



The Roboethics Roadmap

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presented by Bruno Siciliano



The EURON Roboethics Atelier Project

In 2005, EURON funded the **Research Atelier on Roboethics**, with the aim of drawing the first **Roboethics Roadmap**.

The ultimate purpose of the project was to provide a systematic assessment of the ethical issues involved in the Robotics R&D; to increase the understanding of the problems at stake, and to promote further study and transdisciplinary research.

The Roadmap has been made available @

- the EURON Website **<http://www.euron.org/news>**
- the Official Roboethics Website **<http://www.roboethics.org>**



The EURON Roboethics Roadmap

The **Roboethics Roadmap** outlines the multiple pathways for research and exploration in the field and indicates how they might be developed.

The roadmap embodies the contributions of more than 50 scientists and technologists, in many fields of investigations from sciences and humanities.

This study will hopefully be a useful aid in view of cultural, religious and ethical differences.



Disclaimer

Let's see firstly what the Roboethics Roadmap cannot be:

- It is **NOT** an **exhaustive State-of-the-Art in Robotics**, nor a guideline of ethics in science and technology. The reason is that Robotics is a new science still in the defining stage.
- It is **NOT** a list of **Questions & Answers**. Actually, there are no easy answers, and the complex fields require careful consideration.
- It is **NOT** a **Declaration of Principles**. The Euron Roboethics Atelier cannot be regarded as the institutional committee of scientists and experts entitled to draw a Declaration of Principles on Roboethics.



Scope: Near Future Urgency

In terms of scope, we have taken into consideration – from the point of view of the ethical issues connected to Robotics – a **temporal range of few decades**, in whose frame we could reasonably locate and infer – on the basis of the current State-of-the-Art in Robotics – certain foreseeable developments in the field.

For this reason, we consider **premature** – and have only hinted at – problems inherent in the possible emergence of human functions in the robot: like *consciousness, free will, self-consciousness, sense of dignity, emotions*, and so on. Consequently, this is why we have not examined problems –debated in literature – like the need not to consider robot as our slaves, or the need to guarantee them the same respect, rights and dignity we owe to human workers.



Target: Human Centred Ethics

Likewise, and for the same reasons, the target of this Roadmap is not the robot and its *artificial ethics*, but the **human ethics** of the robots' designers, manufacturers and users.

Although informed about the issues presented in some papers on the need and possibility to attribute moral values to robots' decisions, and about the chance that in the future robots might be moral entities like – if not more than– human beings, we have chosen, in this first release of the Roboethics Roadmap, to examine the **ethical issues of the human beings involved in the design, manufacturing, and use of the robots.**



Target: Human Centred Ethics (2)

We have felt that problems like those connected to military robotics and the possible use of robot soldiers against populations not provided with this sophisticated technology, as well as problems of terrorism in robotics and problems connected with biorobotics, implantations and augmentation, were **urging** and **serious** enough to deserve a focused and tailor-made investigation.

It is absolutely clear that without a deep rooting of Roboethics in society, the premises for the implementation of an artificial ethics in the robots' control systems will be missing.



Methodology: Open Work

The Roboethics Roadmap is an **Open Work** susceptible to further development and improvement which will be defined by events in our technoscientific-ethical future. We are convinced that the different components of society working in Robotics, and the stakeholders in Robotics should intervene in the process of building a Roboethics Roadmap, in a grassroots science experimental case:

- The Parliaments
- Academic institutions and Research Labs
- Public ethics committees
- Professional Orders
- Industry
- Educational systems
- The mass-media



Principles to Be Followed in Roboethics

- Human Dignity and Human Rights
- Equality, Justice and Equity
- Benefit and Harm
- Respect for Cultural Diversity and Pluralism
- Non-Discrimination and Non-Stigmatization
- Autonomy and Individual Responsibility
- Informed Consent
- Privacy
- Confidentiality
- Solidarity and Cooperation
- Social Responsibility
- Sharing of Benefits
- Responsibility towards the Biosphere



Ethical Issues in an ICT Society

Roboethics shares many “sensitive areas” with **Computer Ethics** and **Information Ethics**.

These ethical issues belong to the general effects of the Second and Third Industrial Revolutions, in the field of the relationship between Humans and Machines:

- Dual-use technology
- Anthropomorphization of the Machines
- Humanisation of the Human/Machine relationship
- Technology Addiction
- Digital Divide, socio-technological Gap
- Effects of technology on the global distribution of wealth
- Environmental impact of technology



Computer and Information Ethics

From the Computer and Information Ethics we borrow the known **Code of Ethics** called **PAPA**, acronym of: privacy, accuracy, intellectual property and access.

Privacy: What information about one's self or one's associations must a person reveal to others, under what conditions and with what safeguards? What things can people keep to themselves and not be forced to reveal to others?

Accuracy: Who is responsible for the authenticity, fidelity and accuracy of information? Similarly, who is to be held accountable for errors in information and how is the injured party to be made whole?

Property: Who owns information? What are the just and fair prices for its exchange? Who owns the channels, especially the airways, through which information is transmitted? How should access to this scarce resource be allocated?

