PONTIFICIA ACADEMIA | PRO VITA

WORKSHOP 2019

«HUMANS, MACHINES, AND HEALTH»

NEW HALL OF THE SYNOD – VATICAN CITY
FEBRUARY 25th – 27th 2019

MONDAY, FEBRUARY 25, 2019

FIRST SESSION

Moderators: L. Palazzani, F. Profumo

15:00 Welcome

15.15 Roberto Cingolani (Italy)

15:55 Hiroshi Ishiguro (Japan)

16:45 Aude Billard (Switzerland)

17:15 Caratteristiche e interazione dei diversi approcci
(moderatore della discussione: Paolo Benanti, Italia)

18:45 Conclusioni

TUESDAY, FEBRUARY 26, 2019

SECOND SESSION

Moderators: A. Pessina, L. Kovacs

9:00 Robotics and interpretation of reality
Luciano Floridi (UK)

9:30 New challenges and opportunities for Catholic technological reflection
Emmanuel Agius (Malta)

10:00 Robotics and transformation of economics dynamics
Peter J. Opio (Rwanda)

10:30 Discussion

11:00 Coffee break

11:30 Robotics and socio-political issues
Marita Carballo (Argentina)

12:00 THE HUMAN UNDERBELLY OF THE ROBOTICS INDUSTRY
Kizito Kiyimba (Zimbabwe)

12:30 Discussion

13:00 Lunch

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TUESDAY, FEBRUARY 26, 2019

THIRD SESSION
Moderators: M. Ferrari, E. Akiba

15:00 Principles for shaping robotics and artificial intelligence
Christine Woopen (Germany)

15:30 Socially Assistive Robots in Elderly Care: Ethical Aspects
Chris Gastmans (Belgium)

16:00 Computational Surgery: New Perspectives and Implication
Barbara Bass (USA)

16:30 Discussion

17:00 Coffee Break

17:30 Use of Robots in Healthcare: the Japanese Experience and the Relevance of Culture
Kojiro Honda (Japan)

18:00 Roboticas in the Intercultural Arena: Elaborating Shared Criteria in the Global Institution
Luka Omladic (Slovenia)

18:30 Discussion

19:00 Conclusion

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SPEAKERS

- **AGIUS Emmanuel**, Professor of Moral Theology and Philosophical Ethics, University of Malta (Malta); PAV Member.
- **BASS Barbara**, Executive Director, Houston Methodist Institute for Technology, Innovation & Education (USA).
- **BILLARD Aude**, Learning Algorithms and systems Laboratory, École Polytechnique, Fèderal de Lausanne (Svizzera). Adjunct Faculty, Computer Science Department, University of Southem Carolina (USA).
- **CARBALLO Marita**, President «Academia Nacional de Ciencias Morales y Politicas» of Argentina; President, Voices! Research and Consultancy (Argentina).
- **CINGOLANI Roberto**, Scientific Director, istituto italiano di Tecnologia (Italy); PAV Member.
- **FLORIDI Luciano**, Professor of Philosophy and Ethics of Information, University of Oxford (UK).
- **GASTMANS Chris**, Professor of Mediacal Ethics, Catholic University of Leuven (Belgium); PAV Member.
- **HONDA Kojiro**, Associate Professor, Department of Humanities, Kanazawa Medical University (Japan).
- **ISHIGURO Hiroshi**, Intelligent Robotics Laboratory, Dept. of System Innovation, School of Engineering Science, Osaka University (Japan).
- **KIYIMBA Kizito**, Vice Chancellor, Arrupe Jesuit University (Zimbabwe).
- **OMLADIC Luka**, Professor of Practical Ethics, University of Ljubljana (Slovenia); Member of the World Commission on the Ethics of Scientific Knowledge and Technology of UNESCO o (COMEST), Coordinator of the COMEST Working Group on Robotics Ethics.
- **OPIO Peter John**, Vice Chancellor/Rector, Kigali Institute of Management University (Rwanda) WOOPEN Christiane, Professor of Ethics and Theory of Medicine, University of Cologne (Germany); Chair, European Group on Ethics in Science and New Technologies (EGE).
- **WOOPEN Christiane**, Professor of Ethics and Theory of Medicine, University of Cologne (Germany); Chair, European Group on Ethics in Science and New Technologies (EGE).

