PRIVACY E INNOVAZIONE

STUDI E RICERCHE SULLA PROTEZIONE
DEI DATI PERSONALI NELL'ERA DIGITALE

4

# PRIVACY E INNOVAZIONE

## STUDI E RICERCHE SULLA PROTEZIONE DEI DATI PERSONALI NELL'ERA DIGITALE

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Pier Giorgio Chiara

# Artificial Intelligence, Robots and Torts: Challenges and Perspectives

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*To my Family*
*To Carola*

# Table of contents

# Introduction

The need to face technologies subject to rapid change requires to operate speculative methods and strategies in order to predict future trends. Emerging digital technologies, such as Artificial Intelligence (hereafter, AI), advanced robotics and autonomous systems, lead to the creation of new products and services that allow for new opportunities for our economy and society, by creating new systems and complex environments that significantly improve people daily life.

To narrow the scope of analysis within the broad sector of emerging digital technologies, the present work focus on the intertwining relation between the field of AI and robotics.

One of the areas where research is much needed is tort liability: in addressing the regulation of accidents caused by advanced autonomous technology, such as complex AI on embedded robotic system, jurists must assess whether tort liability rules – as they are currently shaped – are suited to govern the various issues of complexity, while simultaneously holding on to their theoretical basis. Whether the current framework proves itself to be inadequate and irreparably 'out of tune' with the new market dynamics, the only alternative will be to amend or renew it.

Against this background, the aim of this work is to present the existing EU legal framework on liability, in particular, having regard to the product liability Directive. The book is outlined as such: in chapter one, I address several meanings of 'autonomy', having regard to the philosophical, legal and engineering understanding of this notion, within the complex interrelation between AI and robotics. Chapter two sheds light

on the horizontal discussion on the manifold challenges posed by robotics and AI to private law (i.e., contractual, extra-contractual, privacy and data protection, and IP) and, through a vertical perspective, addresses three different level of technologies (robots with no autonomy, robots with weak autonomy, and finally, advanced AI systems) constituting a model that ought to guide the legal analysis. Notwithstanding the crucial impact of these technologies on the field of privacy and data protection, on which section 2.1 will briefly dwell on, the investigation focuses on the feasibility of enforcing the existing EU product liability regime to such tripartition.

Yet, since the last level of the model (i.e., advanced AI systems) is likely to bring disruptive effects into the domain of causality, in particular, taking into account machine learning algorithms and deep learning techniques, existing product liability rules may no longer be effective. Thus, chapter three will address product liability cornerstone concepts such as, *inter alia,* 'product', 'defectiveness' and 'burden of proof' to investigate whether they are still sound legal basis in this context.

Chapter four aims at setting forth a multilevel approach in order to adapt Italian traditional civil liability regimes, such as vicarious liability, to advanced autonomous technologies. The analogies taken into consideration (autonomous systems deemed as minors, animals, employees or dangerous things) are quite provocative and aim to show how the enhanced abilities of artificial agents and the broadening range of responsibilities delegated to them will lead to comparisons with agents and other actors in diverse areas of law.

Finally, chapter five concludes the manuscript by casting light on the recent developments, at EU level, in the debate on revising the existing legal frameworks or introducing new civil liability rules for artificial intelligence. After some final considerations – mainly from a legal-economic standpoint – on whether and to what extent existing liability rules are suitable for application to emerging digital technologies, the analysis focuses on the deliverables of the Expert Group on

liability and new technologies appointed by the Commission and the European Parliament Resolution of October 2020 on a civil liability regime for artificial intelligence. These last considerations (section 5.2 and 5.3) have been necessarily added after the presentation and defence of the LM thesis (June 2019), to bring up to date the discussion on the rapidly evolving question of the civil liability of autonomous systems.

May 2022

Chapter I

# Robots and AI, a normative perspective

## 1.1. The intertwining relationship between robotics and AI

In order to develop an appropriate legal theory for robots and artificial intelligence (AI), the starting point is identifying, and subsequently clarifying the nature of, the actors of our theorizing.