Accessibility: What information does a person or an organization have a right or a privilege to obtain, under what conditions and with what safeguards?



Engineering Ethics

By **Engineering Ethics** are meant the Codes of Ethics bearing on the professional responsibilities of engineers, guiding to a responsible conduct in research and practice. In this context, **Security** and **Reliability** are the most important ethical codes of conduct.

Furthermore:

- Hold paramount the safety, health and welfare of the public
- Perform services only in areas of their competence
- Issue public statements only in an objective and truthful manner
- Act in professional matters for each client as faithful agents/trustees
- Avoid improper solicitation of professional assignments

(American Council of Engineering Companies Ethical Guidelines)



Universally Adopted Ethical Principles

In roadmapping Roboethics, we refer to the General Ethical Principles adopted by most Nations, Cultures and People of the World. Among them:

- **United Nations**

Universal Declaration of Human Rights (1948)

- **Unesco**

Declaration on Science and the use of scientific knowledge (1999)

- **European Union**

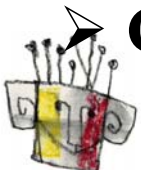
Charter Of Fundamental Rights of the European Union (2000)



EU Charter Of Fundamental Rights

Articles of interest:

- **Human dignity**
- **Right to life**
- **Right to the integrity of the person**
- **Respect for private and family life**
- **Protection of personal data**
- **Freedom of the arts and sciences**
- **Freedom to choose an occupation and right to engage in work**
- **The rights of the child**
- **The rights of the elderly**
- **Integration of persons with disabilities**
- **Environmental protection**
- **Consumer protection**



Common Questions

Some examples of common questions:

- Although farsighted and forewarning, could Asimov's three Laws become really the Ethics of Robots?
- Is Roboethics the ethics of robots or the ethics of robotic scientists?
- How far can we go in embodying ethics in a robot? And, which kind of "ethics" is the correct one for Robotics?
- How contradictory is, on one hand, the need to implement Roboethics in robots, and, on the other, the development of robot autonomy?
- Is it right that robots could develop a "personality"?
- Is it right that robots could feel "emotions"?



Main Positions on Roboethics

Since the First International Symposium on Roboethics, three main ethical positions emerged from the robotics community (D. Cerqui):

- **Not interested in ethics** (This is the attitude of those who consider that their actions are strictly technical, and do not think they have a social or a moral responsibility in their work)
- **Interested in short-term ethical questions** (This is the attitude of those who express their ethical concern in terms of “good” or “bad,” and who refer to some cultural values and social conventions)
- **Interested in long-term ethical concerns** (This is the attitude of those who express their ethical concern in terms of global, long-term questions)



Roboethics Taxonomy (1)

In the period of a year, the Euron Roboethics Atelier carried out a tour d'horizon of the field in Robotics: an overview of the state of the art in Robotics, and of the main ethical issues, driven by the most recent technoscientific developments, which can only just be glimpsed.

A taxonomy of Robotics is not a simple task, simply because the field is in a full bloom.

A classification of Robotics is a work in progress, done simultaneously with the development of the discipline itself.



Roboethics Taxonomy (2)

Aware of the classifications produced by the main Robotics organizations, which differ from one another on the basis of the approach – technological/applicational – we have preferred, in the case of the Roboethics Roadmap, to collect the many Robotics fields from a typological standpoint, according to shared homogeneity of the problems of interface towards the society.

Instead of an encyclopaedic approach, we have followed – with few modifications – the classification of the **EURON Robotics Research Roadmap**.

For every field, we have tried to analyse the current situation rather than the imaginable. Thus, we have decided to give priority to issues in applied ethics rather than to theoretical generality.



Roboethics Taxonomy (3)

- Humanoids

 - Artificial Mind, Artificial Body*

- Advanced production systems

 - Industrial robotics*

- Adaptive robot servants and intelligent homes

 - Indoor Service Robots, Ubiquitous Robotics*

- Network Robotics

 - Internet Robotics, Robot ecology*

- Outdoor Robotics

 - Land, Sea, Air, Space*

- Health Care and Life Quality

 - Surgical Robotics, Bio-Robotics, Assistive Technology*

- Military Robotics

 - Intelligent Weapons, Robot Soldiers, Superhumans*

- Edutainment

 - Educational Robots, Robot Toys, Entertainment, Robotic Art*



Dissemination

- G. Veruggio “The EURON Roboethics Roadmap”, Humanoids'06, December 6, 2006, Genoa, Italy
- G. Veruggio, F. Operto, “The Roboethics Roadmap”, Ethics of Human Interaction with Robotic, Bionic, and AI Systems-Concepts and Policies, October 17-18, 2006 , Naples, Italy
- G.Veruggio, “The Roboethics Roadmap”, Workshop on Roboethics @ ICRA07, April 14, 2007, Rome, Italy
- G.Veruggio, Track 11 “Philosophy and Ethics of Robotics” Chair @ E-CAP’07 European Computing and Philosophy Conference, June 21-23, 2007, University of Twente, Enschede, The Netherlands
- G.Veruggio, “The Birth of Roboethics” invited talk @ E-CAP’07, June 21-23, 2007, University of Twente, Enschede, The Netherlands
- G. Veruggio, F. Operto, “The Roboethics Roadmap”, CEPE2007 Seventh International Computer Ethics Conference, July 12-14 2007, University of San Diego, USA
- G.Veruggio, F. Operto, “Roboethics: a Bottom-up Interdisciplinary Discourse”, International Review on Information Ethics (in press)
- G.Veruggio, F.Operto, Chapter 65 “Social and Ethical Implications” in Springer Handbook of Robotics, Editors B.Siciliano & O.Khatib (in press)



The Roboethics Roadmap Follow-up

Some months ago, in November 2006, we were contacted by a Korean delegation of robotics scientists and experts who were visiting St. Anna of Pisa.