MODERATORS

- **AKIBA Etsuko**, Professor of Law, *University of Toyama* (Japan); Member of the Directive Council of the Pontifical Academy for Life.
- **BENANTI Paolo**, Professor of Moral Theology, Pontificia Università Gregoriana, Rome (Italy); PAV Member.
- **FERRARI Mauro**, President and CEO, Houston Methodist Research Institute; Director, Institute for Academic Medicine at Houston Methodist Hospital; Executive Vice President, Houston Methodist Hospital System, Houston (USA); PAV Member.
- **KOVÁCS László**, Professor of Politics, Ethics and Philosophy, University for Applied Sciences, Augsburg (Germany); PAV Member.
- **PAGLIA Vincenzo**, President, Pontifical Academy for Life (Vatican City).
- **PALAZZANI Laura**, Professor of Philosophy of Law, LUMSA University, Roma (Italy); PAV Member.
- **PEGORARO Renzo**, Chancellor, Pontifical Academy for Life (Vatican City).
- **PESSINA Adriano**, Professor of Moral Philosophy; Department of Philosophy, Catholic University of the Sacred Hearth, Milan (Italy); Member of the Directive Council of the Pontifical Academy for Life.
- **PROFUMO Francesco**, Professor of Electrical Machines and Drives, Politecnico di Torino, Torino (Italy); PAV Member.

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ROBERTO CINGOLANI

Humans, Humanoids and Intelligent Machines: Is there a coexistence problem?

The body-mind nexus of living organisms is hard to imitate by an embodied artificial intelligence, even by merging state of the art supercomputers and robotic systems. A basic comparison between biological intelligence and artificial intelligence explains the origin of such a basic limit. Nevertheless technology has developed intelligent machines capable of understanding and deciding specific tasks, thus raising the problem of envisaging a society in which humans and intelligent machines will operate side by side.

Several questions need to be addressed, such as: (i) are humans, with their individual and independent intelligence, ready to coexist with cognitive machines having a collective intelligence in the cloud? (ii) how will intelligent robots impact the human workforce? (iii) are there real ethical problems with intelligent robots, or should we consider them simply as "useful devices"?

In this frame we will shortly review the current development of intelligent robots, their differences with respect to biological species, and their applications to different domains, such as health, disaster recovery, and assistance to humans.

HIROSHI ISHIGURO

Studies on Interactive Robots

We, humans, have innate brain function to recognize humans. Therefore, very humanlike robots, androids, can be ideal information media for human-robot/computer interaction. The speaker, Ishiguro, has developed various types of interactive robots and androids so far. These robots can be used to study the technologies and understand human natures. He has contributed to establish the research area of Human-Robot Interaction with the robots.

Geminoid, a teleoperated android of an existing person, can transmit the presence of the operator to the distant place. The operator recognizes the android body as his or her own body after talking with someone through the geminoid. He or she has the virtual feeling of being touched when someone touches the geminoid.

However, the geminoid is not the ideal medium for everybody. For example, elderly people often hesitate to talk with adult humans and adult androids. In order to investigate the ideal medium for everyone, the speaker proposes the minimum design of interactive humanoids known as Telenoid. The geminoid is the perfect copy of an existing person and it is the maximum design of interactive humanoids. On the other hand, the minimum design looks like a human but we cannot judge the age and gender. Elderly people like to talk with the Telenoid very much. In this talk, the speaker discusses the design principles for the robots and their effects on conversations with humans.

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Furthermore, Ishiguro is developing and studying autonomous conversational robots and androids. He especially focuses on embodiment, emotion, and the intention/desire of the robots and androids. In addition to these robotics studies, he will discuss a future society in which we have symbiotic relationships with the robots.

AUDE BILLARD

Robots - ready to work with and for humans?

The last decade has seen a sudden growth in interest and funding allocated to robotics. The focus is on intelligent robots that can become good proxies of humans in both their behavior and their understanding of the world. Progress is steady and robots are becoming smarter every day. They are still very far from matching humans, but they are endowed with this ability that is unique to our own species: they can learn. This enables them to acquire new skills on the go. Robots can learn either from observing humans or from trying the task on their own. Robots are hence no longer these machines that, once programmed, can only replicate what they had been programmed for when getting out of the factory. Robots can progress. They can adapt to their environment and hence become increasingly more flexible. This opens the door for introducing robots in our daily environment. Robots may soon work side by side with humans in factories, drive cars, and carry deliveries.

