The world according to Itskov: Futurists convene at GF2045 (Part 1)

August 1 2013, by Stuart Mason Dambrot

As many Phys.org readers undoubtedly know, Einstein famously said that *imagination is more important than knowledge* – but there's more to it.

The full quote reads:

I believe in intuition and inspiration. … At times I feel certain I am right while not knowing the reason. When the eclipse of 1919 confirmed my intuition, I was not in the least surprised. In fact I would have been astonished had it turned out otherwise. Imagination is more important than knowledge. For knowledge is limited, whereas imagination embraces the entire world, stimulating progress, giving birth to evolution. It is, strictly

speaking, a real factor in scientific research.[1]

Futurists, visionaries, scientists, technologists, philosophers, and others who take this view to heart convened on June 15-16, 2013 in New York City at Global Futures 2045 International Congress: Towards a New Strategy for Human Evolution. GF2045 was organized by the 2045 Strategic Social Initiative founded by Russian entrepreneur Dmitry Itskov in February 2011 with the main goals of creating and realizing a new strategy for the development of humanity – one based upon our unique emerging capability to effect *self-directed evolution*. The initiative's two main science projects are focused largely on *Transhumanism* – a multidisciplinary approach to analyzing the dynamic interplay between humanity and the acceleration of technology. Specifically, the 2045 Initiative's projects seek to (1) enable an individual's personality to be transferred to a more advanced non-biological substrate, and (2) extend life to the point of immortality – and those skeptical about the likelihood of achieving these goals should consider Arthur C. Clarke's laws of prediction[2]:

1. When a distinguished but elderly scientist states that something is possible, he is almost certainly right. When he states that something is impossible, he is very probably wrong.

2. The only way of discovering the limits of the possible is to venture a little way past them into the impossible.

3. Any sufficiently advanced technology is indistinguishable from magic.

Following Itskov's keynote on the first day of the Congress, the late Dr. James Martin, who tragically passed away on June 24, 2013, gave a sweeping, engaging talk on *The Transformation of Humankind—Extreme Paradigm Shifts Are Ahead of Us*. An incredibly prolific author of books on computing and related technology, Dr.

Martin founded the Oxford Martin School at Oxford University – an interdisciplinary research community comprising over 30 institutes and projects addressing the most pressing global challenges and opportunities of the 21st century. Dr. Martin – in the highly engaging manner for which he was renowned – presented a remarkably accessible survey of the interdependent trends that will increasingly threaten humanity over the coming decades. Dr. Martin made it disturbingly clear that population growth, resource consumption, water depletion, desertification, deforestation, ocean pollution and fish depopulation, atmospheric carbon dioxide, what he termed *gigafamine* (the death of more than a billion people as a consequence of food shortage by mid-century), and other factors are ominously close to their tipping points – after which their effects will be *irreversible*. (For example, he points out that in 20 years we'll be consuming an obviously unsustainable *200 percent* of then-available resources.) Taken together, he cautioned, these developments will constitute a "perfect storm" that will cause a Darwinian survival of the fittest in which "the Earth could be like a lifeboat that's too small to save everyone."

However, Dr. Martin also emphasized that there are solutions discussing the trends and technologies that – even as he acknowledged the resistance to implementing or even understanding them – could have a positive impact on our future:

- The Singularity and an emerging technocracy
- Genetic engineering and Transhumanism, in particular, a synthetic 24th human chromosome that would contain non-inheritable genetic modifications and synthetic DNA sequences
- Artificial Intelligence and nanorobotics
- Yottascale computers capable of executing 10^{24} operations per second
- Quantum computing
- Graphene – a one-atom thick layer of graphite with an ever-

expanding portfolio of electronic, optical, excitonic, thermal, mechanical, and quantum properties, and an even longer list of potential applications
- Autonomous automobiles
- *Nuclear batteries* in the form of small, ultra-safe and maintenance-free underground Tokamak nuclear fusion reactors
- Photovoltaics that make electricity more cheaply than coal
- Capturing rainwater and floodwater to increase water supply
- *Eco-influence* – Dr. Martin's term for a rich, enjoyable and sometimes complex way of life that does no ecological harm

"We're capable of creating a future which is enormously better than the present we live in today," Dr. Martin said. "What I'm doing is trying to make that happen, as far as one person can." His words, legacy and generosity of spirit are how we all must remember him.

