Trusting Intelligent Autonomous Robots with our Future. Learning from Autonomous Cars Ethics

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http://gordana.se/

http://www.gordana.se/work/presentations.html

https://techdissected.com/editorials-and-discussions/advantages-of-having-a-humanoid-robot

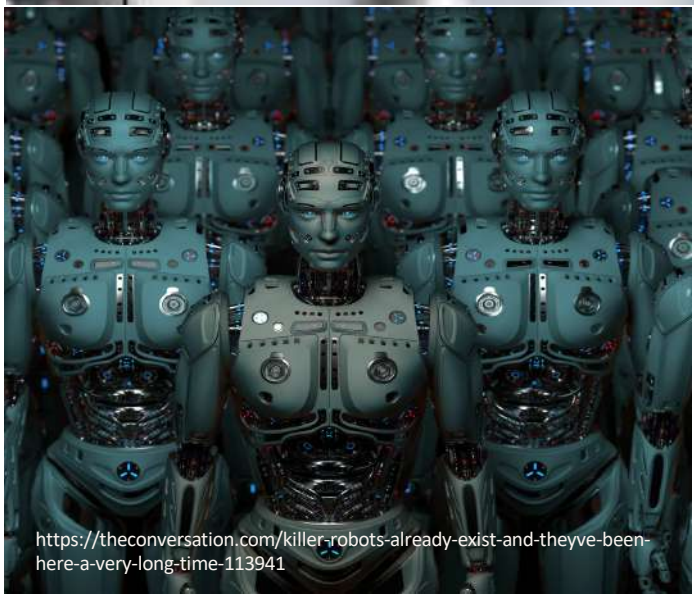
How can we trust intelligent robots?

Trusting the intelligent autonomous robot technology with our future presupposes their anticipated beneficial influence on the societies and individuals, globally. Question of good and bad, right and wrong, and values, in general, are studied within the field of ethics. The emerging fields of Artificial Intelligence (AI) ethics and specifically ethics of intelligent autonomous robotic cars are good examples of ethics research with actionable practical value.

In those ethical fields, a variety of stakeholders, including the legal system with other societal and governmental actors, companies and businesses, collaborate bringing about shared view of ethics.

Drawing from the existing literature on ethics of AI and robotics, and our work on autonomous intelligent robocars, our contribution consists in lessons learned for ethics of autonomous intelligent robots in general, that can help us overview the field with the common set of values and ethical principles, which may help stakeholders in the broader field of intelligent autonomous robotics to connect ethical principles with their applications.

https://robohub.org/from-disembodied-bytes-to-robots-that-think-and-act-like-humans/



https://theconversation.com/killer-robots-already-exist-and-theyve-been-here-a-very-long-time-113941

The Perspective

The aim of this lecture – to offer new views

As the topic of Design Ethics, AI ethics and even AV ethics are huge, what this lecture can do is to open the window with a view, giving you just a glimpse of a huge unexplored territory in front of us.

”I invite readers not on a visit to an archaeological museum, but rather on an adventure in science in making”

Ilya Prigogine. The End of Certainty: Time, Chaos and New Laws of Nature, 1997

https://www.onventanas.com/historia-vidrio/ventana-japonesa/#iLightbox[postimages]/0

Wicked Problems in Design Thinking

Design Unbound. Designing for Emergence in a White Water World

Ann Pendleton-Jullian and John Seely Brown, two volume set, MIT Press 2018

https://mitpress.mit.edu/books/design-unbound-designing-emergence-white-water-world-volume-1

Richard Buchanan (1992) Wicked Problems in Design Thinking. Design Issues, Vol. 8, No. 2, pp. 5-21. The MIT Press

http://www.jstor.org/stable/1511637

TUANA. COMMUNICATIONS OF THE ACM | DECEMBER 2015 | VOL. 58 | NO. 12

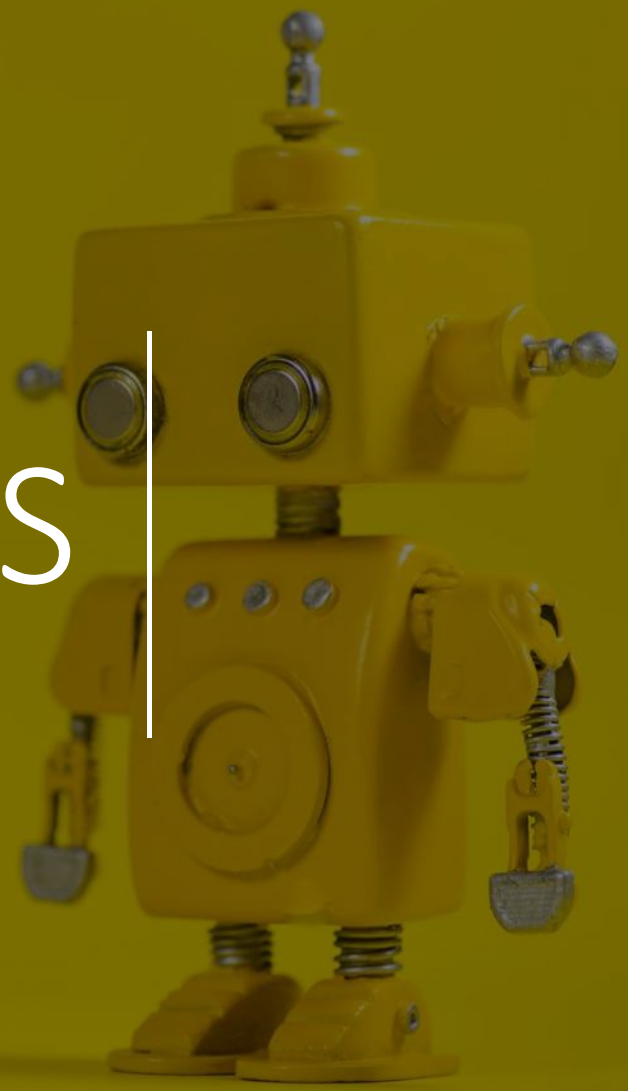
Values

Values serve as a guide to action and knowledge.

They are relevant to all aspects of scientific and engineering practice, including discovery, analysis, and application.

ROBOTS

Humanoid robots
Education robots
Consumer robots
Research robots
Medical robots
Nano robots
Disaster response robots
Industrial robots
Aerospace robots
Underwater robots
Aerospace robots
Military and Security robots
Telepresence robots
Drones
Autonomous cars



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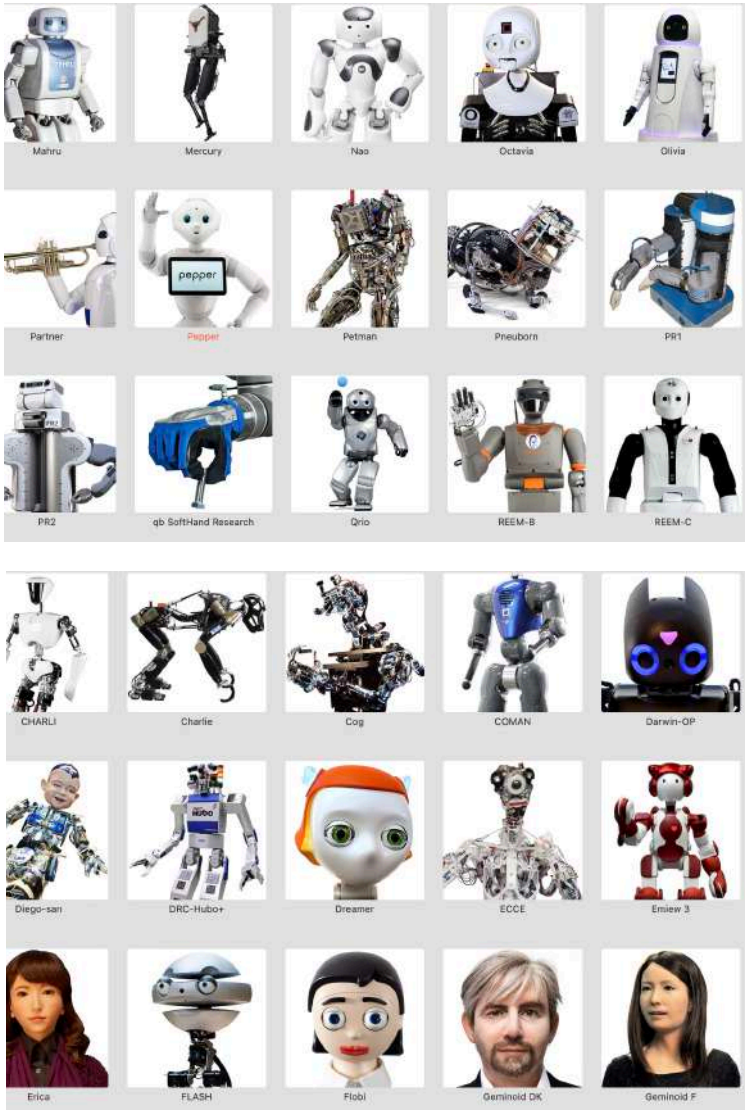
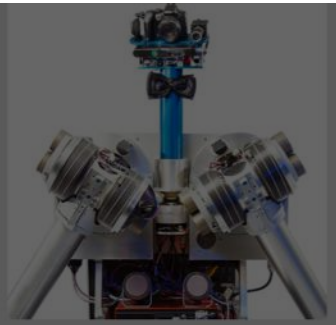