While these advances lead some to dream of more profit and of a better world with safer roads, for others they generate all sorts of fears, including fear of losing one's job to a robot to the fear of being killed by robots. These fears are not to be underestimated. Yet, robots are far from replacing humans and are more likely to improve the quality of our lives than the converse. Next, I review current and expected trends in robot manipulation, an area close to my research.

Robots for factories in the 21st century

Dexterous manipulation of objects is the primary goal of

21st century robotics and a cornerstone of industry 4.0.
It envisions robots capable of sorting objects, packaging, chopping vegetables, and folding clothes. It also requires robots to be aware of humans.
Robots should work side by side with humans, offering their strength to carry heavy loads, while presenting no danger to humans should they inadvertently touch them. The past decade has made a leap forward endowing robots with new levels of dexterity. These advances grew from breakthroughs in mechanics with new sensors for perceiving touch all along the robot's body and new mechanics for soft actuation to offer compliance. Most importantly, it leverages the immense progress in machine learning to encapsulate models of uncertainty and to support further advances on adaptive and robust control. Recent years have therefore witnessed a significant turn toward data-driven methods and use of simulators for data generating. Still, grasping and dexterous manipulation require a level of reality in which existing simulators for soft contact modeling are not yet able to deliver. Learning to manipulate in the real-world is costly both in time and hardware. Two roads are hence pursued. The first one takes inspiration on the way humans acquire skills and has robots learn skills from observing humans performing complex manipulation. This allows robots to acquire manipulation in just a few trials. However, it is not clear how one can generalize the knowledge thus acquired to actions different from those demonstrated. The second road constructs databases of real object manipulation, as to better inform the physics of the simulator. Yet, achieving realistic simulation of friction and material deformation from real textures may not be possible.

One main challenge to achieve a level of human dexterity is the hardware – both in terms of hand design and accompanying sensing. Human hands are flexible with a dexterous thumb whose unique range of motion still eludes robotics. Compliance is a pre-requisite for dexterity, to conform to the object's shape, to absorb unexpected forces at contact, and to compensate for load change during manipulation.

Recent efforts are building on new solutions from 3D manufacturing and material science to create soft hands.
Similar to hardware, perception is a major challenge to dexterous and fluid manipulation. Human manipulation uses haptics, primarily perception of touch and force. Advances in robot perception for manipulation allows multi-modal information processing, combining visual and haptic information in preparation to infer information about texture, shapes, and orientation. Once the object is in hand, other physical properties such as rigidity, mass, and mass distribution, not readily observable, can be inferred through touch and force measurement. Sound has also recently received attention as a means to infer the object's content when it is invisible and for monitoring change in content.

Robotics is now particularly interested in dynamic manipulation, such as when manipulating objects *in-hand*, e.g. twisting a pen across fingers. Manipulation does not stop at simply controlling the hand, but also requires control of the arm, torso, and ultimately the entire body. The challenges listed above only increase in scale when one wishes to enable a full humanoid robot to manipulate objects, as one must take care to not set the robot off balance.

To some researchers, learning has become a solution to many of the problems faced by robotics. Learning methods are, indeed, particularly suited to embed the dynamic nature of manipulating objects. It allows researchers to model the dynamics of complex non-rigid objects that cannot be described analytically. Manipulation actions that generate changes on the object (cutting and crushing) are particularly difficult as they require a model of the deformation and advanced perception to monitor these deformations. They also require a variety of forces applied by the hand, such as controlling the reduction of the friction as one unscrews a bottle cap, or the increase in viscosity as one digs in a melon. Modeling friction and viscosity properties of an object is an intricate task and learning this seem more appropriate.