Perhaps the epitome of that act of creation is our emerging ability to direct our own evolution. Dr. Peter H. Diamandis, founder and chairman of the X PRIZE Foundation and author of *Abundance: The Future Is Better Than You Think*, addressed the long-term implications of this game-changing transition in his talk on *Intelligent Self-directed Evolution Guides Mankind's Metamorphosis Into An Immortal Planetary Meta-intelligence*.

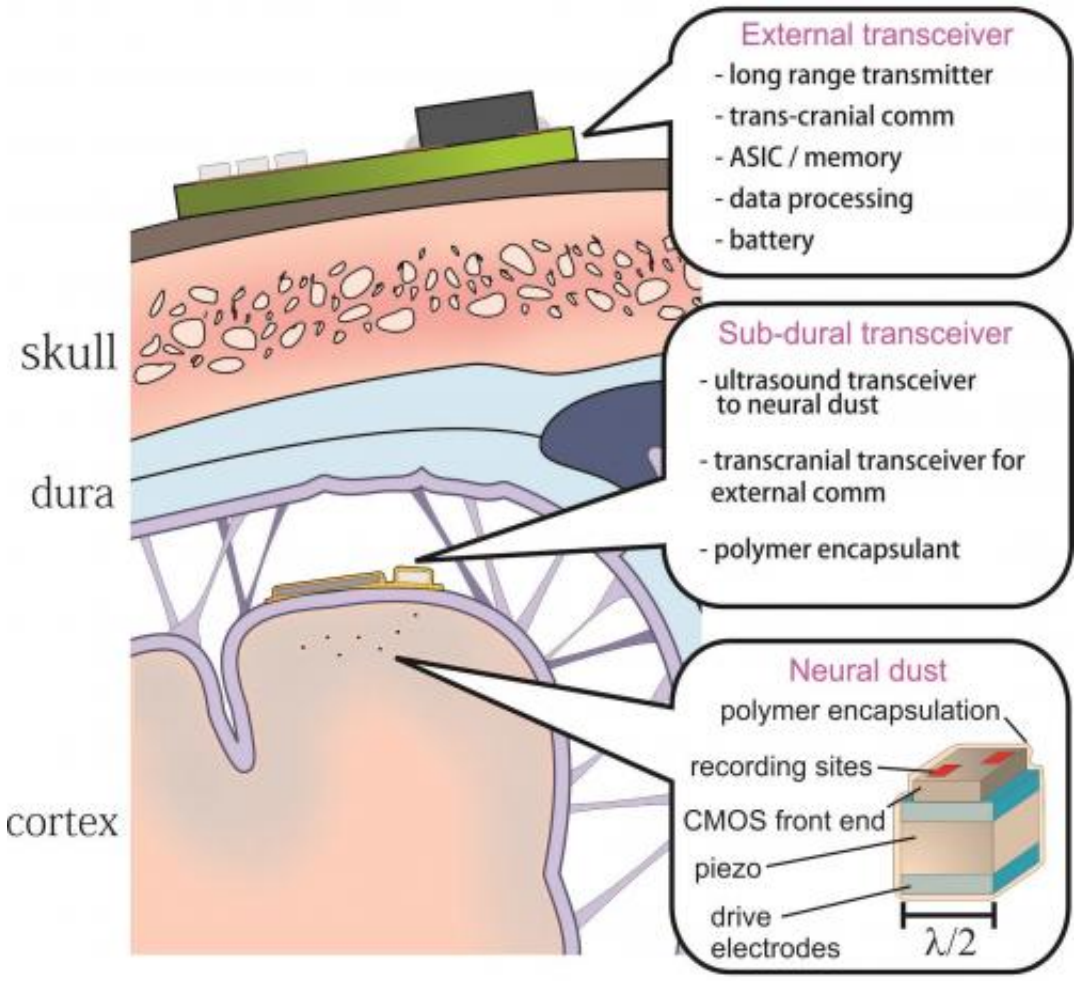
Avatars, androids and robotics were much-discussed topics at GF2045, and these intersected in the presentation given by Dr. Hiroshi Ishiguro, Director of the Intelligent Robotics Laboratory in Osaka, Japan, *The Future Life Supported by Robotic Avatars*. Ishiguro creates human-like robots rich in features that support effective relationships with humans. In particular, his *Geminoid* Teleoperated Androids are based on his research into the experience of *presence* – the feeling of human existence on our physical proximity and interactions – and the capability to transfer or reproduce the human presence through technology. (In fact,