Humanoid Robots

https://robots.ieee.org/

Humanoid Robots


eminoid HI


Herb


HRP-2

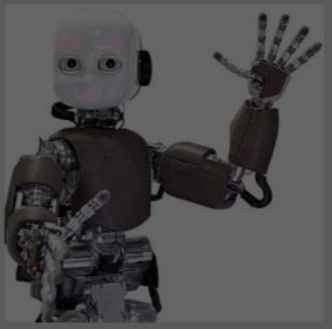

HRP-4


Armar


Asimo


HRP-5P

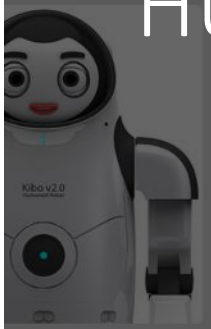

Hubo 2

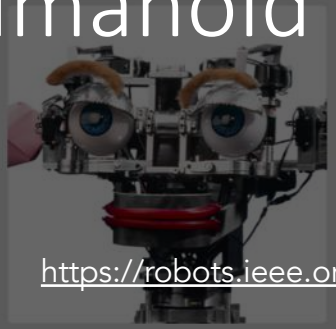

iCub

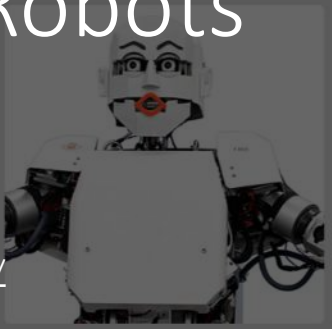

Kaspar

Bruno


CB2


Kibo


Kismet


Kobian


Kojiro

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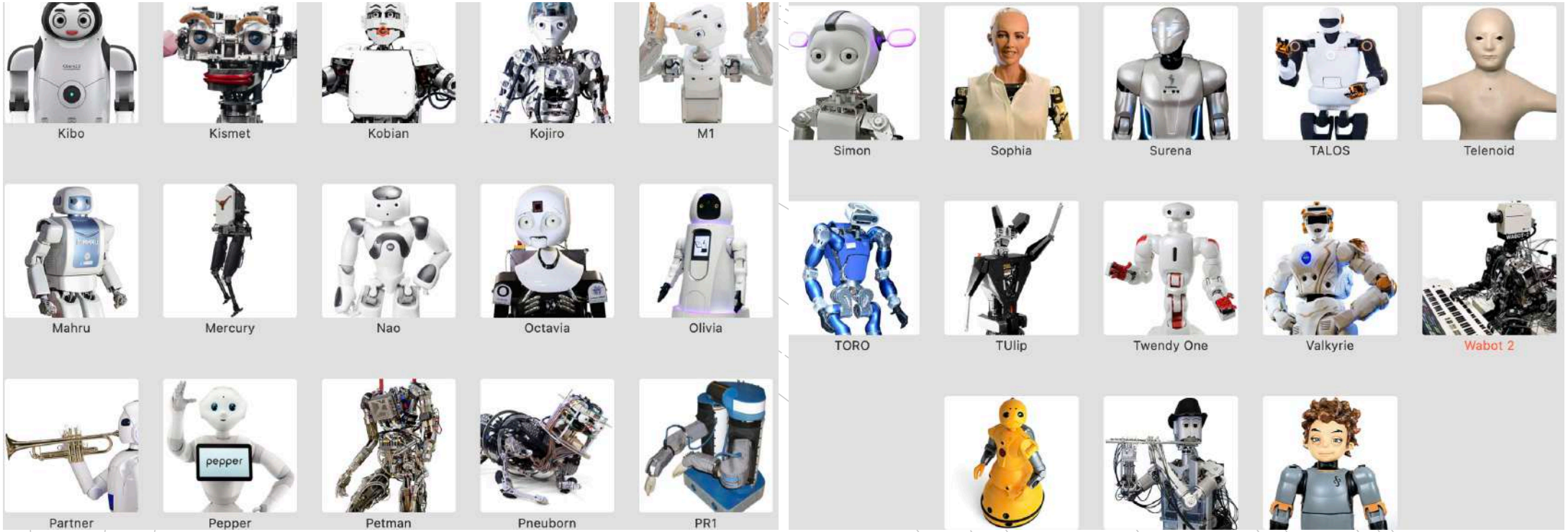
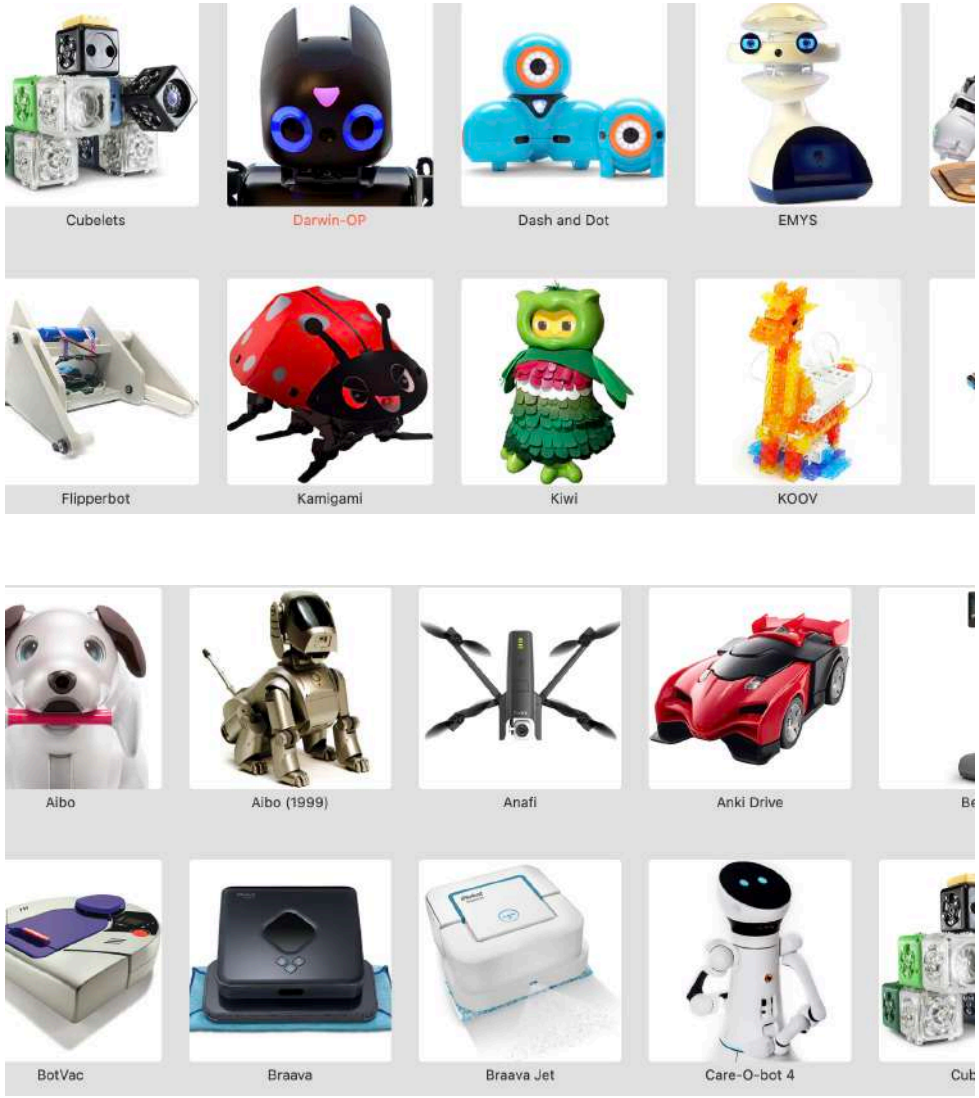


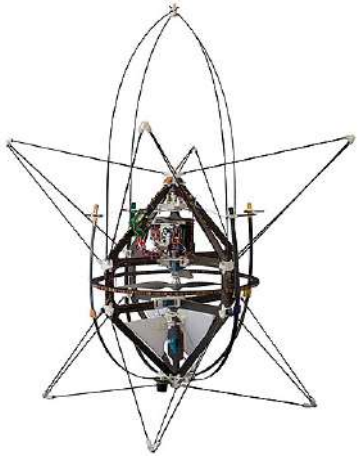
Humanoid Robots

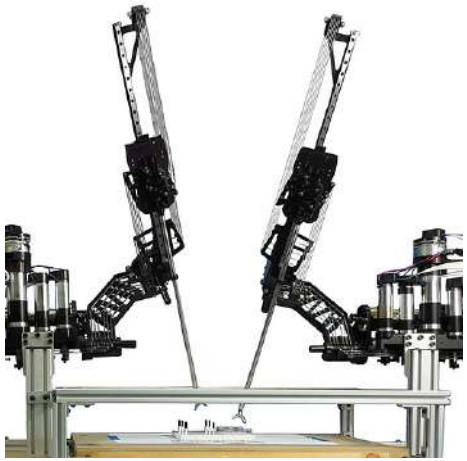
https://robots.ieee.org/



Education & Consumer Robots

https://robots.ieee.org/





Research Robots

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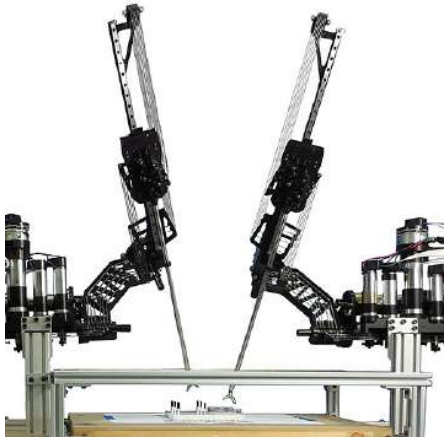


Medical Robots

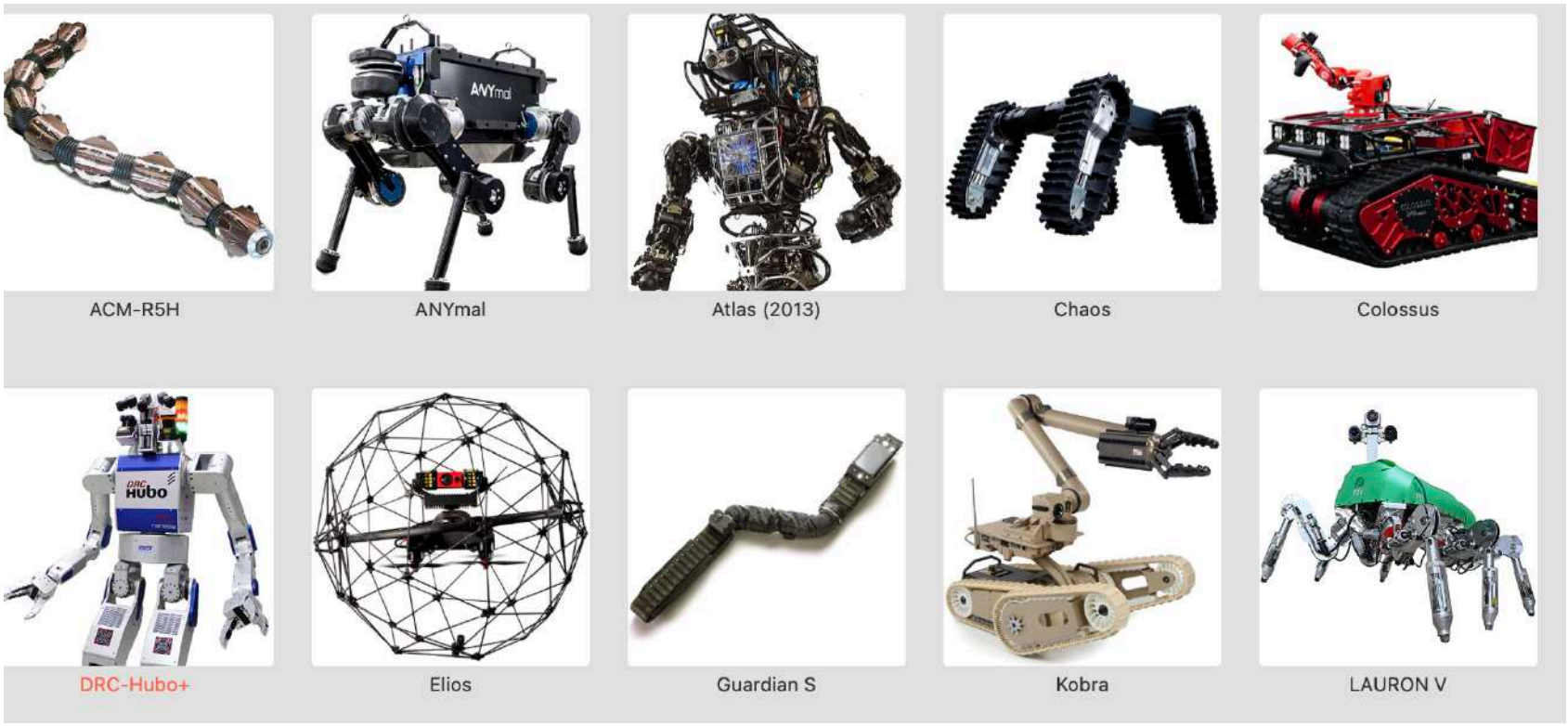
https://robots.ieee.org/

Nano Robots

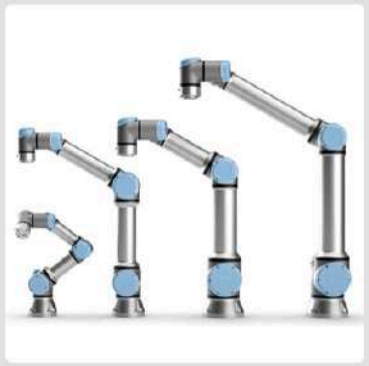
https://www.europeanpharmaceuticalreview.com/news/

