



Social Robotics

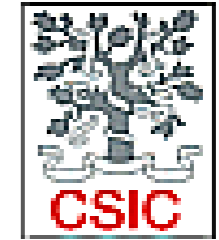
Research, Ethics and Education

Carme Torras @



What future for European Robotics?

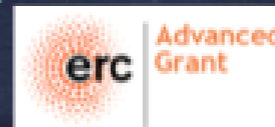
Affiliation: Institut de Robòtica i Informàtica Industrial
Research group: Assistive Robotics + AI



Assisted living facility

CLOTH manipulation Learning
from DEMonstrations

CLOTHILDE



Outline

1. From standalone robots to **robots-interacting-with-people**

2. Research challenges

- Usability
- Uncertainty
- Understanding

3. Ethics implications

- Regulations and standards
- **Education initiatives** based on science fiction

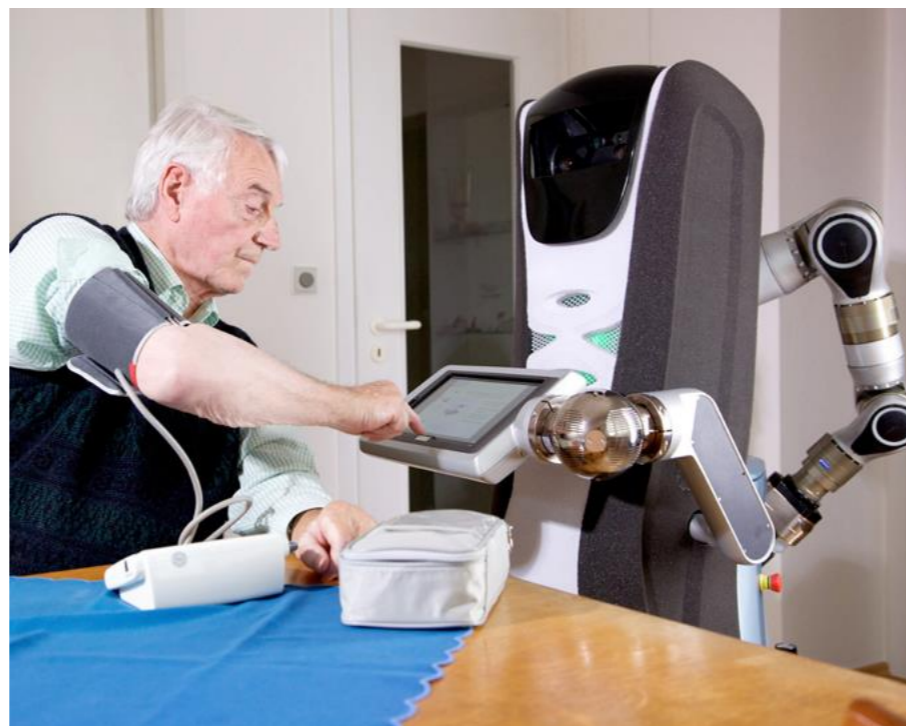
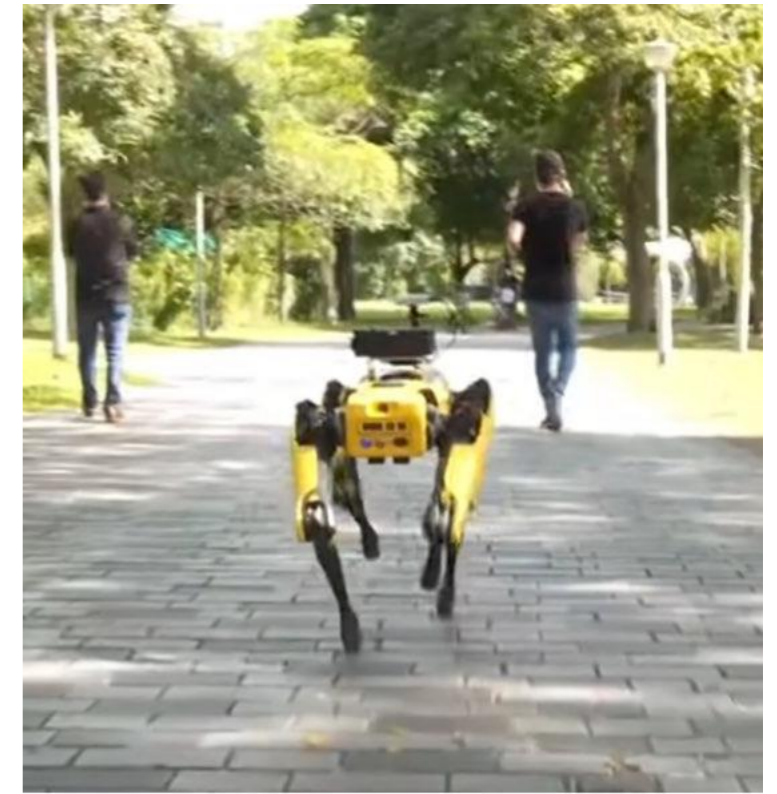
From standalone robots...



to... robots interacting with people



but the pandemics has shown...



but the pandemics has shown...