in his talk Ishiguro described how he often sends his personal Geminoid HI-2 to remote locations, allowing him to teach classes, give lectures and attend meetings via telepresence.) In addition to the highly photorealistic, lifelike *Geminoid*, Ishiguro has developed many other humanoids and androids, including *Robovie, Repliee, Telenoid*, and *Elfoid*.

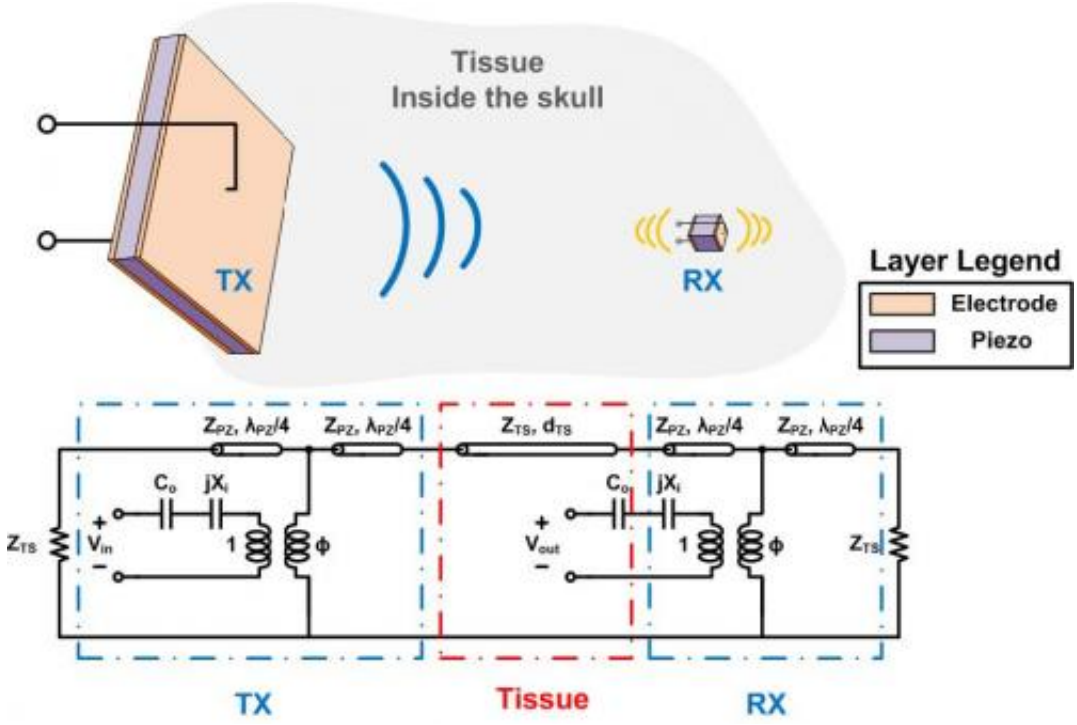
The development of brain-computer interfaces (BCIs) to allow paralyzed individuals to control various external prosthetic devices, such as a remote robotic arm, was another key topic at GF2045. UC Berkeley researchers Dr. Jose Carmena (Associate Professor of Electrical Engineering and Neuroscience, Co-Director of the recently-launched multidisciplinary Center for Neural Engineering and Prostheses, and Principal Investigator at the Brain-Machine Interface Systems Laboratory) and Dr. Michel Maharbiz (Associate Professor in the Department of Electrical Engineering and Computer Science, Co-Director of the Berkeley Sensor & Actuator Center, and member of the Center for Neural Engineering and Prostheses) addressed this topic in their joint presentation, *Brain Control of Prosthetic Devices: The Road Ahead*.