Disaster response

https://robots.ieee.org/



Unimate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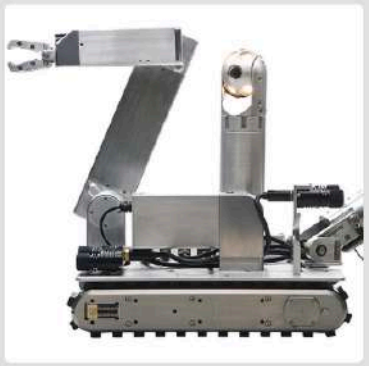
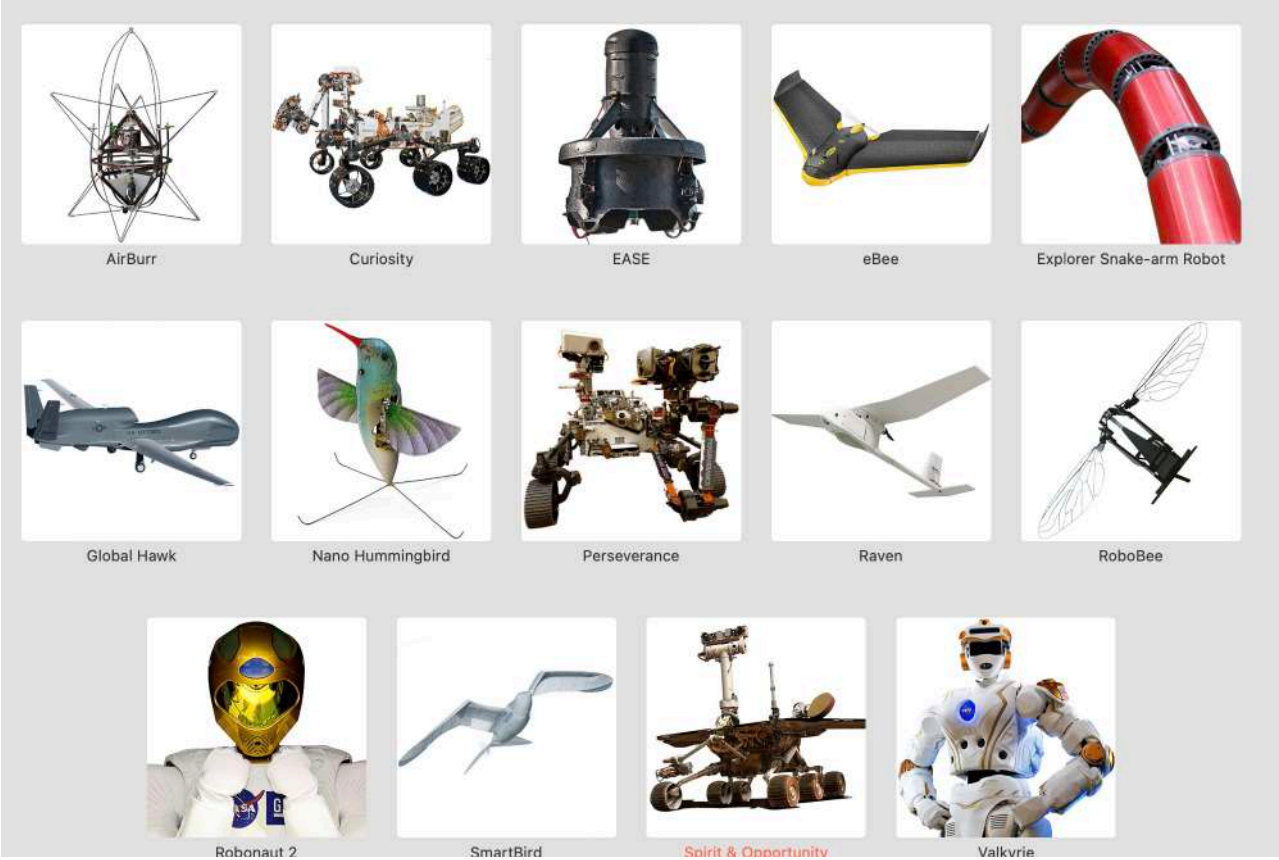