Most deployed robots

- still work in a **standalone way**, without interacting, or
- the **interaction is verbal** and does not entail manipulation, or
- the **manipulation is limited** and without contact with people, or
- the **manipulation entailing contact is very specific**, non versatile.

The robotics community would have liked **robots to be more useful in preventing the exposure of healthcarers to the virus.**

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Research challenges



of AI research in Robotics

- Easy to use by non-experts
- Intrinsically safe for people
- Able to perceive and manipulate non-rigid objects
- Tolerant to noisy perceptions and inaccurate actions
- Capable of goal-driven execution
- Collaborating with people

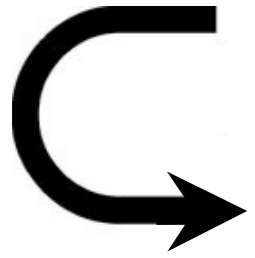
Usability

Uncertainty

Understanding

Usability

Easy instruction and usage by non-experts



Exhaustive **programming** taking into account all situations

Learning from **demonstration** (+ **reinforcement** learning)

Usability

Learning from demonstration



Usability

Learning from demonstration and reinforcement



A. Colomé and C. Torras. Dimensionality reduction for dynamic movement primitives and application to bimanual manipulation of clothes. *IEEE Transactions on Robotics*, 34(3): 602-615, 2018.

Uncertainty

Tolerant to noisy perceptions and inaccurate actions



High-resolution perception & **Accurate** manipulation planning

Task-oriented perception & **Probabilistic** planning

(+ **Adaptability** to the user and situation **through interaction**)

Uncertainty

Task-oriented perception and probabilistic grasp planning



P. Jiménez, C. Torras. Perception of cloth in assistive robotic manipulation tasks. *Natural Computing*, 19(2): 409-431, 2020.

J. Borràs, G. Alenyà, C. Torras. A grasping-centered analysis for cloth manipulation. *IEEE Trans. on Robotics*, 36(3): 924-936, 2020.

Uncertainty

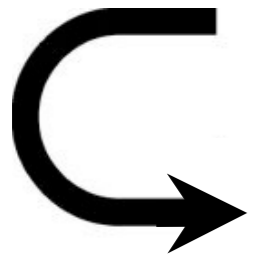
Adaptability to the user and the situation through interaction



G. Canal, E. Pignat, G. Alenyà, S. Calinon and C. Torras. "Joining high-level symbolic planning with low-level motion primitives in adaptive HRI: application to dressing assistance", *IEEE Intl. Conf. Robotics and Automation (ICRA)*, Australia, pp. 3273-3278, 2018.

Understanding

From associations to situated reasoning and communication



Associative learning (perception \longrightarrow motion)

