

EMERGING TECHNOLOGIES, SPECULATIVE INTERACTION DESIGN AND ETHICS

Gordana Dodig-Crnkovic Chalmers University of Technology Gothenburg 2020 11 06 <u>http://gordana.se/</u>

MIT Technology Review

A 3-D Printer That Really Matters Fostare, 78 Cancer Cures For a Lucky Few Festare, 28 Time to Consider Geoengineering?

Feature p. 43

Mysterious Machines

EMERGING TECHNOLOGIES

Artificial intelligence is a black box that thinks in ways we don't understand. That's thrilling and scary. p. 54

https://ytd2525.wordpress.com/2020/07/23/the-next-big-thing-in-technology-20-inventions-that-will-change-the-world/

EMERGING TECHNOLOGIES

- 1. Artificial Intelligence (AI) in IxD and its ethical aspects
- 2. Robots in IxD and their ethical aspects
- 3. Internet of Things (IoT) in IxD and its ethical aspects
- 4. Virtual Reality (VR) in IXD and its ethical aspects
- 5. Augmented Reality in IXD and its ethical aspects
- 6. Mixed Reality in IXD and its ethical aspects
- 7. Generative Design
- 8. 3D printing (additive manufacturing) in IXD and its ethical aspects
- 9. Active Materials in IxD and their ethical aspects
- 10. Nano-technologies in IxD and their ethical aspects
- 11. Neuroscience and neuro-technologies (brain-computer interfaces) in IxD and their ethical aspects
- 12. Biomimicry in IxD and their ethical aspects

ARTIFICIAL INTELLIGENCE



NATURAL INTELLIGENCE & ARTIFICIAL

AI definition

"The theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages."e

English Oxford Living Dictionary

Also, very important: ABILITY TO LEARN and TO LEARN HOW TO LEARN!



Intelligence: Natural, Artificial, Mix (Cyborgs)

TYPES OF

EMBODIED: HUMAN, CYBORG, ROBOT "DISEMBODIED": SOFTWARE, INFRASTRUCTURE

GENERAL (STRONG): HUMAN LEVEL AND ABOVE NARROW (WEAK): PRESENT INTELLIGENT ARTIFACTS

TYPES OF INTELLIGENCE

EMBODIED: HUMAN, CYBORG, ROBOT "DISEMBODIED": SOFTWARE, INFRASTRUCTURE



EXAMPLES OF EXISTING WORK People + AI Research (PAIR) (Google)

← → C ☆ @ research.google/teams/brain/pair/

Our work





Design & Machine Learning How ML is changing the way we build experiences and interact with the world.



PAIR @ Medium

Exploring perspectives from a diverse range of contributors on participatory approaches to machine learning.



Model interpretibliity

Can machines explain the "why' behind their decisions? We're investigating ways for people to understand more about ML models, starting with visualizations that look under the hood of complex systems. See this video: Visualizing High-Dimensional Space.



Peole+Al

Research



PAIR | People + Al Research Initiative

Bringing Design Thinking and HCI to Machine Learning pair.withgoogle.com



PAIR TOOLS ARE AVAILABLE ONLINE

Available on the web, visualization tools

pair.withgoogle.com/



AI APPLICATIONS TODAY



AI APPLICATIONS TODAY



M. Cordts, M. Omran, S. Ramos, T. Rehfeld, M. Enzweiler, R. Benenson, U. Franke, S. Roth, and B. Schiele, "The Cityscapes Dataset for Semantic Urban Scene Understanding," in Proc. of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2016.

VIRTUAL WORLDS FOR AI – CHALLENGES



Shortening of solution development steps with help of Virtual Worlds:

- How can Al and virtual worlds help support validation testing? The goal is to find bugs in virtual environment that typically only would be found during live testing.
- Can virtual data be generated for corner cases during simulation?
- Can a machine be taught to improvise to solve new situations? If so, how can we guarantee safe operation?