Knowing about the Euron Roboethics Roadmap, they were so interested that asked us to send them the last release.

We knew that the Korean government, as well as the Japanese one, were very interested in the Euron Roadmap, because they are drawing up guidelines for the legislation concerning the design and use of robots in society.

Although the Korean Charter is still a work-in-progress, we know for sure that it was inspired by the Euron Roboethics Roadmap.



BBC News

On March 7th, 2007, the BBC News was the first news agency featuring the story about the Korean Roboethics Charter:

BBC NEWS, Wednesday, 7 March 2007, 13:46 GMT

Robotic age poses ethical dilemma

An ethical code to prevent humans abusing robots, and vice versa, is being drawn up by South Korea.

...

“The European Robotics Research Network is also drawing up a set of guidelines on the use of robots.

This ethical roadmap has been assembled by researchers who believe that robotics will soon come under the same scrutiny as disciplines such as nuclear physics and Bioengineering.”...



National Geographic

Few days after Stefan Lovgren interviewed Gianmarco Veruggio:

National Geographic News March 16, 2007

Robot Code of Ethics to Prevent Android Abuse, Protect Humans

The government of South Korea is drawing up a code of ethics to prevent human abuse of robots—and vice versa.

...

The so-called Robot Ethics Charter will cover standards for robotics users and manufacturers, as well as guidelines on ethical standards to be programmed into robots, South Korea's Ministry of Commerce, Industry and Energy announced last week.

...



IEEE-RAS TC on Roboethics

The TC was started in January 2004, at the First International Symposium on Roboethics, Villa Nobel, Sanremo, Italy, by IEEE-RAS Presidents Paolo Dario and Kazuo Tanie.

Co-chairs:

Gianmarco Veruggio <gianmarco@veruggio.it> (corresponding chair)

Ronald C. Arkin <arkin@cc.gatech.edu>

Atsuo Takanishi <takanisi@waseda.jp>

Current Number of Members: 78

www.roboethics.org
info@roboethics.org



ICRA'07 Workshop on Roboethics

The IEEE-RAS TC on Roboethics has organized a Workshop on Roboethics at ICRA2007, Roma, Italy. The Workshop will be hosted on April 14th at the University of Roma "La Sapienza".

The workshop will be attended by 25 speakers, among the most distinguished robotics scientists and experts of ethics.

On the occasion of the Workshop the EURON Roboethics Roadmap will be officially presented.

The Program of the Workshop is available at

<http://www.roboethics.org/icra07/program.html>

To register refer to **<http://www.icra07.org/>**



EURON SIG on Roboethics (1)

A group of EURON members is working on the proposal of a *Special Interest Group on Roboethics*, which aims at promoting the debate on Roboethics, stimulating more researchers to contribute to the continuous improvement of the Roboethics Roadmap, to open new research activities in the field, to support EURON members in managing ethical issues, and to side the dissemination activities dealing with sensitive issues in the field. The Roboethics SIG could assist the definition of European legislation guidelines for the field. It could be also a tool to improve the East-West understanding between roboticists of Europe, USA, and Japan.



EURON SIG on Roboethics (2)

A privileged channel of dissemination should be the European school reseau. It is very important to address our young generations with the ethical problems in Robotics, since they are going to be the ones who will live in a "robotic" society.

For this reason the Roboethics SIG will promote the development of educational material:

- model courses in Roboethics
- training modules to raise the awareness of researchers in the ethics field
- educational methodologies and tools for teachers



EURON SIG on Roboethics (3)

Initial members:

- Gianmarco Veruggio, Scuola di Robotica, Genova, Italy (SIG Coordinator)
- Bruno Siciliano, PRISMA Lab, Università di Napoli Federico II, Italy
- Paolo Dario, Scuola Superiore Sant'Anna, Pontedera, Italy
- Raja Chatila, LAAS-CNRS, Toulouse, France
- Thomas Christaller, Fraunhofer Inst. for Autonomous Intelligent Systems, Munich, Germany
- Paolo Fiorini, Università di Verona, Italy
- M. Isabel Ribeiro, Institute for Systems and Robotics, Lisbon, Portugal
- Alícia Casals, Univ. Politècnica de Catalunya, Barcelona, Spain
- Kostas Kyriakopoulos, National Technical University of Athens, Greece

New members are welcome!

Please email to **gianmarco@veruggio.it**



The End

Thank You! 😊