Goal-driven execution + **personalization**

Building a **user model** + human in the loop

Understanding

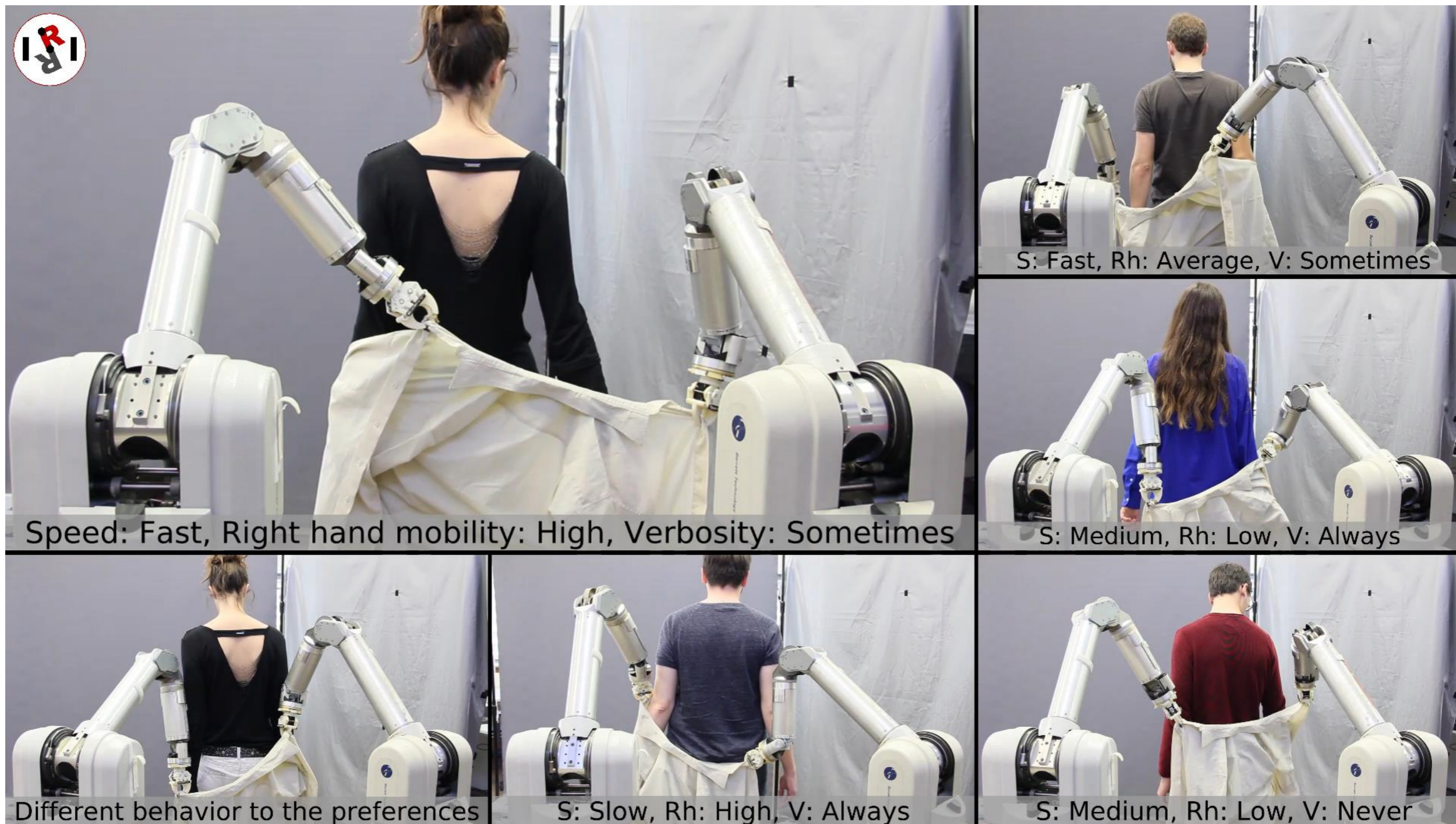
From associations to goal-driven execution



G. Canal, G. Alenyà and C. Torras. Personalization framework for adaptive robotic feeding assistance, *8th International Conference on Social Robotics*, Kansas City, USA, pp. 22-31, 2016.

Understanding

From associations to goal-driven execution



G. Canal, G. Alenyà and C. Torras. A taxonomy of preferences for physically assistive robots, **26th IEEE International Symposium on Robot and Human Interactive Communication**, Portugal, pp. 292-297, Lisbon, Portugal, 2017.

Understanding

Learning to engage the user + caregiver in the loop



A. Andriella, C. Torras and G. Alenyà. Cognitive system framework for brain-training exercise based on human-robot interaction. *Cognitive Computation*, 12: 793-810, 2020.

D. Martínez, G. Alenyà and C. Torras. Relational reinforcement learning with guided demonstrations. *Artificial Intelligence*, 247: 295–312, 2017.

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Ethical and social implications

Assistive robots & AI

Issues shared with other technologies:

- incidence on the job market
- legal liability
- privacy
- digital gap
- ...

New issues in entering the domains of:

- **communication**
- **decision making**
- **feelings & relationships**
- **human enhancement**

Roboethics: subfield of applied ethics studying both the **positive and negative** implications of Robotics/AI **for individuals and society.**

1. **Human ethics** applied to robotics/AI
2. Codes of ethics embedded in the robots/programs themselves
(“**machine ethics**”)