Improved robustness on the market:

- Can virtual data be a substitute to real data for training of machine learning algorithms? What level of photo-realism is needed in that case? If not, can virtual data be generated as substitute for sub-sets e.g. where real-world data is missing?
- Can inference stability be improved? What about robustness in dirty environment such as grass clippings on lenses etc.?

Husqvarna

Future has already begun





VIRTUAL WORLDS FOR AI – AN INDUSTRIAL PERSPECTIVE

WASP4AII

2020-11-04 Adam Tengblad, Director Emerging Business Husqvarna Robotics, Digital and Innovation

TRANSFORMER MACHINE LEARNING MODEL

The **Transformer** is a <u>deep learning</u> model introduced in 2017, used primarily in the field of <u>natural language processing</u> (NLP).

Since the Transformer model facilitates more parallelization during training, it has enabled training on larger datasets than was possible before it was introduced. This has led to the development of <u>pretrained systems</u> such as <u>BERT</u> (Bidirectional Encoder Representations from Transformers) and <u>GPT</u> (Generative Pre-trained Transformer), which have been trained with huge general language datasets, and can be fine-tuned to specific language tasks. (Wiki)

Talk to Transformer: https://app.inferkit.com/demo

DIGITALIZATION & COGNITIZATION INTELLIGENCE & ARTIFICIAL INTELLIGENCE

- Digitalization happens in parallel with introduction of cognitive properties and intelligence into artifacts
- Ethical implications of the digitization of our society: new technologies are followed by **regulatory and legal vacuums**
- My background: theoretical physics, computer science, philosophy of computing and ethics, computational models of cognition, recent interest: interaction design Interdisciplinary elucidation of AI.

<u>https://link.springer.com/article/10.1007/s43681-020-00007-2</u> AI for climate: freedom, justice, and other ethical and political challenges

IoT



https://www.youtube.com/watch?v=7AIZPW9NNFk How To Design UX Driven IoT Products – Map (video)(20:09)

https://dzone.com/articles/7-cool-iot-apps-and-how-to-develop-one 7 Cool IoT Apps and How to Develop One (article)

ROBOTS & CYBERPHYSICAL SYSTEMS

https://www.youtube.com/watch?v=xauEexkgYWY Interactive Design of 3D Printable Robotic Creatures (video)(3:01)

https://www.youtube.com/watch?v=ViXnIRKpg3A Lego robots workshop, Prototyping and Interaction Design - Chalmers University of Technology (robots known as "Breitenberg vehicles") (video)(1:29)

https://medialist.info/en/2019/10/16/paralyzed-human-moves-in-mind-reading-exoskeleton/ Application of robotics for exoskeleton (article+video)(2:81)



VR, AR, MR



Virtual Reality (VR) offers an immersive experience requiring a HMD (Head Mounted Display). The software is powered on a mobile phone or from a VRoptimized PC. Users feel like they are "there" and the experience is in first person. First person user experience can change perception in profound ways.

Augmented Reality (AR) offers mobile (tablet and phone) experiences that layer interfaces, objects and information onto the real-world. Headset versions for AR or VR/AR blending (switch between modes) are emerging.

Mixed Reality (MR) captures 3D object integration into AR scenes, with a headset. Users augment their existing real world with floating or transparent interfaces. The MR is needed since traditional AR overlays using GPS primarily, whereas MR (Microsoft Hololens and now devices with Google's Project Tango) does motion tracking, spatial depth sending and spatial mapping "to actual scale" eg. edge detection can make a "hologram" appear to fall off an actual table edge or slide down an actual wall. Gestural interactions also become part of the mixed reality experience.

https://www.experiencedynamics.com/blog/2016/05/v r-and-more-designing-immersive-user-experienceswow-factor