Versatrax


WAM

YuMi

Industrial Robots

https://robots.ieee.org/



Aerospace Robots

https://robots.ieee.org/

ACM-R5H

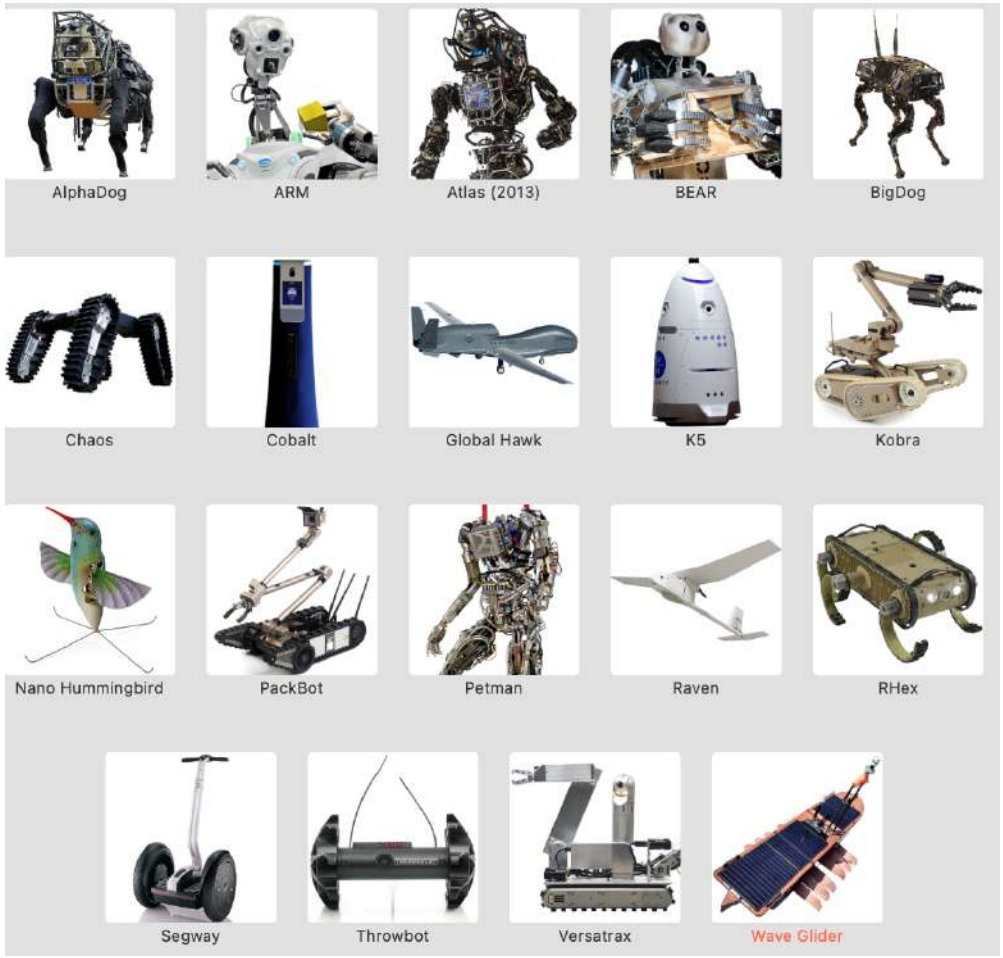
Aqua2

Aquanaut

Wave Glider

Underwater Robots

https://robots.ieee.org/

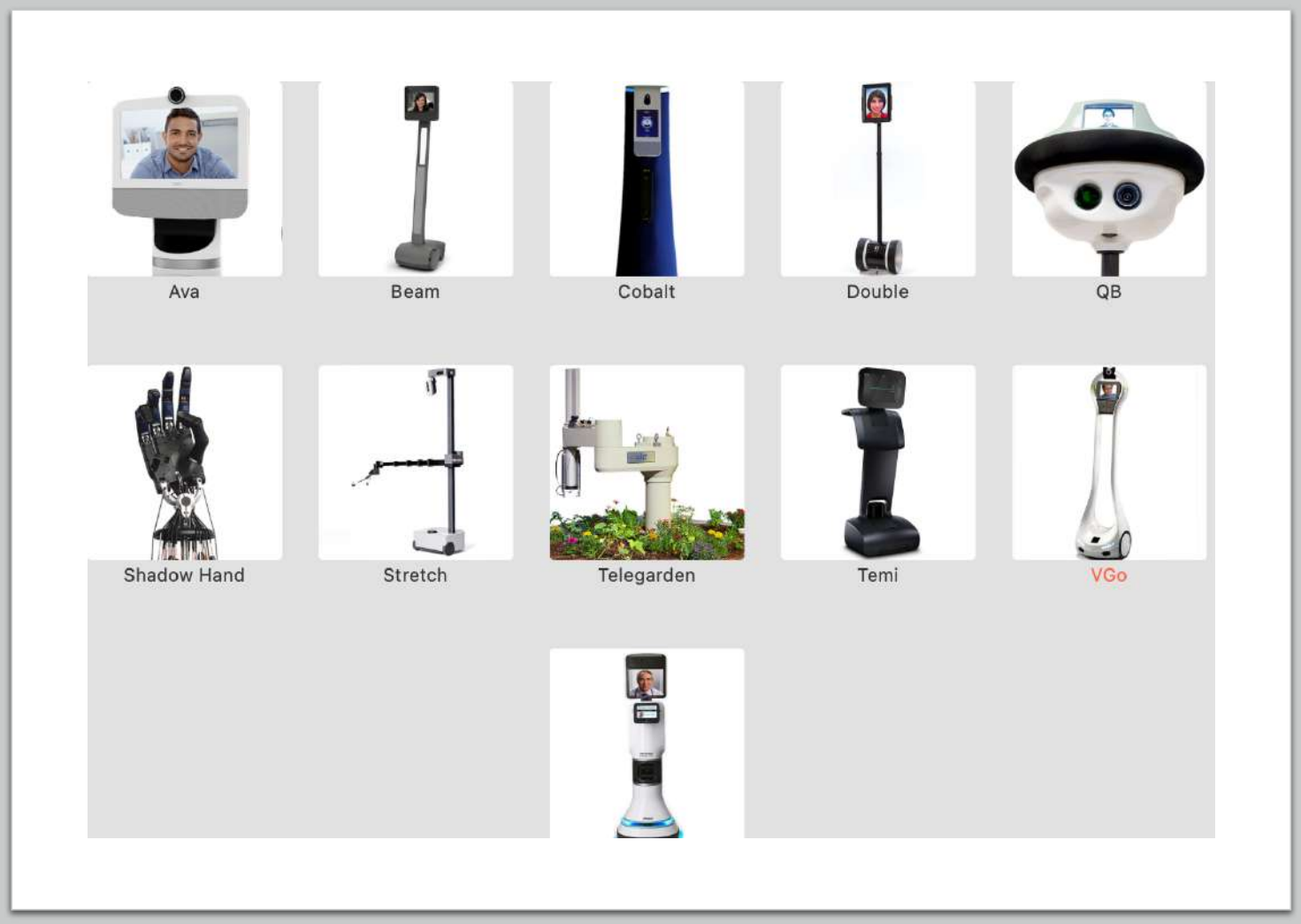


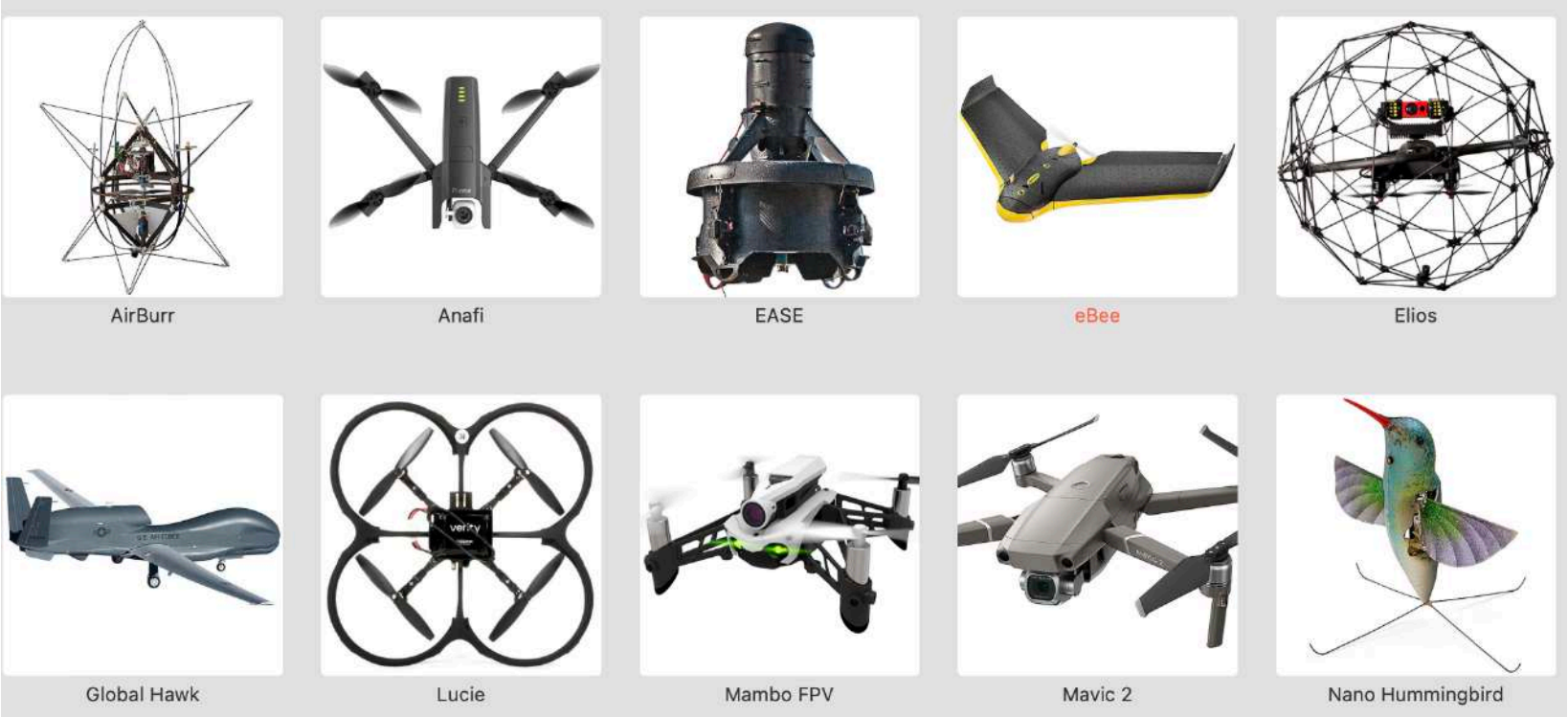
Military and Security Robots

https://robots.ieee.org/

Telepresence Robots

https://robots.ieee.org/





Drones

https://robots.ieee.org/

Autonomous Cars

https://robots.ieee.org/

Boss

Google Self-Driving Car

nuTonomy

Stanley

Waymo

WHAT CAN WE LEARN FROM AUTONOMOUS CARS ABOUT ETHICS ASPECTS OF OTHER ROBOTS?

Autonomous Cars

Based on:

Holstein, T., Dodig-Crnkovic, G., & Pelliccione, P. (2021). Steps Towards Real-world Ethics for Self-driving Cars: Beyond the Trolley Problem. In Steven John Thompson (Ed.), Machine Law, Ethics, and Morality in the Age of Artificial Intelligence. IGI Global

Picture: https://www.aarete.com/insights/what-is-the-business-case-for-autonomous-vehicles-in-the-supply-chain/

Self-Driving (Autonomous) Cars as Intelligent Robotic System

We take Self-driving cars as an example of emerging technology that is combining advances in several underlying emergent technologies such as electric mobility and artificial intelligence (with connected driving, intelligent cities, intelligent infrastructure, etc.)

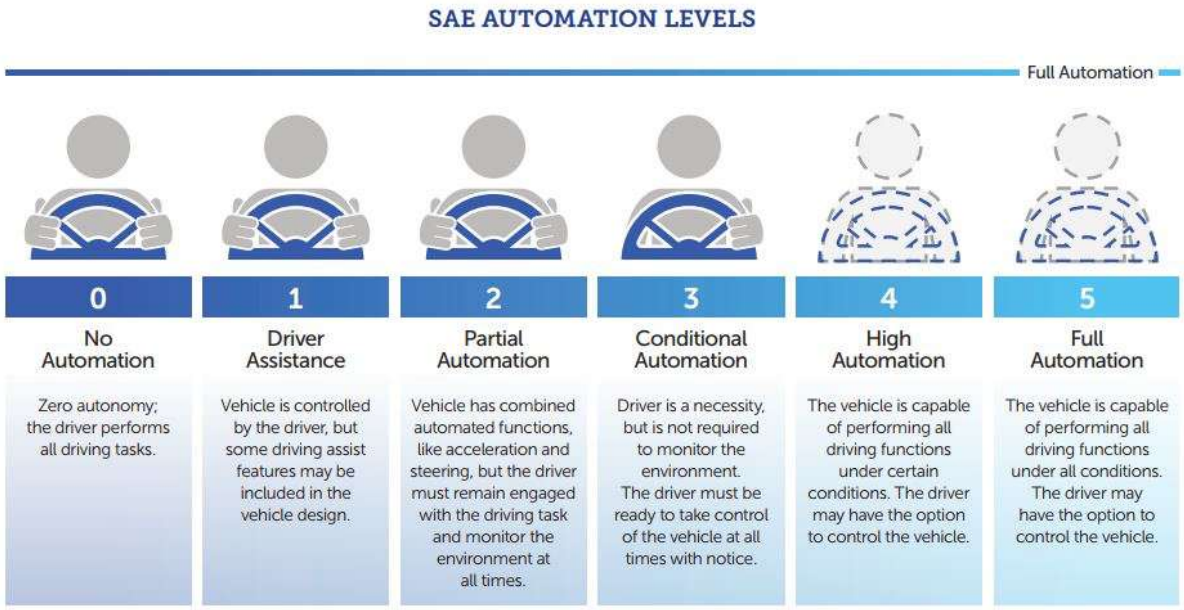
Technology emerges not in vaccuum but in its social context that today is global technosocial environment

How can we contribute in different roles as stakeholders to the development of good society with help of new powerful technologies. Who are the main actors/stakeholders and how do they affect the development? Autonompus cars have been studied a lot and we can learn from the development so far.