A very recent example of the BCI research Carmena and Maharbiz discussed is *Neural Dust: An Ultrasonic, Low Power Solution for Chronic Brain-Machine Interfaces*[3], a theoretical pre-print paper by Maharbiz, Carmena, lead author Dongjin Seo, Jan M. Rabaey, and Elad Alon published in July 2013. The paper proposes *neural dust* – thousands of ultra-miniaturized, free-floating, independent sensor nodes that detect and report local extracellular electrophysiological data – with neural dust power and communication links established through a *subcranial interrogator*. With the purpose being to enable "massive scaling in the number of neural recordings from the brain while providing a path towards truly chronic BMI," the researchers' goal is "an implantable neural interface system that remains viable for a lifetime." The paper

explores "the fundamental system design trade-offs and ultimate size, power, and bandwidth scaling limits of neural recording systems built from low-power CMOS circuitry coupled with ultrasonic power delivery and backscatter communication."



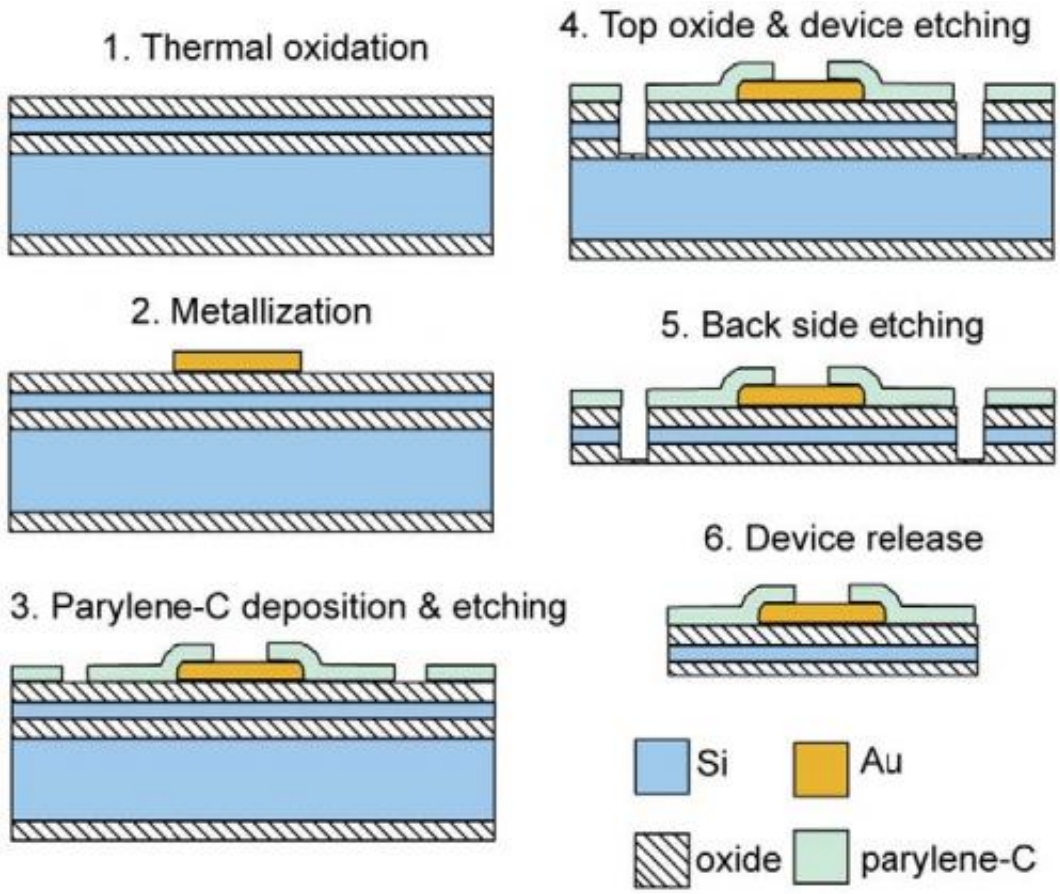
Dr. Michel Maharbiz: Neural dust system diagram showing the placement of ultrasonic interrogator under the skull and the independent neural dust sensing nodes dispersed throughout the brain. Source: arXiv:1307.2196v1