The field of robots could be seen as the cross-disciplinary sector *par excellence*, since computer science, cybernetics, mathematics, mechanical science, electronic science, neuroscience, and so on, converge in it.[1]

Considering that even expert roboticists struggle with a clear definition of 'robot'[2], it is not an easy task to define what a 'robot' is. Nonetheless, there is a measure of consensus around the so-called 'sense-think-act cycle'[3], a pattern used to shape human intelligence that has been so influential in the robotics and AI communities. In turn, robotic could also be seen as a field of AI aimed at creating machines that sense the environment where they are posed, process what they sense, and act upon the world[4].

The notion of 'AI' includes the larger concept of 'intelligence'. As pointed out by Durante, which highlights the conceptual dependence of the notion of AI on the concept of 'intelligence', the

[1] U. Pagallo, *Robotica,* in *Manuale di informatica giuridica,* edited by M. Durante and U. Pagallo*,* Utet giuridica, 2012, p. 143.

[2] R. Calo, A. M. Froomkin, I. Kerr, *Robot Law,* Edward Elgar, 2016, p. 6.

[3] *Inter alia*, see G.A. Bekey, *Biologically inspired control of autonomous robots,* vol. 18(1.2), Robotics and Autonomous Systems, 1996, p. 29; cfr. with R. Pfeifer and C. Scheier, *Understanding Intelligence,* A Bradford Book, 1999, p. 37; R. A. Brooks, *Intelligence without reason*, Mit Artificial Intelligence Laboratory, 1991, p. 569 – 570.

[4] R. Calo, *Robotics and the lessons of Cyberlaw*, vol. 103(3), California Law Review, 2015, p. 529.

research in the context of AI rests on two different and complementary paradigms, namely an epistemological and a heuristic one. The former founds its research on the inner workings of the human mind, whereas the latter bases its results on the themes of the production of rational-choice models, problem solving and gaining experience[5]. Therefore, the expression 'AI' should be clarified insofar it refers to the science aimed at developing computational models of intelligent behavior, thus ensuring that machines/computer can perform tasks that they would require human intelligence[6].

The concept of AI was closely related with the sub-field of "symbolic AI", which was very popular until the end of the 1980s. Notwithstanding, in order to overcome some constraints of symbolic AI, "sub-symbolic methodologies such as neural networks, fuzzy systems, evolutionary computation and other computational models started gaining popularity, leading to the term 'computational intelligence' emerging as a subfield of AI"[7], later addressed in Chapter four.

All in all, the intertwining relationship between robotics and AI could be explained by saying that the former forces the latter to deal with real objects in the real world whereas "techniques and representations developed for purely cognitive problems, often in toy domains, do not necessarily extend to meet the challenge"[8].

AI has played, and continues to do so, a significant role in the rise of the robots by providing robots with the 'intelligence' in terms of connecting the sensing to the acting, raising the level of autonomy, ensuring a higher grade of adaptability to changing conditions, minimizing set-up time and cost and, enhancing

[5] M. DURANTE, *L'Intelligenza artificiale nella prospettiva dell'informatica giuridica,* in *Manuale di informatica giuridica,* edited by M. DURANTE and U. PAGALLO, Utet giuridica, 2012, p. 92.

[6] G. SARTOR, *Intelligenza Artificiale e Diritto: un'introduzione,* Giuffrè Editore, Milano 1996, p. 9.

[7] J. A. PEREZ, F. DELIGIANNI, D. RAVI and G. Z. YANG, *Artificial Intelligence and Robotics*, 2018, p. 2, https://arxiv.org/abs/1803.10813.

[8] M. BRADY, *Artificial Intelligence and Robotics,* in *Robotics and Artificial Intelligence,* edited by M. BRADY, L.A. GERHARDT and H.F. DAVIDSON, NATO ASI Series, 1984, p. 48.

human productivity by letting computers face with growing quantities of the specification of program details[9].

Among the influent scholars in the field of robotics and AI, Brady was one of the first to suggest, in the late 1980s, that AI must have a key role in the field of robots "if the connection is to be intelligent", since robotics is the field "concerned with the connection of perception to action"[10].