VR, AR, MR



https://www.forbes.com/sites/jessedamiani/2 018/06/21/vr-and-ar-mark-the-greatestrevolution-in-the-history-of-uxuidesign/#70c6c6dc68a6 VR And AR Mark The Greatest Revolution In The History Of UX/UI Design (article + videos) https://youtu.be/7WFFSekYmvU (1:54)

https://www.youtube.com/watch?v=hxV-<u>1pJ2hjk</u> UX/UI Design for VR and Mixed Reality (video)(18:31)

https://www.youtube.com/watch?v=braV_c4 M8ol Designing UI and UX in VR (video)(59:05)

<u>https://www.interaction-</u> <u>design.org/literature/topics/augmented-</u> <u>reality</u> Augmented Reality (article + video)(4:09)

GENERATIVE DESIGN

https://www.autodesk.com/solutions/generative-design GENERATIVE DESIGN

Generative design mimics nature's evolutionary approach to design. Designers or engineers input design goals into generative design software, along with parameters such as materials, manufacturing methods, and cost constraints. The software explores all the possible permutations of a solution, quickly generating design alternatives. It tests and learns from each iteration what works and what doesn't.

https://en.wikipedia.org/wiki/Digital_morphogenesis DIGITAL MORPHOGENESIS

Digital morphogenesis is a type of generative design in which complex shape development, or morphogenesis, is enabled by computation. It is applicable in design, art, architecture, and modeling. In architecture, it describes tools and methods for creating forms and adapting them to a known environment. It is described as *similar to biological morphogenesis*: developing gradually, without an explicit definition of the methods of growth or adaptation. Parallels can be seen in emergent properties and self-organization."

https://www.youtube.com/watch?v=bEm-fXkLw7g Morphogenesis in robot swarms (video)(2:04) https://vimeo.com/3764762 Morphogenesis // Processing // Collective Entity (Artistic) (video)(2:21)

GENERATIVE DESIGN TECHNOLOGY

<u>https://www.youtube.com/watch?v=sNkx-JR7jxM</u> Generative Design Technology (video)(2:37)



GENERATIVE DESIGN TECHNOLOGY

<u>https://www.youtube.com/watch?v=WaqlmeRfPFE</u> AI and Creativity: Using Generative Models To Make New Things (video)(30:41)



ACTIVE MATERIAL AND DIGITAL DESIGN SYNTHESIS, 3D PRINTING

"The ultimate display would, of course, be a room within which the computer can control the existence of matter. A chair displayed in such a room would be good enough to sit in" [Sutherland, The Ultimate Display, Proc. IFIP 65, 506–508, 1965].

https://www.youtube.com/watch?v=JN7BUKb0OIA Programmable matter (video) (4:20)

<u>https://www.youtube.com/watch?v=lvtfD_rJ2hE&t=8s</u> Amazing Technology Invented By MIT -Tangible Media (video)(3:40)

Hensel, Michael and Achim Menges (2006). 'Material and Digital Design Synthesis', Architectural Design, 76, 2, pp. 88–95 <u>http://onlinelibrary.wiley.com/doi/10.1002/ad.244/pdf</u> (article, illustrations)

<u>http://icd.uni-stuttgart.de/?p=23559</u> Bio-based and Bio-inspired 3D-printed Shape-changing Material Systems (description)

https://youtu.be/lx_CP3V7IZU?list=PLB1379Ylrc1r_iFHRi5on80vLwrwRjKIc 3D printing (2:58)

CYBER PHYSICAL MATERIALS

http://icd.uni-stuttgart.de/?p=23178 Cyber Physical Macro Material (exemples, pictures) video (2:18)

https://tangible.media.mit.edu/ Tangible media lab, MIT (information webpage)

<u>https://engineering.princeton.edu/impact/robotics-and-cyberphysical-systems</u> Robotics and Cyberphysical Systems

https://vimeo.com/254783179 ACTIVE MATTER Book (video)(0:20)

https://www.media.mit.edu/groups/mediated-matter/overview/ Mediated Matter Group@MIT