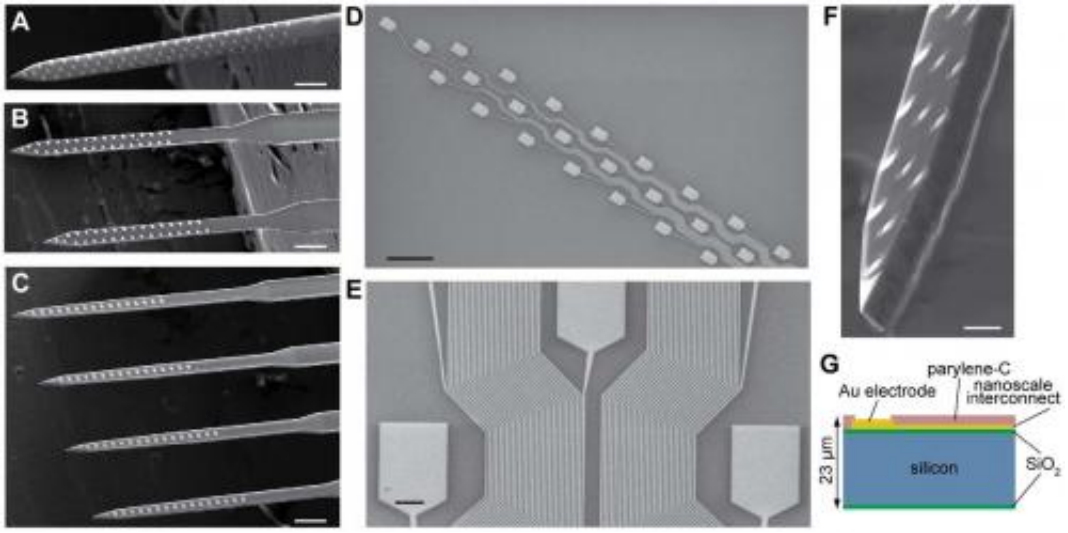
Dr. Michel Maharbiz: Complete single interrogator, single neural dust power and communication through link models. Source: arXiv:1307.2196v1

Maharbiz also contributed to the implementation and engineering of an inspired BCI project at the Berkeley Sensor & Actuator Center, *A Modular System for High-Density, Multi-Scale Electrophysiology* – the brainchild of Tim Blanche, Investigator at the Allen Institute for Brain Science and previously at Redwood Center for Neuroscience. Based on *Multiplexed, High Density Electrophysiology with Nanofabricated Neural Probes*[4], the project is intended to advance both fundamental neuroscience research and development of next-generation neural prosthetic devices. Based on the elusive goal of large-scale electrophysiology simultaneous recording of thousands of individual neurons in multiple brain areas, the project will establish a complete system for multi-scale electrophysiology in awake, freely behaving mice,

using state-of-the-art nano/neural interfaces comprising tiny silicon probes integrated with on-chip optical waveguides and compliant monolithic polymer cables connected a unique lightweight head-mounted recording system, based on a custom Application-Specific Integrated Circuit, that will perform electrophysiological recording, signal amplification, filtering, signal multiplexing, and digital sampling on a single chip. Moreover, this technology will allow optogenetic neuronal excitation/inhibition and the recording of large ensembles of individual neurons in many different brain regions to be simultaneously performed.