Based on the achievements made in mechatronics, electrical engineering and computer science, robotics is fostering development through sophisticated sensorimotor functions that bestow the power of the robots to adapt to their ever-changing environment. Today, the system of industrial production can be integrated more easily into an existing environment, whereas hitherto it has been organized around the machine itself; it has been calibrated basing on its environment, tolerating minimal variations[11].

Against this backdrop, the autonomy of a machine in an environment can be subdivided into perceiving, planning and execution or, as seen before, 'sense-think-act'. The main idea, therefore, of converging AI and robotics is to try to optimize the level of autonomy through learning processes; this level of intelligence can be assessed as the ability of predicting the future, as accurately as possible, either in scheduling tasks, or in interacting with the environment where they are placed[12].

Even though building a complex autonomous system hosting human-like intelligence remains elusive, there have been many attempts to build intelligent robots; yet artificial agents are increasingly present and crucial in our societies as they perform specialized autonomous tasks[13], such as driving[14], flying in both

[9] *Ibidem*, p. 49.
[10] *Ibidem*, p. 47.
[11] J. A. PEREZ, F. DELIGIANNI, D. RAVI and G. Z. YANG, *op. cit*., p. 24.
[12] *Ibidem*.
[13] *Ibidem*.
[14] C. ROGERS, *Google Sees Self-Driving Cars on Road within Five Years*, Wall Street Journal, 14 January 2015.

artificial and natural environments[15], swimming[16], carrying loads and various items in different terrains[17], picking up objects[18] and putting them down[19].

'Perception' is a crucial challenge for the application of AI in robotics. Back in the '80s, scholars and technicians used to struggle with severely limited perceptual abilities of commercially available robots[20]; nowadays, robots can sense the environment by means of integrated sensors or computer vision, as the improvement of both sensing and vision occurred in the last decade[21]. Perception is also crucial to the end of creating an artificial sense of robotic self-awareness.

Historically, scholars used "to distinguish contact -including tactile and force sensing- and non-contact sensing -including passive sensing in both visual and non-visual spectral brands and active sensing using infra-red, sonar, ultrasound and millimeter radar"[22]; now, the debate on the interactions of the robot with other agents in the same environment, namely social robotics, is more focused on covering two broad domains: human-robot interactions (HCI) and cognitive robotics[23].

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[15] D. Floreano and R. J. Wood, *Science, technology and the future of small autonomous drones*, vol. 521, Nature, 2015, pp. 460-466.

[16] Z. Chen, X. Jia, A. Riedel, and M. Zhang, *A bio-inspired swimming robot*, Conference Proceedings IEEE International Conference on Robotics and Automation (ICRA), 2014, pp. 2564-2564.

[17] Y. Ohmura and Y. Kuniyoshi, *Humanoid robot which can lift a 30kg box by whole body contact and tactile feedback*, Conference Proceedings IEEE/RSJ International Conference on Intelligent Robots and Systems, 2007, pp. 1136-1141.

[18] Z. Kappassov, J.-A. Corrales, and V. Perdereau, *Tactile sensing in dexterous robot hands—Review*, vol. 74, Robotics and Autonomous Systems, 2015, pp. 195-220.

[19] H. Arisumi, S. Miossec, J.-R. Chardonnet, and K. Yokoi, *Dynamic lifting by whole body motion of humanoid robots*, Conference Proceedings IEEE/RSJ International Conference on Intelligent Robots and Systems, 2008, pp. 668-675.

[20] M. Brady, *op.cit*., p. 49.

[21] J. A. Perez, F. Deligianni, D. Ravi and G. Z. Yang, *op. cit*., p. 24.

[22] M. Brady, *op.cit*., p. 49.

[23] J. A. Perez, F. Deligianni, D. Ravi and G. Z. Yang, *op. cit*., p. 24.

The intent of HCI is to enhance the robotic perception in terms of understanding human activities[24], emotions[25], non-verbal communications[26] and ultimately enabling artificial agents to navigate through a complex environment along with humans[27].

Instead, the field of cognitive robotics aims to equip robots and software agents with high-level cognitive functions such as reasoning over actions, goals and environments, as well as behaviour planning[28] through autonomous learning abilities. Knowledge shall be acquired from sophisticated levels of perception based on imitation and experience[29]: cognitive robots must be able to reason about goals, space, events, actions and time; what to look for in the cognitive states of other agents; explain observations; perform tasks[30].