AUTONOMOUS CARS DEVELOPMENT

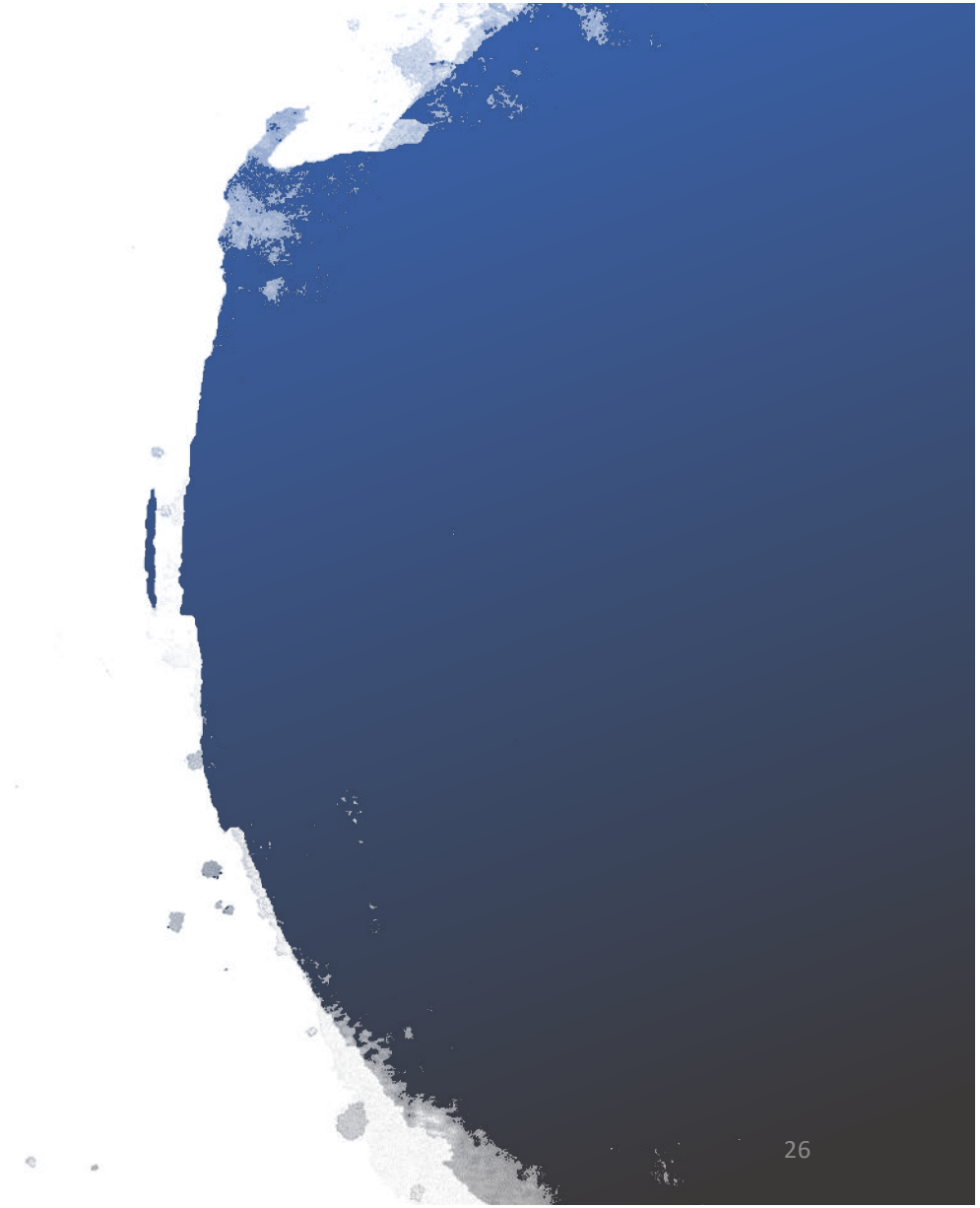
LEVELS OF AUTOMATION

Equivalent for Intelligent Robotics Needed!

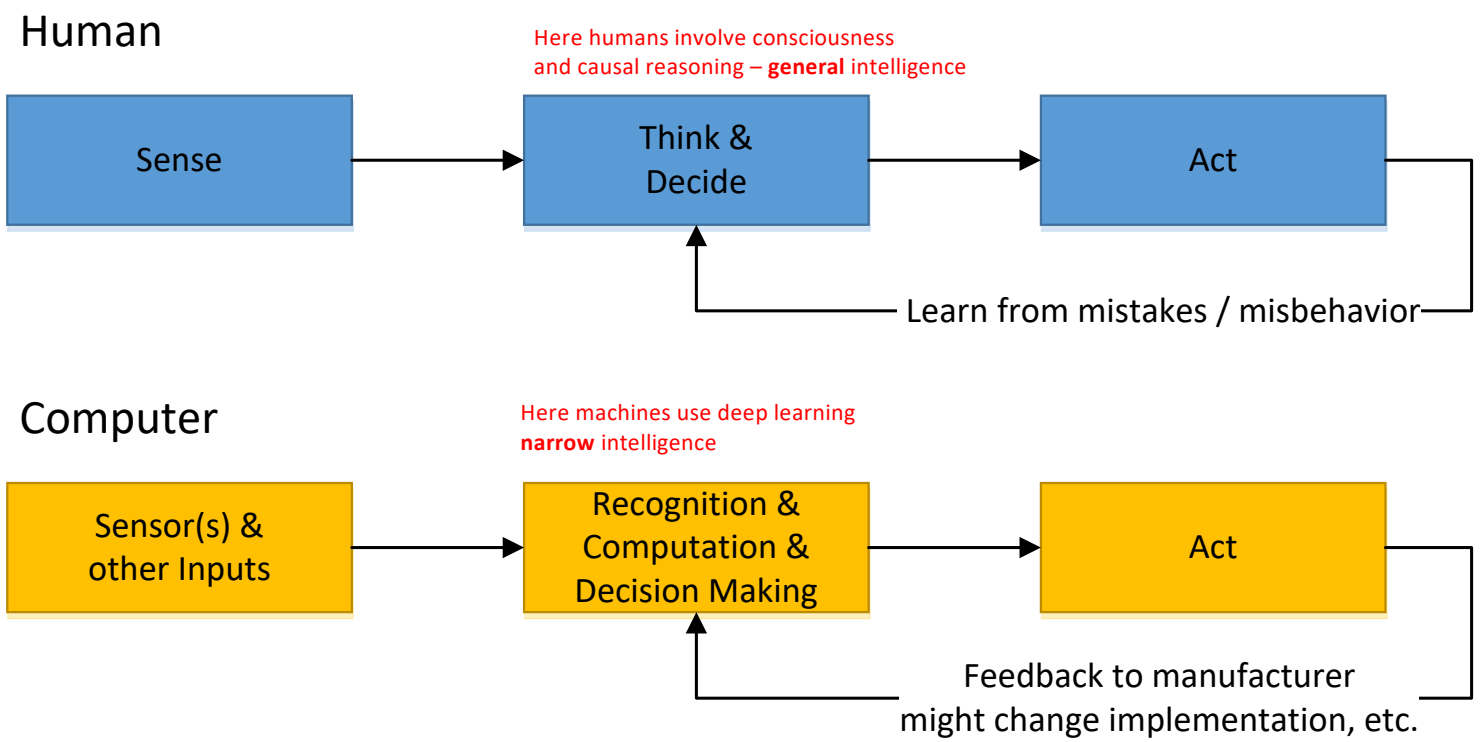


INTELLIGENCE OF AUTONOMOUS CARS – NARROW AI

(FAR FROM HUMAN LEVEL GENERAL AI)



Human Decision-making Process versus Self-Driving Car (Computer)



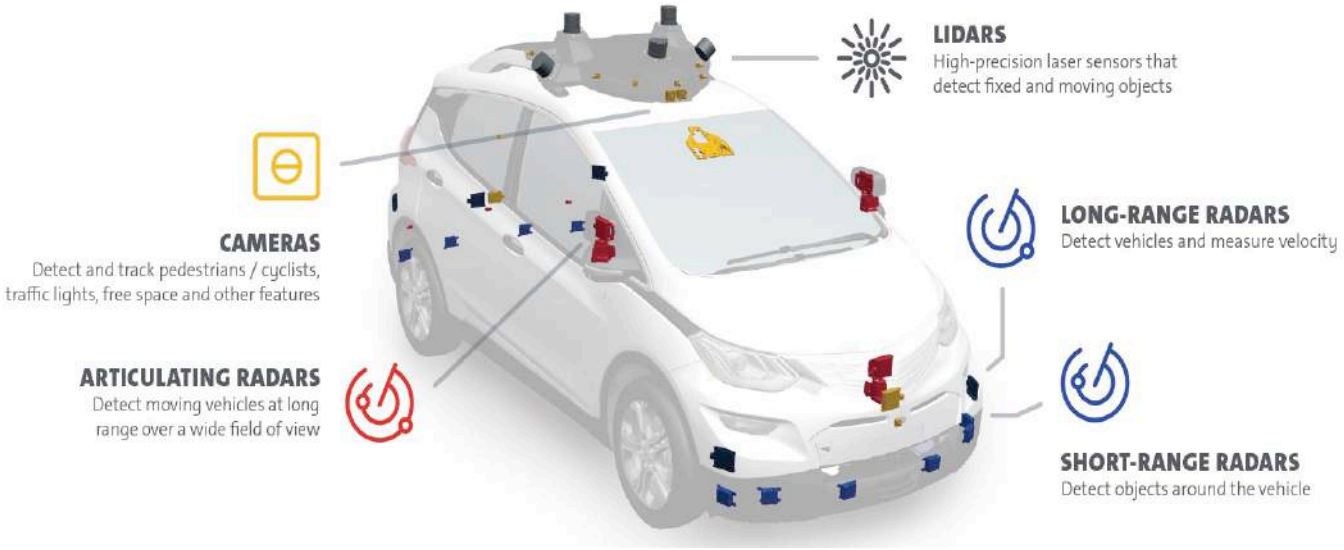
Decision Making in Self-Driving Cars

Decision making process involves sensors, external sources of information, networks, hardware, software, etc.

Environmental influences, such as weather conditions (rain, bright sun, storm, …)

Complex input must be filtered and only represents an abstraction of the real world.

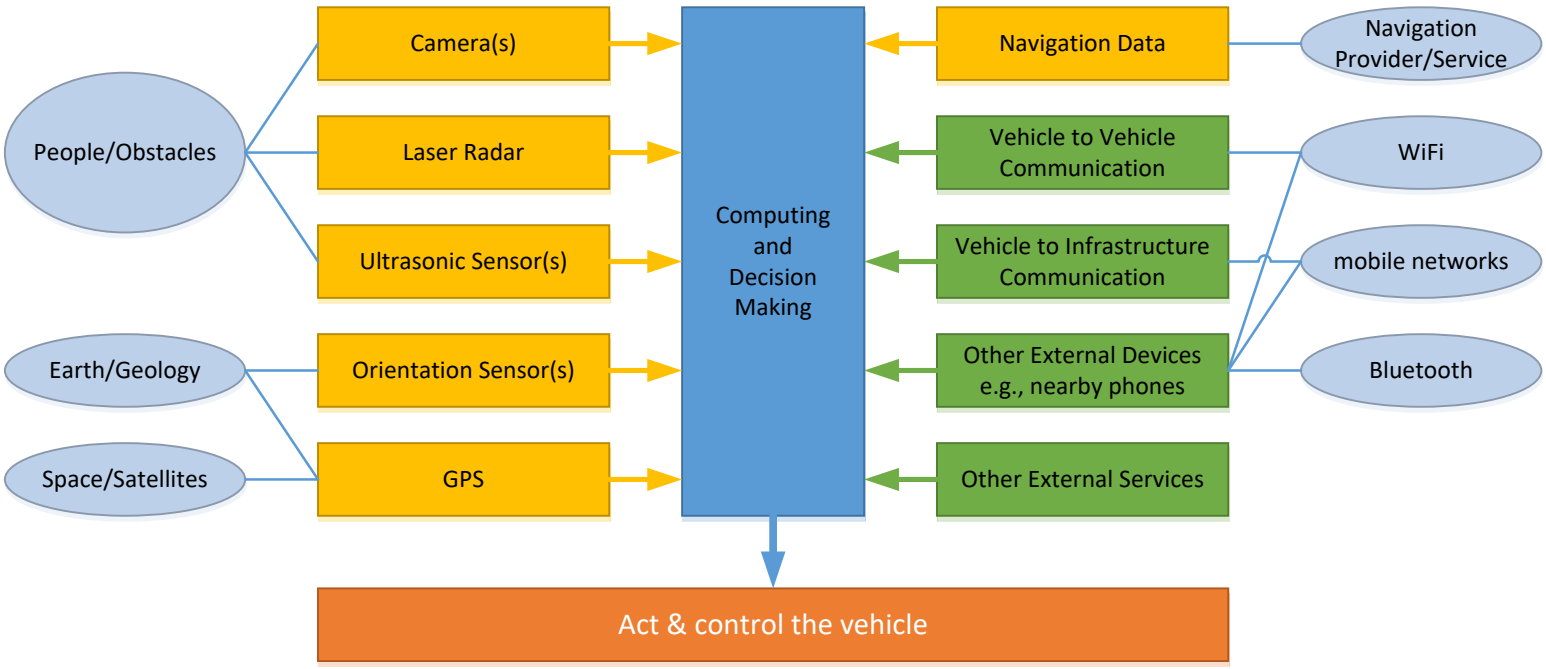
Technical Components



Picture Source: General Motors Safety Report 2018

What does a Self-Driving Car “see”…

Abstract Decision Making Process



This is an outline of what a decision making process might include.
Based on a literature review and official press releases (Tesla, Google, GM).