Process flow schematic for the nanofabrication of 64 channel silicon neural probes. doi:10.1371/journal.pone.0026204



64 channel silicon-based neural probes with nanoscale leads. (A–C) Three configurations of probes. Scale bars, 200 mm. (D) Gold recording sites and nanoscale leads, patterned with e-beam lithography. The lead width ranges from 1000 nm at the top left-hand corner, to 290 nm at the bottom right-hand corner of the image. Scale bar, 50 mm. (E) A section of interconnecting leads belonging to the “honeycomb” array configuration displayed in (A) and (D). The narrowest traces have width and spacing of 290 nm. Scale bar, 5 mm. (F) Characteristic chisel-shaped profile of the probes resulting from deep reactive ion etching of silicon. Scale bar, 25 mm. (G) Silicon device cross-section.
doi:10.1371/journal.pone.0026204

Walking the talk of prosthetic augmentation, Nigel Ackland, who lost his right arm in a metals smelting accident in 2006, described (in his first time speaking in public) his experience with the bebionic3 myoelectric prosthetic hand manufactured (and supplied to Ackland at no cost) by RSLSteeper in England. Ackland – whose moving and engaging talk received a well-deserved standing ovation – said that the loss of his arm left him feeling that it was "game over," but added that having worn the

bebionic3 for about a year, his life had now become "extraordinary." Ackland then demonstrated some of the bebionic3's features and functions, which were indeed remarkable.

Although Dr. Ben Goertzel, leading Artificial General Intelligence (AGI) Researcher and Founder of the OpenCog AGI project[5,6], and Robotics Designer & Researcher Dr. David Hanson were scheduled to introduce GENI Lab and the Adam Z1 Genius Machine intelligent robot project at GF2045, their talk unfortunately encountered a scheduling conflict. However, Goertzel and Hanson were in attendance at the conference and were able to informally discuss their work with many attendees, and briefly present Adam Z1 to some, after the conference. The GENI Lab team – Goertzel, Hanson, Robotics Physicist Mark Tilden, and Consciousness and Design Researcher Gino Yu – are focused on creating and broadly disseminating intelligent robots, and conducting R&D aimed ultimately at the production of robots with greater-than-human consciousness, creativity, and compassion. A non-profit organization, GENI Lab embraces open source, open standards, and open collaboration to integrate adaptive intelligence, social and emotional interaction, and life-like mechanical controls and bodies.

GENI Lab's central medium-term goal is the creation of a life-sized humanoid robot with

- a realistic, emotional face and personality
- a fluidly moving body, based on the integration of analog, digital and mechanical control
- the ability to communicate about its physical environment and its tasks and behaviors therein
- the capability of simple but socially and emotionally appropriate communication in natural language

Their short-term work with Adam Z1 and other robots is being pursued

in the interest of this goal. The core *adaptive general intelligence* technology underlying GENI Lab robots rests largely on. Goertzel's OpenCog architecture, and integrates the Hanson Robotics APIs and the DeSTIN machine vision system (initially developed at University of Tennessee at Knoxville by Itamar Arel[7]). "For example," Goertzel told Phys.org, "our pattern recognition software identifies patterns in DeSTIN's interpretation of visual scenes observed by a robot's camera, and feeds these patterns into OpenCog."

A key aspect of GENI Lab's approach is overcoming the limitations of current robotics technology by creating robots that elicit rich social and emotional interactions from humans. "To this end," Goertzel says, "we overhauled OpenCog's motivational and emotional system, creating a new system called OpenPsi[8,9] gives OpenCog a more human-like emotional makeup." (OpenPsi is modeled on Joscha Bach's MicroPsi AI system, which is based on German psychologist Dietrich Dörner's Psi model of mind.)

In essence, Goertzel notes, Adam Z1 will be unique on two ways. "Internally, he will be the first robot that integrates deep learning- based visual perception with symbolic logical reasoning. Behaviorally, our main goal is for him to engage in creative social play like a young child. A good example would be: If you ask him to "Build me something I haven't seen before," he would remember what he'd seen you see, and then build you something different, While a smart three year old could accomplish this seemingly simple task - which integrates visual perception, movement, theory of mind and social interaction, and planning – no robot today can. "Further down the road," he adds, "we would like the robot to be the first one to pass the standard preschool IQ test without any special test-specific training."