Outlook

Many questions remain on how to enable robots to deal with the most unpredictable agent of all, the human. With industry 4.0, the fences that used to separate humans from robots will disappear and robots will be engaged in collaborative tasks where they jointly manipulate objects. One challenge to achieve this is to enable robots with advanced interaction capabilities so as to become a smooth partner that synchronizes its motion to that of the human. This requires advancements beyond simple object interaction. Robots will need better understanding of how humans interact and achieve joint goals through planning and direct physical interaction. There is also a need to develop robots that are safe by design, putting focus toward soft and lightweight structures as well as control and planning methodologies that are based on multisensory feedback. The human way of acting will continue to serve as an inspiration to build future robot systems and robots will serve as a tool for understanding humans better.

Ethical concerns:

This talk cannot be closed without discussing some of the current and open ethical issues related to the use and dangers arising from industry 4.0 robots.

Dexterous robots will ultimately take over jobs currently performed by unskilled workers, leaving those jobless. New jobs will be created but will require different sets of skills. It becomes an issue of public policy to determine the right tradeoff between benefits and harms brought by these robots. Unskilled workers may stand a chance to keep their job and to improve their working condition if they are trained for more skilled works. We can hope that employers may see a benefit to offer such training to their employees. We can also reach out to governments and advocate need for coaching programs to those working in areas most at risk.

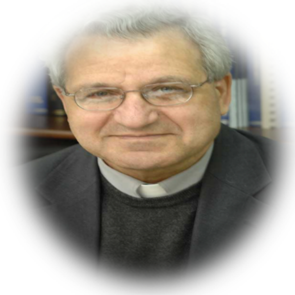
LUCIANO FLORIDI

Robotics and Interpretation of the World

In this talk, I shall discuss some challenges and opportunities offered by our increasing success in engineering smart and autonomous agents (AI), and some of the most significant initiatives concerning the ethics of AI. I shall argue that: (a) AI's challenges and opportunities are best understood if we interpret AI not as a marriage but as a divorce between the ability to solve problems and the necessity of being intelligent in doing so; (b) AI does not lead to any fanciful realization of science fiction scenarios (e.g., Singularity), which are at best distracting and at worst irresponsible; (c) human intelligent behaviour is confronted by artificial smart behaviour, which can be adaptively more successful in the infosphere; (d) human free behaviour is confronted by its predictability and manipulability by AI, and by the development of artificial autonomy; and (e) human sociable behaviour is confronted by its artificial counterpart, which can be both attractive for humans and indistinguishable by them.

In the conclusion, I shall suggest that all this invites us to reflect more seriously and less complacently about who we are, could be, and would like to become, and therefore about our self-understanding and our ethical responsibilities towards the world and each other.

Photo courtesy of Ian Scott, 2016



EMMANUEL AGIUS

New Challenges and Opportunities for Catholic Theological Reflection

The classical definition of theology as ‘faith seeking understanding’ means that faith in God as revealed in Jesus Christ prompts a questioning search for deeper understanding of human experience. Theological reflections cannot remain indifferent to the emergence of robotics, which is affecting all spheres of life. Which questions can theological ethics pose to this innovative development in AI? Theology revolves around the centrality of the human person created in the image of God.

The dignity of the human person, the concept of personhood, and moral agency are truly philosophical concepts, but they are intimately theological at their foundation. Faith needs to ask hard questions about the value and nature of robots, their influence on human flourishing, their societal benefits and risks, their impact on the labour market, healthcare, industry, and economy.

It is for this reason that Pope Francis, at the meeting of the World Economic Forum, held on January 12th, 2018 at Davos, remarked: “Artificial intelligence, robots, and other technological innovations must be employed that they contribute to the service of humanity and to the protection of our common home, rather than to the contrary, as some assessments unfortunately assess.” Robots need to be human-centred. Robotics raises many epistemological issues relating to how knowledge is represented in a leaning machine.

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However, a better starting point is to begin with the ontological issues.

The ontological question helps us to discern what separates humans from machines. Do robots have intrinsic value or instrumental value? Can we assign personhood to robots? Can we talk about the dignity of robots? Are robots self-conscious? Do they have feelings and emotions? Christian anthropology can shed light on this very significant debate on what it means to be human. Once we clarify the ontological question concerning who we are and what learning machines are, then we can start asking the questions about the appropriate use of robots.