TECHNICAL CHALLENGES WITH ETHICAL CONSEQUENCES IN AUTONOMOUS CARS

Safety

How can we test self-driving cars? and when is testing sufficient?

Real world vs Abstract world Training of Neural Networks

Security

Attacks against car systems and sensors

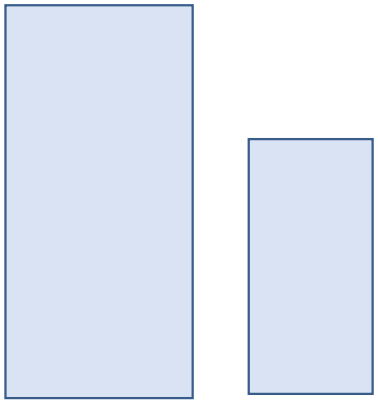
System & security updates

Do we need a “black box” in self-driving cars like in aircrafts?

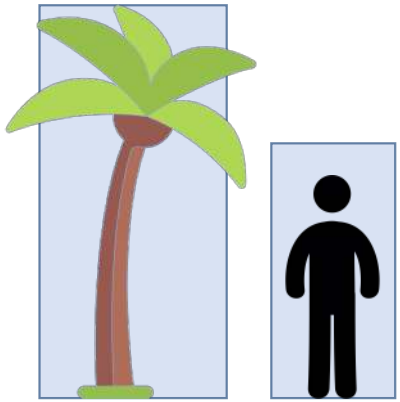
Privacy

- What data should the car have access to?
  - Who will have access to that data?
  - How will the data be used?
- What data is collected?

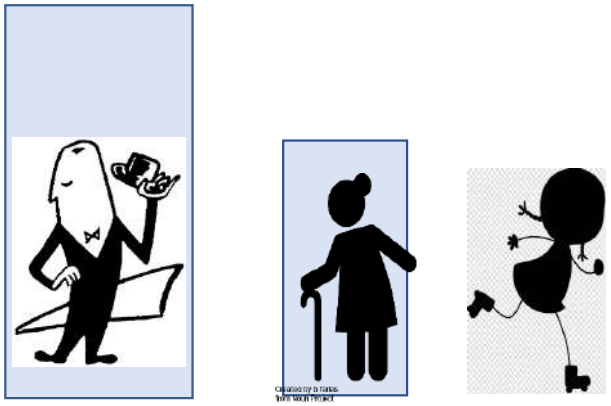
Privacy
What does the car “recognize” ?- Equivalent for Intelligent Robotics!



Objects, different size,
Position, moving or stationary



Objects vs Person(s)



„Everything“ including human identity – connected to data-bases

Trust

How trustworthy are data sources?

E.g., GPS, map data, external services

Trust between self-driving car and services

How trustworthy is the self-driving car?

E.g., Trust between user and car

Transparency

Multi-disciplinary challenge to ensure transparency, while respecting intellectual property rights, corporate secrets, security concerns, etc.

How much should be disclosed, and disclosed to whom?

Reliability

What do we have to rely on?

- What if sensor(s) fail?
- What if networks fail?

Redundancy for everything?

Responsibility and Accountability

- Who is responsible and for what?
- Who is accountable and for what?
- How is responsibility distributed among:
  - Developers
  - Car manufacturers
  - Safety inspectorates
  - Governmental institutions
  - Involved participants in the traffic
  - Other stakeholders

Quality Assurance Process

- Lifetime of components
- Maintenance
- Ethics-aware decision making in all processes will help to make ethically justified decisions.

SOCIAL CHALLENGES WITH ETHICAL CONSEQUENCES IN AUTONOMOUS CARS

Equivalent for Intelligent Social Robots will be Central!

Stakeholders Interests

- Loss of jobs (for cabs/taxi/truck/heavy industrial vehicles drivers)
- Humans in the loop
- Impact on Society

Stakeholders Interests

Freedom of movement

Will the car go, where I want it to go?

Implementation of restrictions

Route to Destination

Can the passenger define the route, or is it determined by the system?

Road trips?

Addressing Organisational Ethical Issues of AI

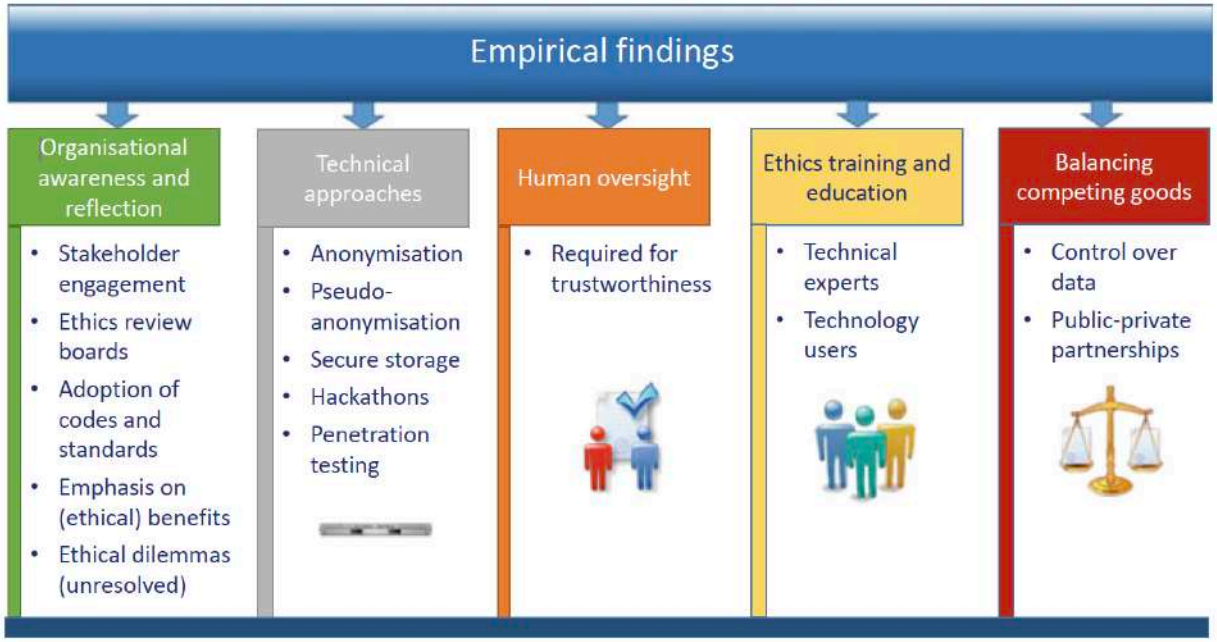
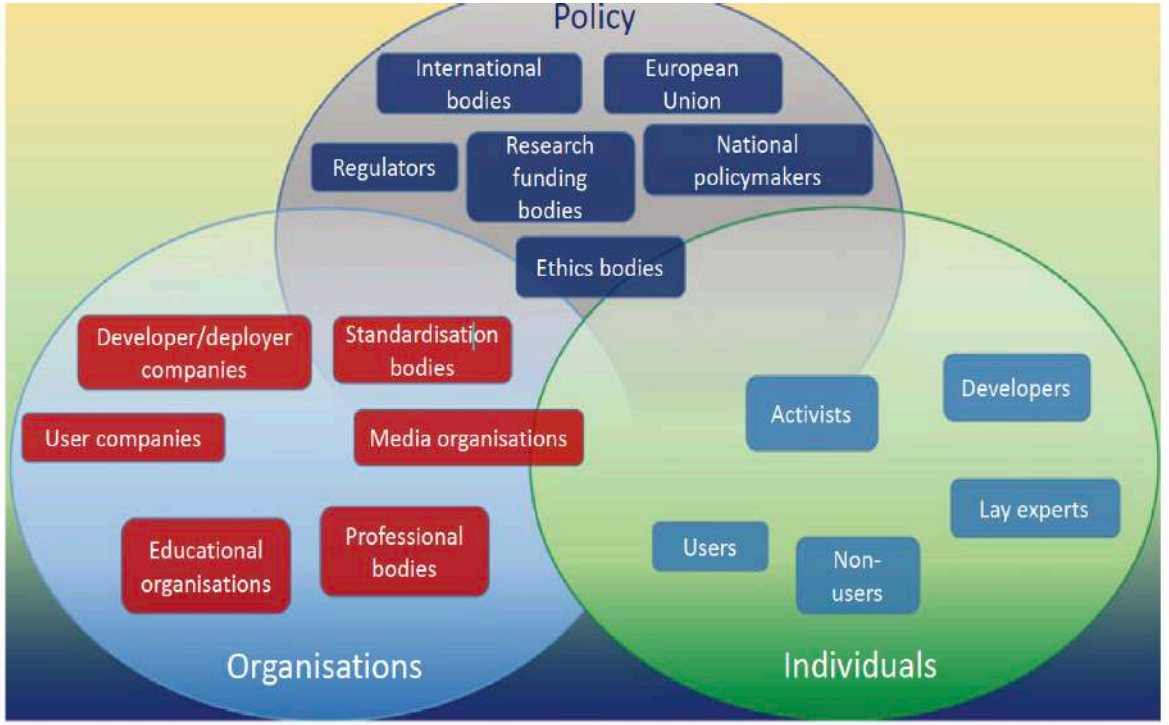


Fig. 5.2 How case study organisations address ethical issues of AI: empirical findings

Bernd Carsten Stahl (2021) Artificial Intelligence for a Better Future, https://link.springer.com/book/10.1007%2F978-3-030-69978-9

Overview of AI stakeholders, Artificial Intelligence for a Better Future



Bernd Carsten Stahl (2021) Artificial Intelligence for a Better Future, https://link.springer.com/book/10.1007%2F978-3-030-69978-9