NEURO- SCIENCE & -TECHNOLOGY, NANOTECHNOLOGY

https://www.uxmatters.com/mt/archives/2012/07/using-neuroscience-to-inform-your-uxstrategy-and-design.php Using Neuroscience to Inform Your UX Strategy and Design

<u>https://www.youtube.com/watch?v=wse_Z_jP2tY</u> Neuralink: The Hyperloop For The Mind (video)(27:54) <u>https://www.teslarati.com/elon-musk-neuralink-human-trials-to-begin-in-2020/</u> Elon Musk's Neuralink targets human trials for brain-machine interface in 2020 -article

<u>https://medium.com/dark-matter-and-trojan-horses/the-garage-of-small-things-</u> <u>nanotechnology-biomimicry-and-design-practice-b8c22e5f5b67</u> The Garage of Small Things; nanotechnology, biomimicry and design practice - article





DESIGN BIOMIMICRY & NATURE-INSPIRED TECHNOLOGIES

BIOMIMICRY

Biomimicry is the practice of applying lessons from nature to the invention of healthier, more sustainable technologies for people. Biomimetic designers focus on understanding, learning from, and emulating the strategies used by living things, with the intention of creating designs and technologies that are sustainable.

https://toolbox.biomimicry.org/introduction/

BIOMIMICRY

https://biomimicry.org/ THE BIOMIMICRY INSTITUTE resources

https://toolbox.biomimicry.org/introduction/BIOMIMICRY text

https://toolbox.biomimicry.org/introduction/biomimicry-film/ video BIOMIMICRY (3:47 technology; 4:43 materials; 6:25 self-assembling; 7:29 carbon capture; 9:03 energy, swarm logic; 10:50 water; 14:18 toxic; 16:14 self-cleaning; 17:48 Structure; 18:56 the future)

https://youtu.be/3QZp6smeSQA TED (2010): Michael Pawlyn: Using nature's genius video (16:50)

http://bii.ia.ac.cn/~yizeng/ Yi Zeng: Brain-inspired Intelligence

BIOMIMETIC DESIGN

http://www.technologystudent.com/prddes1/biomimetic1.html Examples of biomimetic design









30

NERIOXMAN MEDIATED MATTER LAB @MIT MEDIALAB

Design at the Intersection Between Technology and Biology



https://www.ted.com/talks/neri_oxman_design_at_the_intersection_of_technology_and_biology/discussion?utm_

EMERGING TECHNOLOGIES

- 1. Artificial Intelligence (AI) in IxD and its ethical aspects (Group 2)
- 2. Robots in IxD and their ethical aspects
- 3. Internet of Things (IoT) in IxD and its ethical aspects (Group 5)
- 4. Virtual Reality (VR) in IXD and its ethical aspects
- 5. Augmented Reality in IXD and its ethical aspects
- 6. Mixed Reality in IXD and its ethical aspects
- 7. Generative Design
- 8. 3D printing (additive manufacturing) in IXD and its ethical aspects
- 9. Active Materials in IxD and their ethical aspects (Group 6)
- 10. Nano-technologies in IxD and their ethical aspects (Group 7)
- 11. Neuroscience and neuro-technologies (brain-computer interfaces) in IxD and their ethical aspects (Group 8)
- 12. Biomimicry in IxD and their ethical aspects (Group 1, 3, 4)

HOW TO APPROACH THE PROJECT

Ponder over emerging technologies and their potential as "design material"

Think of future challenges you want to address

Think in terms of UN sustainability goals

Think "what if"

Discuss within your group and choose among variety of possible technologies, designs, and goals

START WITH SOA: STATE OF THE ART ANALYSIS

No idea to design already existing things

REALITY: MULTIPLE CONCURRENT DIALOGUES



<u>http://icsa-conferences.org/2020/attending/keynotes/index.html#andre</u> What Makes Expert Software Designers Successful? André van der Hoek, University of California, keynote speech