PETER JOHN OPIO

Robotics and the Transformation of Economic Dynamics

Africa is emerging as a competitive player in the robotics industry. Ethiopia, for example, is acclaimed as a 'Growing Miracle' due to its comparatively high investment in Artificial Intelligence. In contrast, there are high unemployment rates among the youth (29.3% and 10.3% for Northern and Sub-Saharan Africa respectively); increasing poverty rates, poor health and infrastructure. The increasing use of robots for industrial automation poses risks to youth employment, with Ethiopia leading globally at 85%. The African economic story remains astoundingly bleak.

This paper critically examines the robotics wave across the African continent, avoiding on the one hand, the neoclassical economic positive narrative which justifies the use robotics for productivity gains, the negative consequences notwithstanding; while on the other hand, we challenge as unhelpful the position of critics that equate economic challenges on the use of robots. We maintain that in order for the robotics wave to deliver and foster sustained socio-economic transformation in Africa, both investment decisions in robotics and what type of robotics to employ should be informed by the common good and should be directed towards promoting the wellbeing of all, particularly the most disadvantaged.

In the light of the discourse on wellbeing and the common good, we examine the following robotics initiatives in Africa: (1) Ethiopia's Sheba Valley Initiative; (2) delivery drones for medical supplies in Rwanda; and (3) the use of drones in the utility sector in Kenya.

Drawing on the lessons learnt from these robotics initiatives, the paper proposes a framework to guide policies and decision mechanisms for determining robotic investments in Africa in the context of the socio-economic experiences of the people.

MARITA CARBALLO

Robotics and Socio-Political Issues

The technological advances taking place in the world are profound, rapid and cross-cutting. They traverse every order of life and encompass many technologies that are developed simultaneously and, at the same time, integrated to each other. The characteristics of the coming change are so deep that they are unparalleled in human history. The neologism *post-human* that has been coined in recent decades is indicative of the disruptive nature of this transformation.

The consequences of these changes in politics, the economy, society, biology, and the environment are already generating strong debates about what the future will look like. One of the technologies covered by this wide spectrum of techniques is robotics. It is gradually emerging to touch and transform almost all daily areas, such as our homes, the way in which we do business, how we protect ourselves, how we relate to each other, how we work, and it even has implications in areas as dissimilar as politics, education, and health.

In light of these trends, robotics, artificial intelligence, and the other new technologies provide advantages but also pose potential risks. In this presentation we will analyze how citizens foresee some of these changes, what their attitudes and opinions are about these new technologies, and how they think these will affect them. To this end, we will rely on recent surveys conducted to the highest scientific standards, including both national and international studies.

KIZITO KIYIMBA

The Human Underbelly of the Robotics Industry

The anthropological questions that arise today, when we find ourselves in the presence of an ever more potent, human-like robot, do not have to be new. Their apparent novelty can be daunting, but the threat in them can be lessened or at least dealt with. In order to address the apparently novel questions around the existence of robots among us, we need to (re-)evaluate the whole process in which the robotics industry operates, from conception, through blue-printing/proto-typing, production, mass production, and marketing all the way to use and disposal.

If we did not make a judicious effort to weave humanity into each or any of these stages, we have set ourselves up for surprises and apparently novel and unwieldy questions in the later stages. I argue that there is a similarity between the "daunting questions" of science, and the "daunting questions" of robotics. A rethinking of the process would include tracing the judicious anthropological/ethical conscious choices made at each stage. The central argument is that this exercise would help show the actual human underbelly of the robotics industry. Where such choices have been woven into the processes of the industry, the novelty of the daunting questions at the end or at any one stage is lessened.

As an observer/philosopher from the Global South, I show what the anthropological contribution from the South to the robotics industry is, from conceptualization to disposal. The greater and more equitable the contribution of the entire human species is at each stage, the more human(e) will the industry be.

The alternative is that we shall continue to enhance the skills gap and the digital divide with dire consequences of creating a super sub-species who will have access to the benefits of super-robots, living side-by-side, or sharing the same planet as a lesser sub-species who continue to suffer from the negative impacts of an unequally robotized world.

My conceptual framework is a re-reading of the argument of Michael Polanyi, in his *Personal Knowledge: Towards a Post-Critical Philosophy*. Polanyi singles out a "Laplacean fallacy" that squeezes out the person from the attainment of an unrealistic, uninformed objectivity.