KEY CHALLENGES OF ETHICAL GOVERNANCE OF AI SYSTEMS

Fig. 7.1 Key challenges of ethical governance of AI ecosystems

Bernd Carsten Stahl (2021) Artificial Intelligence for a Better Future, https://link.springer.com/book/10.1007%2F978-3-030-69978-9

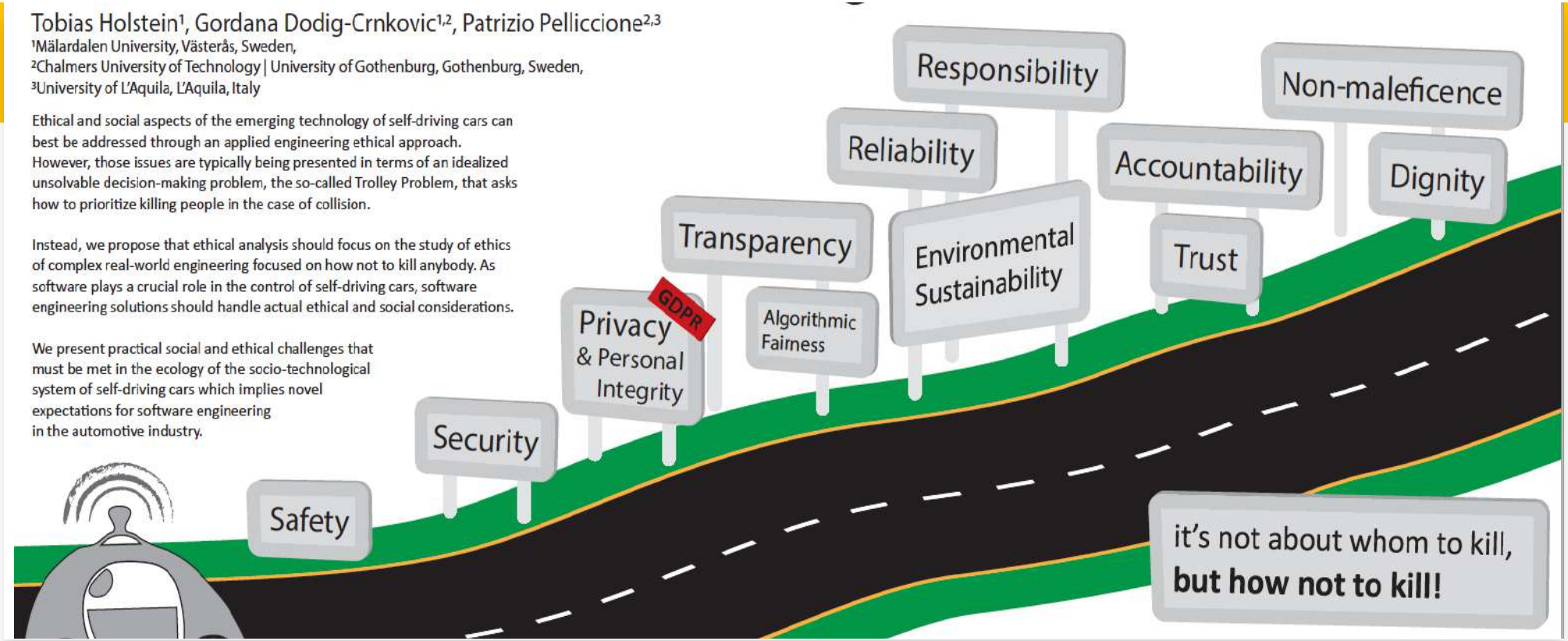
Ethical Issues of AI

Table 4.1 Three categories of ethical issues of artificial intelligence

1. Issues arising from machine learning	
Privacy and data protection	Lack of privacy
	Misuse of personal data
	Security problems
Reliability	Lack of quality data
	Lack of accuracy of data
	Problems of integrity
Transparency	Lack of accountability and liability
	Lack of transparency
	Bias and discrimination
	Lack of accuracy of predictive recommendations
	Lack of accuracy of non-individual recommendations
Safety	Harm to physical integrity
2. Living in a digital world	
Economic issues	Disappearance of jobs
	Concentration of economic power
	Cost to innovation
Justice and fairness	Contested ownership of data
	Negative impact on justice system
	Lack of access to public services
	Violation of fundamental human rights of end users
	Violation of fundamental human rights in supply chain
	Negative impact on vulnerable groups
	Unfairness
Freedom	Lack of access to and freedom of information
	Loss of human decision-making
	Loss of freedom and individual autonomy
Broader societal issues	Unequal power relations
	Power asymmetries
	Negative impact on democracy
	Problems of control and use of data and systems
	Lack of informed consent
	Lack of trust
	Potential for military use
	Negative impact on health
	Reduction of human contact
	Negative impact on environment
Uncertainty issues	Unintended, unforeseeable adverse impacts
	Prioritisation of the "wrong" problems
	Potential for criminal and malicious use
3. Metaphysical issues	
	Machine consciousness
	"Awakening" of AI
	Autonomous moral agents
	Super-intelligence
	Singularity
	Changes to human nature

https://link.springer.com/book/10.1007%2F978-3-030-69978-9 Artificial Intelligence for a Better Future (book)

Ethical Guidelines for Self-Driving Cars



Ehics Of Self-Driving Cars

Presented at major SE conference ICSE2020 as poster

Extended version in a book chapter:

Holstein, T., Dodig-Crnkovic, G., & Pelliccione, P. (2021). Steps Towards Real-world Ethics for Self-driving Cars: Beyond the Trolley Problem. In Steven John Thompson (Ed.), Machine Law, Ethics, and Morality in the Age of Artificial Intelligence. IGI Global

Requirements	Technical Challenges	Approaches
Safety	Hardware and software adequacy. Vulnerabilities of machine-learning algorithms. Trade-offs between safety and other factors (like economic). Possibility of intervention in self-driving cars (including for the Police). Systemic solutions to guarantee safety in organizations (regulations, authorities, safety culture).	Setting safety as the first priority. Learning from the history of automation. Learning from driving experience - perception and input interpretation processes. Specification of how a self-driving car will behave in cases when the car is not able to operate autonomously. Clarification of the role of the police. Regulations, guidelines, standards being developed as the technology develops.
Security	Minimal necessary security requirements for deployment of self-driving cars. Security in systems and connections. Deployment of software updates. Storing and using received and generated data in a secure way.	Technical solutions that will guarantee minimum security under all foreseeable circumstances. Anticipation and prevention of the worst-case scenarios regarding security breaches. Provide active security. Accessibility of all data, even in the case of accidents, has to be provided, so that it can be analysed to foster knowledge and to provide facts for next generation developments.
Privacy	Trade-offs between privacy and data collection/recording and storage/sharing.	Following/applying legal frameworks to protect personal data, such as GDPR.
Transparency	Information disclosure, what and to whom. Transparency of algorithmic decision making. Transparency in the techno-social ecosystem.	Assurance of transparency and insight into decision making. Active sharing of knowledge to ensure the interoperability of systems and services.
Algorithmic Fairness	Algorithmic decision making is required to be fair and not to discriminate on the grounds of race, gender, age, wealth, social status etc.	This requirement is related to transparency of decision making and expectation of explainability of the ground for decision making.
Reliability	Reliability of sensors and software and need for redundancy. Reliability of required networks and solution for the case when the network is unavailable.	Definition of different levels for reliability, such as diagnostics, vehicle input sensors, software, and external services, set the ground for reliability measures of the car as a system and its components. Standardized process required to shift from fail-safe to fail-operational architecture.
Environmental Sustainability	Environmental sustainability ethics refers to new ways of production, use, and recycling for autonomous vehicles.	Production, use, and disposal/recycling of technology rises sustainability issues (batteries, car sharing) that must be addressed.
Intelligent behavior control	Intelligent behaviour may lead to unpredictable situations resulting from learning and autonomous decision making.	Development of self-explaining capability and other features ensuring desired behavior in intelligent software.
Transdisciplinarity -Systemic approach	Ethics in design, requirements engineering, software-hardware development, learning, legal and social aspects, software-hardware interplay.	Adoption of transdisciplinarity and system approaches is increasing and should be given even more prominent role.
Quality	Quality of components. Quality of decision making. Lifetime and maintenance. QA process. Adherence to ethical principles/guidelines	Ethical deliberations included in the whole process starting with design and development. Ethics-aware decision making to ensure ethically justified decisions.

Table 1 Summary of the technical challenges and approaches, grouped by requirement

Requirements	Social Challenges	Approaches
Non-maleficence	Technology not causing harm. Disruptive changes on the labor market. Change of related markets and business models (e.g., insurances, manufacturers).	Partly covered by technical solutions. Preparation of strategic solutions for people losing jobs. Learning from historic parallels to industrialization and automatization.
Stakeholders involvement	In this field different stakeholders are involved – from professionals designing, developing, maintaining cars, to their users, and general public.	Active involvement of stakeholders in the process of design and requirements specification as well as decisions of their use.
Beneficence	Values and priorities: Ensure that general public values will be embodied in the technology, with interests of minorities taken into account.	Initiatives as "AI for good" exemplify this expectation that new technology not only do not cause harm, but actively do good for its stakeholders.
Responsibility and Accountability	Assignment and distribution of responsibility and accountability are among central regulative mechanisms for the development of new technology. They should follow ethical principles.	The Accountability, Responsibility and Transparency (ART) principle based on a Design for Values approach includes human values and ethical principles in the design processes (Dignum, 2019).
Freedom and Autonomy	Freedom of choice hindered by the system (e.g. it may not allow to drive into a certain area)	The freedom of choice determined by regulations. Determination and communication of the amount of control a human has in context of the self-driving car
Social Sustainability	In the domain of business, social sustainability is about identifying and managing business impacts on people	Pursuing social equity, community development, social support, human rights, labour rights, social responsibility, social justice, etc.
Social Fairness	Ascertaining fairness of the socio-technological system.	Fairness of the decision-making. Related to transparency and explainability.
Dignity and Solidarity	This requirement refers to the entire socio-technological system.	Challenges come from the lack of common wholistic view.
Social Trust	Establishing trust between humans and highly automated vehicles as well as within the social system.	Further research on how to implement trust across multiple systems. Provision of trusted connections between components as well as external services
Justice: legislation, standards, norms, policies and guidelines	Keeping legislation up to date with current level of automated driving, and emergence of self-driving cars. Creating and defining global legislation frameworks. Including ethical guidelines in design and development processes	Legislative support and contribution to global frameworks. Ethics training for involved engineers. Establishment and maintenance of a functioning socio-technological system in addition to functional safety standards

Table 2 Summary of the social challenges and approaches, grouped by requirement

Holstein, T., Dodig-Crnkovic, G., & Pelliccione, P. (2021). Steps Towards Real-world Ethics for Self-driving Cars: Beyond the Trolley Problem. In S. J. Thompson (Ed.), Machine Law, Ethics, and Morality in the Age of Artificial Intelligence. IGI Global

New for Intelligent Robots – Cognitive and Psychological Effects of Social/Companion Robots

Cognitive and psychological effects of social/ companion robots on humans	Personal integrity Cognitive load Deception	Further research on how social robots and especially increasingly intelligent and human-like robot companions affect users. Solid understanding of effects, after stakeholders interests are taken into consideration should be followed by regulation/legislation. Humanoid or zoomorphic robots may cause emotional attachment to some users. "Robots should not be designed in a deceptive way to exploit vulnerable users" (Boden et al. 2017)

Boden, Margaret, Joanna Bryson, Darwin Caldwell, Kerstin Dautenhahn, Lilian Edwards, Sarah Kember, Paul Newman, et al. 2017. "Principles of Robotics: Regulating Robots in the Real World." Connection Science. https://doi.org/10.1080/09540091.2016.1271400.