Within this framework, Goertzel continues, there are many R&D challenges to address. "One of these challenges is to successfully get

vision and audition received from the robot sensors to work effectively with OpenCog's symbolic reasoning. Another is doing natural language comprehension effectively via speech input – and given the mediocre state of current speech-to-text software, the system will have to use its emerging cognitive understanding to compensate for the ambiguities and errors in the output of speech to text software. A third challenge is optimizing the OpenCog core system for real-time processing at the speed needed for intelligent robot control, given that the robotics context involves a lot more data than the virtual-agent context we've mostly been dealing with lately."

The robot Adam Z1, as designed by Hanson (a former Disney sculptor and Imagineer), is cute in a toy-like sense, rather than having a more human appearance. "We did this to remain on the right side of the so-called Uncanny Valley – that is, to appeal to human emotions without creeping anyone out," Goertzel explains. "Also, its intelligence is going to be human-*like* rather than precisely human, so it seems appropriate that its appearance has the same quality."

Mark Tilden, Ben Goertzel, David Hanson, Adam Z1. Caption: Copyright © GENI Lab

To accelerate their work, GENI Lab is running a crowdfunding campaign to secure additional support using Indiegogo as their crowdfunding platform. "We chose Indiegogo," Goertzel points out, "because it's a big-time, recognizable brand, but provides more flexibility in how you structure and manage your campaign than other crowdfunding engines." He adds that their Indiegogo project has already been mentioned on KurzweilAI, Next Big Future and other sites – and

that Adam Z1 and an updated DeSTIN paper[10] to be presented at the Sixth Conference on Artificial General Intelligence (AGI-13) at Peking University on July 31 - August 3, 2013.

When considering the emergence of powerful human-like Artificial General Intelligence that may well evolve its own emotional responses and values, an important and hotly-debated question is whether or not it is possible – and if so, how – to create ethical machines. In *Making Minds Morally: the Research Ethics of Brain Emulation,* Dr. Anders Sandberg – a Computational Neuroscientist, and James Martin Research Fellow at the Future of Humanity Institute at Oxford University, and Research Associate at the Oxford Neuroethics Center – addressed the social and ethical impact of cognitive enhancement and whole brain emulation.

"We want to get to the future," Sandberg said in his talk, "but that implies that the future had better be a good place. Otherwise, there wouldn't be a point in getting there – but that would mean in turn that the methods we're going to use to *get* to the future had better be good as well." Sandberg went on to describe his approach of being *ethically proactive* as it applies to the 2045 Avatar Project and questions of death and identity.

Dr. Natasha Vita-More, designer and author, professor at the University of Advancing Technology, and currently Chairman of Transhumanist organization Humanity+, presented her vision of building platform-diverse bodies that could be mind-driven avatars for parlaying our personas within computational systems and telepresence in *Substrate Autonomous, Networked Avatar Bodies by Design*. "The three biggest challenges to implementing my vision for Bodies by Design are located within the complex sphere of social awareness," Vita-More tells Phys.org. Specifically, she explains, these are the beliefs that the human body should be strictly biological; the brain will not, at some point, be

backed up and transferable to a non-biological bodily system; and if a brain were backed up and transferred to a non-biological bodily system, it would be the same identity or person as the biological system. "To this end," she adds, "I think that within the next five years we will see academic courses focused on the Transhumanist worldview, on my work and research in whole-body prosthetics, and significant competition amongst engineers and designers building whole-body prosthetics. In addition, anyone who wants to contribute to *Bodies by Design* can contact me at Natasha Vita-More Projects."

"These three challenges offer a new perspective on how we consider concepts such as *what is natural to be human* and *how far we can go in human enhancement in order to still be a person*," Vita-More continues. "Also, it objectifies the body as a sensory-adept transportation and communication system for the brain and mind. However, before my concept of a whole-body prosthetic system is less threatening to society, there needs to be more awareness of the need for prosthetics replacement parts for the body and the extreme need for organ transplants, and that in order to preserve human well-being, we need to provide sufficient knowledge to the public these requirements. In other words" she adds, "we have to be aware that if we want to be healthy and protect ourselves from the damages of disease, we need to protect our biological bodies and be as healthy as possible for as long as possible – and if we want to continue living, we might bet benefit from opting for technological advances in the development of my vision of a whole-body networked prosthetic."