A counter-argument to this Polanyian view would be that the current expressions of artificial intelligence have superseded such a framework, moving into connectionism. But I argue that the same fallacy still lurks in the robotics process, and that a re-emphasis of the human aspect of the industry will go a long way in helping realise the goal of robotics, which is to provide tools for the human person, rather than enter into a competition.

The way to achieve the goals of robotics is to keep the aspirations and goals of humanity, the entire human family, as the goal of robotics. In that way, the intellectual passions of human society will best be served, and a mechanism for resolving novel daunting questions will be put in place.

CHRISTIANE WOOPEN

Ethical Principles for Shaping Robotics and Artificial Intelligence

Big Data, robotics and artificial intelligence are rapidly and profoundly transforming healthcare. Far reaching hopes regarding personalised medicine, more patient autonomy and safety, more effective prevention and a highly efficient and learning healthcare system meet fears of financial viability of healthcare, “roboters” replacing doctors and nurses, and violations of patient privacy and data protection.

The debate in Europe is especially focused on ethical principles and on building ethics into artificial intelligence from the beginning of its development in order to harness the potential of modern technologies while at the same time avoiding associated risks and mitigating harm. There are several sets of ethical principles for artificial intelligence which are suggested by advisory groups, policy makers, companies and research organisations.

The presentation will introduce the ethical principles that have been proposed by the European Group on Ethics in Science and New Technologies in its Statement on Artificial Intelligence, Robotics, and ´Autonomous´ Systems in March 2018. Their relevance and implications for health and healthcare will be discussed.

CHRIS GASTMANS

Socially Assistive Robots in Elderly Care: Ethical Aspects

With decreasing birth rates and increasing longevity, populations are aging across the world. Combined with a decreasing number of caregivers to support older adults, one has to ask how dignity-enhancing care for older adults will be ensured in the next decades. In the past ten years more attention has been paid to robotics as a possible solution to address these challenges of aged care. In my lecture, I will focus on Socially Assistive Robots (SARs). This type of robot is characterized as embodied technologies with a certain degree of independence, having a social capability by which they formulate expressions while carrying out assistive functions.

This 'robotic solution' leads to several ethical concerns related to topics such as privacy, autonomy, deception, objectification of older adults, dehumanization of care practices and of society as a whole, etc. My lecture's overall aim is to give an overview of the ethically sensitive issues regarding SAR use in aged care settings.

To reach this aim I will establish a dialogue between older adults' perceptions regarding the ethics of SAR use, existing ethical concepts regarding robot use in aged care, and applied ethical argumentations. Starting a dialogue between the results of empirical research and philosophical-ethical research creates the possibility to develop applied-ethical considerations on SAR use that are grounded in and enriched by lived experiences of older adults and by philosophical reflections.

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BARBARA BASS

Computational Surgery: A beneficial but Potentially Disruptive Advance in Surgery

The process of surgery is exquisitely personal. One human being in need of a procedure– the repair of an injured or failing element, removal of an infected or invasive part, or even replacement of a failed organ - seeks the help of a skilled and knowledgeable stranger: a surgeon. That surgeon uses his or her hands and tools, skills, knowledge, wisdom and experience to perform the task—often an invasive operation with inherent risks and benefits. As the patient sleeps silently on a metal table, a group of capable strangers composed of nurses, technicians, and anesthetists all gather as a team to perform the operation.

The levels of trust present during an operation are remarkable, both for the patient and for the surgeon, who inherently causes some harm to the patient. In this way, surgery appears to be a unique expression of trust between individuals. The surgeon's role includes direct contact with the patient and with warm human tissue, a sure sign of life. A surgeon's experience and knowledge of anatomy, physiology and disease primarily guides his or her hands. However, in recent years, mechanical devices have begun to span the space between a surgeon's hand and the patient's body, replacing tactile contact with purely visual clues to guide the procedure.

In fact, over the last two decades, the human process of surgery is being augmented by new technologies, including computer aided surgery, imaging technology to allow augmented visualization and devices to enable precision of the surgical procedure.

