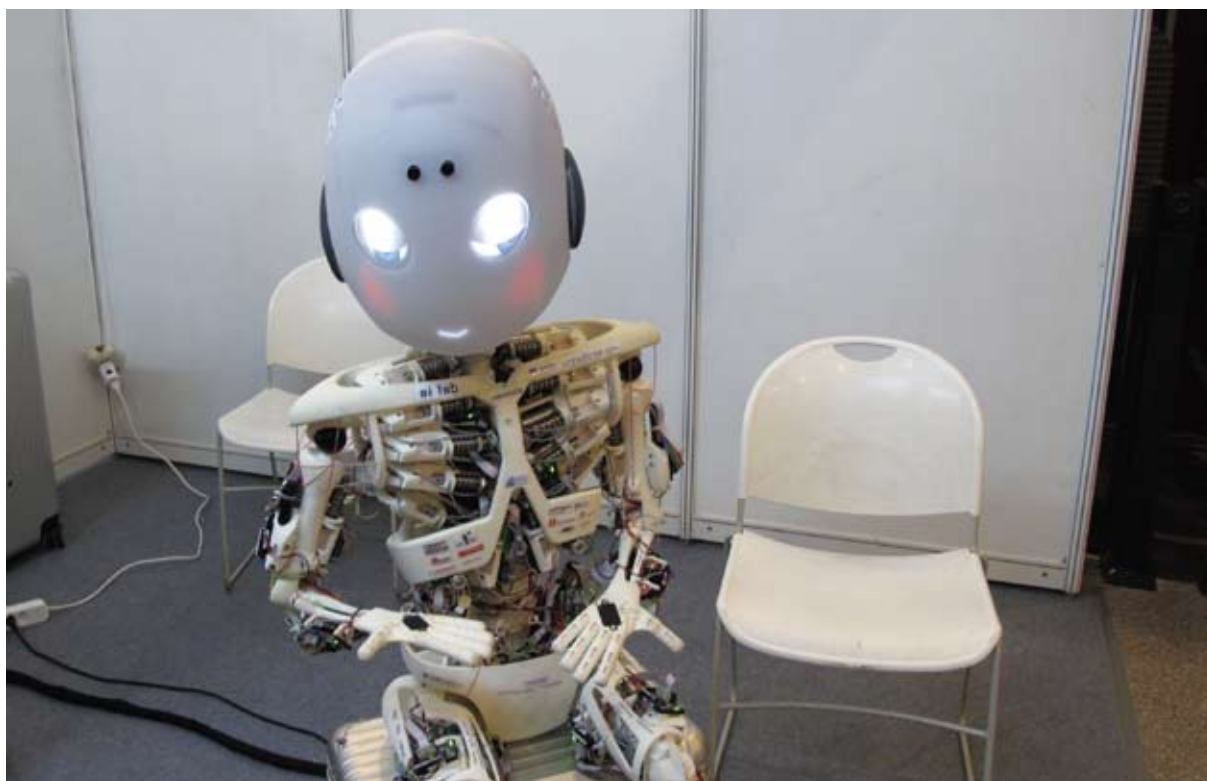
The AI exhibition hosted by the Conference provided an easy way for the public to understand what AI could do for human society and how it could affect human life. At the venue, visitors could see AI machines produced by high-tech companies as well as the most novel ideas from research, most strikingly, robots. Among them, Roboy might be a well-agreed star.

A brainchild of project coordination in 2011 between internationally leading research institutions and industry partners who are at the forefront of development in mechanics and electronics, Roboy represents the most state-of-the-art robotics technology resulting from a combination of the latest discoveries from labs and advanced expertise of the industry sector.

One of the outstanding breakthroughs achieved on this platform is the anthropomorphic tendon-driven arm. Able to make seven facial expressions, including “angry”, “surprised”, and “shy”, it is among the most human-like robots to date.

A robot developed for research and education by Aldebaran Robotics, and a sample machine of industrial robot produced by ABB were also in the spotlight. According to the staff from Aldebaran, their robot could be used in AI-related teaching, and psychological treatments and experiments, for example treatments aimed at improving syndromes of autistic disorder. As for the ABB robot, it was originally designed for 3C manufacture, but it could also be re-programmed to suit the requirements

“I could be shy”: Roboy, a research platform for “soft robotics” as well as a humanoid, can make 7 facial expressions and move more softly than ordinary robots. Driven by as many as 48 motors, it is built with metal “muscles” balanced by springs.





of other industries. According to ABB staff, sales of their products were seeing a booming growth in Chinese market, increasing at an annual rate over 30% in the past few years, suggesting strong demands from equipment upgrade of plants in China.

At the stand of Tianlian Tech, a China-based high-tech

company, a 3D printer and its products attracted a large crowd of people. According to the staff, the producer of low-cost 3D printers aimed to make this device a must-have on everyone's desktop.

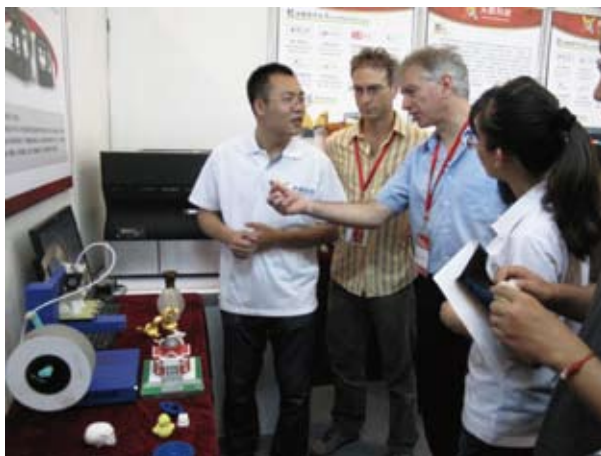
How far are we from an era of AI? Maybe it is closer than we have ever conceived.



On exhibition is a robot from Aldebaran Robotics designed for AI-related teaching and scientific research.



An industrial robot developed by ABB. The staff was very optimistic towards its sales and future applications in China.



Left: Staff from Tianlian Tech describing a 3D printer to the visitors on their exhibition stand.  
Right: A product from the 3D printer developed by Tianlian Tech.  
(All photos in this report by SONG J)