Vita-More emphasizes that addressing these challenges will require significant scientific, technological, cultural, and other developments, including greater advances in neuroscience, cognitive science, information technology, and human-computer interaction. "In other words" she says, "the body is a necessary component of personal identity – as our transportation vehicle and our sensory system – that provides

data to the brain in order to be a sentient and sapient being. However," she cautions, "science and technology are only part of the puzzle. Design is *essential* because its function or purpose is to identify and solve problems – a process known as *need-finding*."

The second aspect of design, Vita-More continues, "is to resolve the need in an iterative process until a viable outcome is developed, followed by iteratively testing that outcome. In a sense," she notes, "design is never fully completed or finished. Rather, it can be seen as a work in progress that continues to take advantage of new tools and methods."

That said, Vita-More notes that there are two immediate developments needed to address the challenges of designing and building platform-diverse bodies that benefit from semi- and non-biological devices implanted or wearable systems: how to backup the brain and transfer it into these bodies, and how to present this idea to society so that it is understood as a an alternative to a biological body. 'The central issue is a cultural bias that the person would be a robot or cyborg, which is a misunderstanding of terms. Instead," she concludes, "the person would be a transitional human – still a humane, empathic, passionate person – but not 100% biological."

Towards that end, Vita-More is creating a transdisciplinary Human Enhancement Design (HED) educational program, that explores biotechnology and genomics, nanotechnology and nanomedicine, information technology and Artificial General Intelligence, robotics and smart prosthetics, neuroscience and cognitive sciences, consciousness studies and ethics, and other areas that pertain to issues of backing up the brain and whole body prosthetics. Moreover, as an ecological system comprising humans and the environment, HED explores ways to improve our relationship with the environment, extend lifespan, and map the future of human-computer interface devices.

More information: The world according to Itskov: Futurists convene at GF2045 (Part 2)

[1]Cosmic Religion: With Other Opinions and Aphorisms (1931) by Albert Einstein; also in Einstein on Cosmic Religion and Other Opinions and Aphorisms (2009) by Albert Einstein (Kindle version)

[2]*Hazards of Prophecy: The Failure of Imagination* in the collection Profiles of the Future: An Enquiry into the Limits of the Possible (1962, rev. 1973, this edition published 2000)

[3]Neural Dust: An Ultrasonic, Low Power Solution for Chronic Brain-Machine Interfaces, arXiv:1307.2196v1 (PDF)

[4]Multiplexed, High Density Electrophysiology with Nanofabricated Neural Probes, *PLoS ONE* 6(10): e26204 (2011), doi:10.1371/journal.pone.0026204 (PDF)

[5]OpenCog: A Software Framework for Integrative Artificial General Intelligence, *Proceedings, AGI-08*, Memphis

[6]OpenCogBot: Achieving Generally Intelligent Virtual Agent Control and Humanoid Robotics via Cognitive Synergy, *Proceedings, International Conference on Artificial Intelligence (ICAI) 2010*, Beijing (PDF)

[7]DeSTIN: A Scalable Deep Learning Architecture with Application to

High-Dimensional Robust Pattern Recognition, *Proc. AAAI 2009 Fall Symposium on Biologically Inspired Cognitive Architectures (BICA)*, November, 2009

[8]OpenPsi: Realizing Dörner's "Psi" Cognitive Model in the OpenCog

Integrative AGI Architecture

[9]Dynamics of a computational affective model inspired by Dörner's PSI theory, *Cognitive Systems Research*, v.17-18, 2012 July-August, p.63(18), doi:10.1016/j.cogsys.2011.11.002

[10]Integrating Deep Learning Based Perception with Probabilistic Logic via Frequent Pattern Mining