KOJIRO HONDA

Use of Robots in Healthcare: the Japanese Experience and the Relevance of Culture

When a Japanese engineer, Takanori Shibata, invented the seal-like robot "Paro", which was developed to care for the elderly, there began arguments for and against it in the Western world. On the one hand, Danish government soon decided to introduce the robots into hospitals because of their curative effect for dementia, while on the other hand Sherry Turkle held a warning for human's high dependence on technology quoting fifth graders' words: "Don't we have people for these jobs?" (Turkle 2011: 125) In contrast, there were few criticisms about the acceptance of Paro as a care-giving agent in Japan. Why? The Japanese might espouse "Cybernetic Religion" which Erich Fromm formulated as the following: "We have made the machine into a god and have become godlike by serving the machine." (Fromm 1976: 153)

At the very beginning, the Japanese have professed nature itself rather than technology. For example, in Japan, there has been a traditional custom to hold a memorial service for shabby tools such as needles or food-choppers with raising a tomb. From a Western point of view, which deems nature as created by God, this custom may seem to be odd. But if you know the old nature-views in Japan, you can find the reason why the Japanese do so.

In Shinto-ism, nature was not created by God, but rather it is a part of a God. The ecosystem is a kind of God as called *Ubusuna-gami*. And all things in nature belong to the God. Shinto-ism deems all things as living matter.

So, every material has four kinds of soul. (*Nigi-mitama*: soul of compassion. *Ara-mitama*: soul of fighting. *Saki-mitama*: soul of love. *Kushi-mitama*: soul of curiosity). And it explains that the functions of the four souls produce each and every transformation of nature. And only human beings have a God-given spirit (*Naobi-tama*), which has a function of reflection and a role to maintain balance among the four souls in nature.

Old Japanese prayers "Ooharae-no-kotoba" say that, in the old divine era, even stones as well as plants, fish and beasts had the verbal capacity. In addition, the old mythologem "Kojiki" says that the verbal capacity of 'creature' and 'thing' were expelled from Japan when a man-shaped God named *Ninigi-no-mikoto*, who is considered an ancestor to the Emperor's family in Japan, descended to earth.

Nevertheless, the old memory of direct communication between human beings and nature itself has been resonant again and again in the history of Japanese literature: not only in *waka* or *haiku* but also in modern literature such as that of Kenji Miyazawa (1896-1933). What kind of impression will this cultural identification of Japan provide its citizens when they first come up against robots? The answer is 'nostalgia'. This would be a clear difference of culture between Japan and other countries.

In the Old Testament, human beings were created in God's image, which is why some people in Western societies feel antipathy to humanoid robots. Because human creation belongs to the realm of God and not of man. In contrast, a lot of Japanese feel sympathy to humanoid robots because speaking-objects evoke old memories of the divine era when all the things communicated with each other with a verbal capacity.

In this presentation, the author will consider the character of Japanese robot-culture in the context of healthcare by associating it with the traditional religion: Shinto-ism. The insight will provide you a vision that robot-culture in Japan would be founded not only on 'Techno-philia' but also on 'Techno-animism'.

LUKA OMLADIČ

UNESCO Science and Technology Ethics Comission's work on Robotics and AI Ethics

Robots can help humanity, and they have done so since the mid-20th century. While initially being mostly used for industrial and military applications, they are currently emerging in other areas, such as transportation, healthcare, education, and the home environment. Contemporary robotics is increasingly based on artificial intelligence (AI) technology, with human-like abilities in sensing, language, interaction, problem solving, learning, and even creativity.

The main feature of such 'cognitive machines' is that their decisions are unpredictable, and their actions depend on stochastic situations and on experience. The question of accountability of the actions of such cognitive robots is therefore crucial. The rapidly increasing presence of cognitive robots in society is becoming more challenging. In its 2017 report on Robotics Ethics, UNESCO COMEST (Commission mondiale d'éthique des connaissances scientifiques et des technologies) recognized some fundamental ethical values and principles that need to be observed in using and particulary in designing robots and cognitive machines.

These are human dignity, values of autonomy, privacy, responsibility, beneficence, transparency and accountability, justice, precautionary principle and responsible research and innovation. We argue how these must be used for value sensitive design of the machines. We also propose the notion of a technology-based ethical framework, one that can be used in practice by engineers and designers.

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