In conclusion, robotic artificial agents usually overlap with the field of AI since the latter would grant the former the ability to go further than performing pre-defined tasks, the long-term goal being acting similarly to humans[31]. We may "be misled if we insist on too sharp a distinction between robotics and AI fields, because we do not yet know all the ways that technology will be developed and deployed"[32].

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[24] M. ASADA, *Towards artificial empathy*, vol. 7, International Journal of Social Robotics, 2015, pp. 19-33.

[25] L. ZHANG, M. JIANG, D. FARID, and M. A. HOSSAIN, *Intelligent facial emotion recognition and semantic-based topic detection for a humanoid robot*, vol. 40(13), Expert Systems with Applications, 2013, pp. 5160-5168.

[26] N. MAVRIDIS, *A review of verbal and non-verbal human–robot interactive communication*, vol. 63(1), Robotics and Autonomous Systems, 2015, pp. 22-35.

[27] T. KRUSE, A. K. PANDEY, R. ALAMI, and A. KIRSCH, *Human-aware robot navigation: A survey*, vol. 61(12), Robotics and Autonomous Systems, 2013, pp. 1726-1743.

[28] M. BHATT, E. ERDEM, F. HEINTZ and M. SPRANGER, *Cognitive robotics*, vol. 28(5), Journal of Experimental & Theoretical Artificial Intelligence, 2016, pp. 779-780.

[29] J. A. PEREZ, F. DELIGIANNI, D. RAVI and G. Z. YANG, *op. cit*., p. 24.

[30] M. BHATT, E. ERDEM, F. HEINTZ and M. SPRANGER, *op.cit*., p.780.

[31] C. CEVENINI, *Agenti software e sistemi multi-agente: profili tecnico giuridici,* in *Manuale di informatica giuridica,* edited by M. DURANTE and U. PAGALLO*,* Utet giuridica, 2012, p. 117.

[32] J.M. BALKIN, *The Path of Robotics Law,* vol. 6, California Law Review Circuit, 2015, p. 51.

## 1.2. Autonomous Robots: what does autonomy mean?

It is necessary, for the purpose of this work, to narrow down the category of robots: consideration will be given only to autonomous and cognitive agents.

Therefore, a clear statement on what we consider 'autonomy' is of utmost importance since the term is strictly connected to an advanced and complex form of control systems aimed at removing the dependency on human intervention. When compared to other forms of control, such as a tele-operated system, which still relies on a human operator both for the acquisition of data and the decision-making process, an autonomous system acquires inputs and makes decisions by its own in the environment where it has been placed[33].

The field of robots is not exempt from 'anthropomorphism'. Robots are given human characteristics with a view to helping us rationalize a situation: anthropomorphic activity helps us to deal with not familiar situations and intangibles[34].

Anthropomorphism could be responsible for augmenting the level of users' expectations towards the actual capabilities of an autonomous robot, or for making them believe that autonomous robots are truly technologically independent i.e., having a "will of their own": in this sense, there is a real risk of overconfidence of the AI-Robotic field, generated by its own storytelling. Therefore, anthropomorphism may risk to foster, especially from the user perspective, a generalized understanding which seemingly ignore that robots are animated by mysterious mechanisms, or even 'souls', but are rather deterministic, moved by causal links, which have been programmed by human beings.

Nonetheless, this argument may be true if the system under investigation is intended as a tool and not when the effort is to

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[33] C. Leroux, R. Labruto, C. Boscarato, F. Caroleo, J. Günther, S. Löffler, F. Münch, S. Beck, E. May, C. Huebert-Saintot, M. de Cock Buning, L. Belder, R. de Bruin, A. Bonarini, M. Matteucci, P. Salvini, B. Schafer, A. Santosuosso, E. Hilgendorf, *Suggestion for a green paper on legal issues in robotic,* 2012, p. 11.

[34] B.R. Duffy, *Anthropomorphism and the Social Robot,* vol. 42(3-4), Robotics and Autonomous Systems, 2003, p.180.