Ehics Of Self-driving Cars Paper* Method

1. A list of ethical values (requirements) for autonomous cars was compiled from an extensive literature study and connected to challenges together with approaches for their fulfilment.
2. The proposed analysis with values, challenges and approaches for technical and social aspects was presented to different stakeholders and discussed via seminars.
3. Finally we number of experts was invited to review the results.

* Holstein, T., Dodig-Crnkovic, G., & Pelliccione, P. (2021). Steps Towards Real-world Ethics for Self-driving Cars: Beyond the Trolley Problem. In Steven John Thompson (Ed.), Machine Law, Ethics, and Morality in the Age of Artificial Intelligence. IGI Global

Practical Use of the Proposed Ethical Framework

Ethical requirements must be fulfilled in all phases in the life-cycle of a product (autonomous car/robot) The context of:

1. Conceptualization/Design/Prototyping/ Construction/Development/Testing/Production
2. Deployment/Application/
3. Maintenance/Support
4. Oversight/Regulation

https://www.indiamart.com/kaynes-tecnology-india-pvt-ltd/product-life-cycle-management.html

The First Ethical Guidelines For Automated Driving Equivalent for Robotics Needed!

German Ethics Commission's report comprises 20 propositions. The key elements are:

Automated and connected driving is an ethical imperative if the systems cause fewer accidents than human drivers (positive balance of risk).

The protection of individuals takes precedence over all other utilitarian considerations.

In hazardous situations, the protection of human life must always have top priority.

https://www.bmvi.de/SharedDocs/EN/publications/report-ethics-commission.pdf?__blob=publicationFile

The First Ethical Guidelines For Automated Driving

Equivalent for Robotics Needed!

In the event of unavoidable accident situations, any distinction between individuals based on personal features (age, gender, physical or mental constitution) is impermissible.

In every driving situation, it must be clearly regulated and apparent who is responsible for the driving task: the human or the computer.

It must be documented and stored who is driving (to resolve possible issues of liability, among other things).

Drivers must always be able to decide themselves whether their vehicle data are to be forwarded and used (data sovereignty)

https://www.bmvi.de/SharedDocs/EN/publications/report-ethics-commission.pdf?__blob=publicationFile

“Learning By Experience” And “Proven In Use” Concepts Equivalent for Robotics Needed!

“Learning by experience” (recording data from autonomous cars) presupposes a functioning socio-technological system that provides strong coupling among legislation, guidelines, standards and use, and promptly adapts to lessons learned.

H. Schäbe and J. Braband. Basic requirements for proven-in-use arguments. CoRR, abs/1511.01839, 2015.

Challenges

Legislation	Global framework	Guidelines	Including Ethics into all phases in the life-cycle
Keeping legislation up-to-date with current level of automated driving, and emergence of self-driving cars	Creating and defining global legislation frameworks for the implementation of interoperable and development of increasingly automated vehicles	Defining the guidelines that will be adopted by society for building self-driving cars	Including ethical guidelines in design, development and other processes in the life-cycle of a product.

Holstein, Dodig-Crnkovic, Pellizzione: Ethical and Social Aspects of Self-Driving Cars, ArXives

Recommendations - Applied for Robotics

Producers supporting and collaborating with legislators in their task to keep up-to-date with the current level of technology

Legislative support and contribution to global frameworks to ensure a smooth enrollment of the emerging technology

Include ethics in the overall process of design, development and implementation of technology. Ensure Ethics training for involved engineers

Establish and maintain a functioning socio-technological system in addition to functional safety standards.

Holstein, Dodig-Crnkovic, Pellizzione: Ethical and Social Aspects of Self-Driving Cars, ArXives

Conclusions

It is time to stop discussing unsolvable ethical dilemmas that obfuscate much bigger actual ethical challenges.

Discuss the real-world ethical challenges surrounding emerging technology.

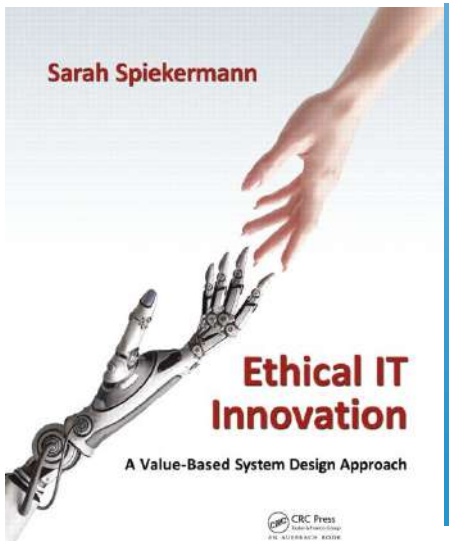
Define what is technically possible and ethically justifiable.

Create transparency to support evaluations by independent organisations/experts.

Ethicality/Ethicity as non-functional property? (Ethicality: the state, quality, or manner of being ethical.)

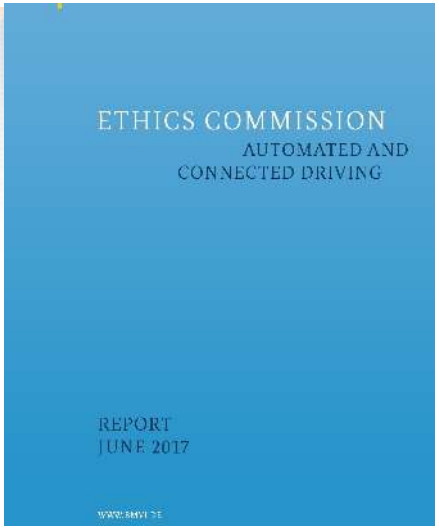
There is already a body of normative documents that can support ethicality of design and implementation.

A Value-Based Design Approach



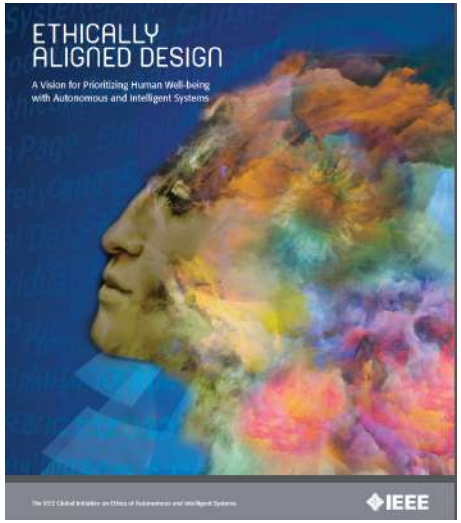
Sarah Spiekermann

Ethical IT Innovation:
A Value-Based System Design Approach



Ethics Commission: Automated and connected driving (Report by Federal Ministry of Transport and Digital Infrastructure of Germany [BMVI])

BMVI = Bundesministerium für Verkehr und digitale Infrastruktur



https://ethicsinaction.ieee.org/

Soma Design – Intertwining Aesthetics, Ethics and Movement - Kristina Höök

Values explored from within somaesthetics

Connecting socially grounded, negotiated understanding of values with the individual perspective from the point of view of soma – individual body. This connection is important. How do values feel on the individual somatic level?

Soma design — examines and improves connections between sensation, feeling, emotion, subjective understanding and **values**.

Soma design builds on **somaesthetics** by Shusterman.

It combines soma as in our first-person experience of the world through our senses, with ***aesthetics*** *as deepening knowledge of our sensory experiences to* ***live a better life***.

Our cultural practices and digitally-enabled objects enforce a form of sedimented, agreed-upon movements, enabling variation, but with *certain prescribed ways to act, feel and think*.

Höök argues that by engaging in a soma design process we can better probe which movements lead to deepened **somatic awareness**; **social awareness of others** in the environment and how they are affected by the human-technology assemblage;

enactments of bodily freedoms rather than limitations; making norms explicit;

engaging with a *pluralist feminist position* on who we are designing for; and

aesthetic experience and expression.

https://dl.acm.org/doi/10.1145/3313831.3376678 Ethics in Movement: Shaping and Being Shaped in Human-Drone Interaction
SOMA - the body as distinct from the soul, mind, or psyche.

FURTHER READING

Legislation and Standards

Legislation implemented with rigorous monitoring the behavior of technology.

Implementation is within the responsibility of producers. That means that design and implementation of software should follow ethical guidelines.

Ethics & Law Aspects Equivalent for Robotics Needed!

Ryan Jenkins (2016) Autonomous Vehicles Ethics & Law: Towards an Overlapping Consensus

https://www.academia.edu/29332066/Autonomous_Vehicles_Ethics_and_Law_Towards_an_Overlapping_Consensus

Patrick Lin (2015) Why Ethics Matters for Autonomous Cars.

In: Autonomes Fahren Technische, rechtlische und gesellschaftliche Aspekte

https://www.springerprofessional.de/en/why-ethics-matters-for-autonomous-cars/4397684

Ethically Aligned Design

A Vision for Prioritizing Human Well-being With Autonomous and Intelligent Systems

https://ethicsinaction.ieee.org/

Embedding Values into Autonomous Intelligent Systems - The IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems

https://standards.ieee.org/develop/indconn/ec/ead_embedding_values.pdf

An example of ethical guidelines thinking one step further is described in the book:

Sarah Spiekermann. Ethical IT Innovation: A Value-Based System Design Approach. Taylor & Francis, 2015.

Policy Concerning Automated Vehicles (US DOT) Equivalent for Robotics Needed!

"DOT/NHTSA Policy statement concerning Automated Vehicles" 2016 update to "Preliminary statement of policy concerning automated vehicles".

Technical report, National Highway Traffic Safety Administration (NHTSA).

http://www.nhtsa. gov/staticfiles/rulemaking/pdf/Autonomous-Vehicles-Policy-Update-2016.pdf

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- Sapienza, G., Dodig-Crnkovic, G. and I. Crnkovic. Inclusion of ethical aspects in multi-criteria decision analysis. In 2016 1st International Workshop on Decision Making in Software ARCHitecture (MARCH), pages 1–8, April 2016.
- Thekkilakattil A. and G. Dodig-Crnkovic. Ethics aspects of embedded and cyber-physical systems. In 2015 IEEE 39th Annual Computer Software and Applications Conference, volume 2, pages 39–44, July 2015.