Roboethics

Regulations and standards

2017

Barcelona Declaration

for the proper development and usage of AI in Europe

Montreal Declaration

for the responsible development of AI



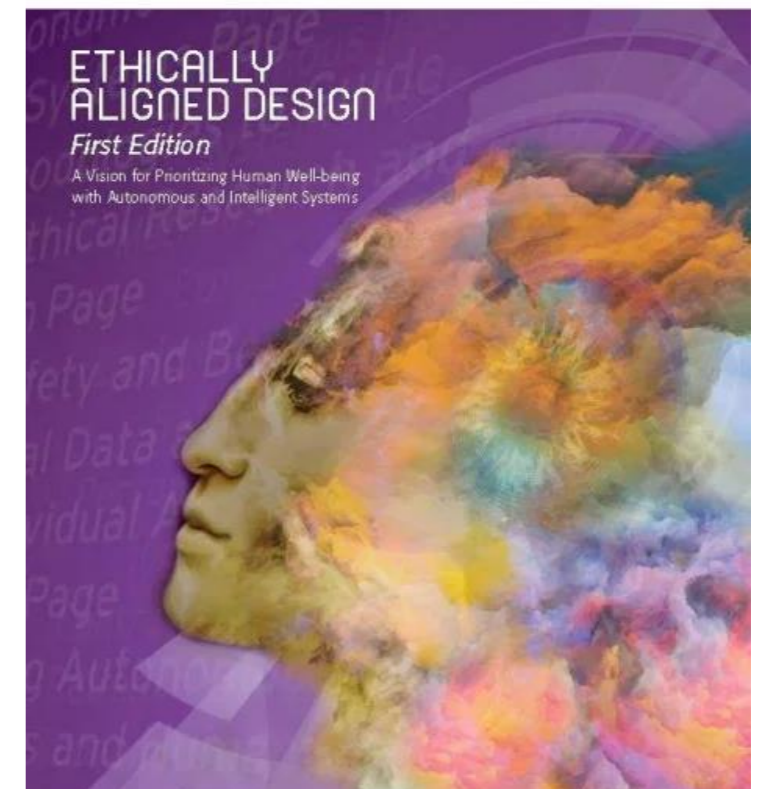
Civil Law Rules on Robotics

2018



Ethics Guidelines for Trustworthy AI

2020



Ethically Aligned Design



Roboethics

Education and dissemination

A Cooperative Project of



Association for
Computing Machinery

Advancing Computing as a Science & Profession



IEEE

IEEE
computer
society

The [ACM/IEEE Computer Science Curricula](#) consists of 18 knowledge areas, one of which is: “Social Issues and Professional Practice” that includes courses on **Ethics in Technology, Professional Ethics, Society and Technology**, and the like.

- Philosophical textbooks and papers
- Classical science fiction readings



“By making ethical reasoning a central element in the curriculum, students can learn to think not only about what technology they could create, but also whether they should create that technology.” [Barbara J. Grosz, 2019]

Role of Science Fiction

Ethics education in Computer Science and Engineering

1. Anticipate possible future scenarios

2. Engage technology students



“What SF stories can do better than almost anything else is to provide not just an idea for some specific technical innovation, but also to supply a coherent picture of that innovation being integrated into a society, into an economy, and into people’s lives.”

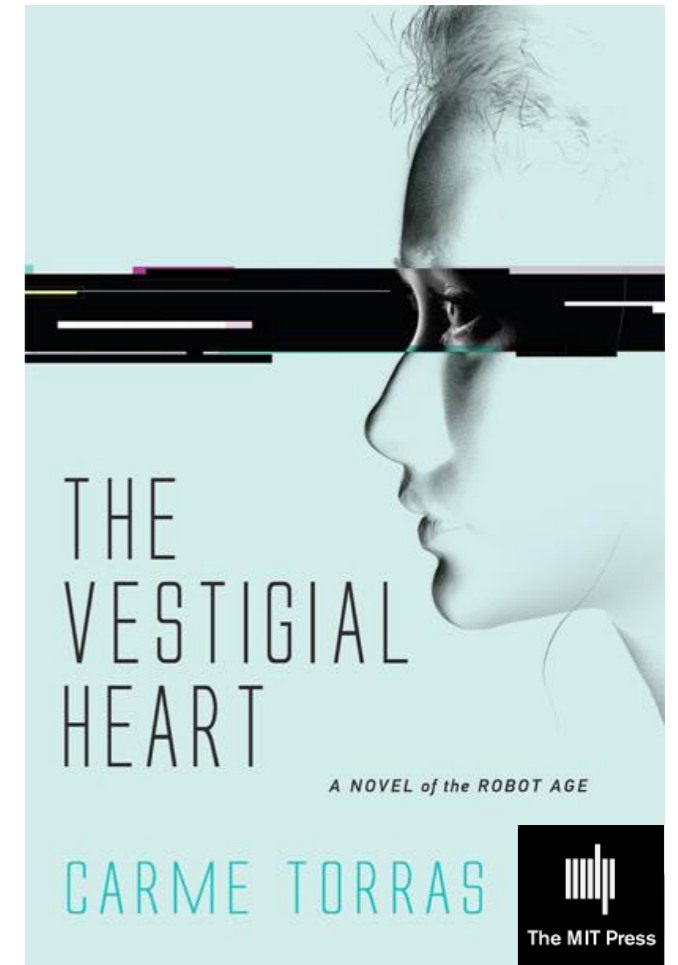
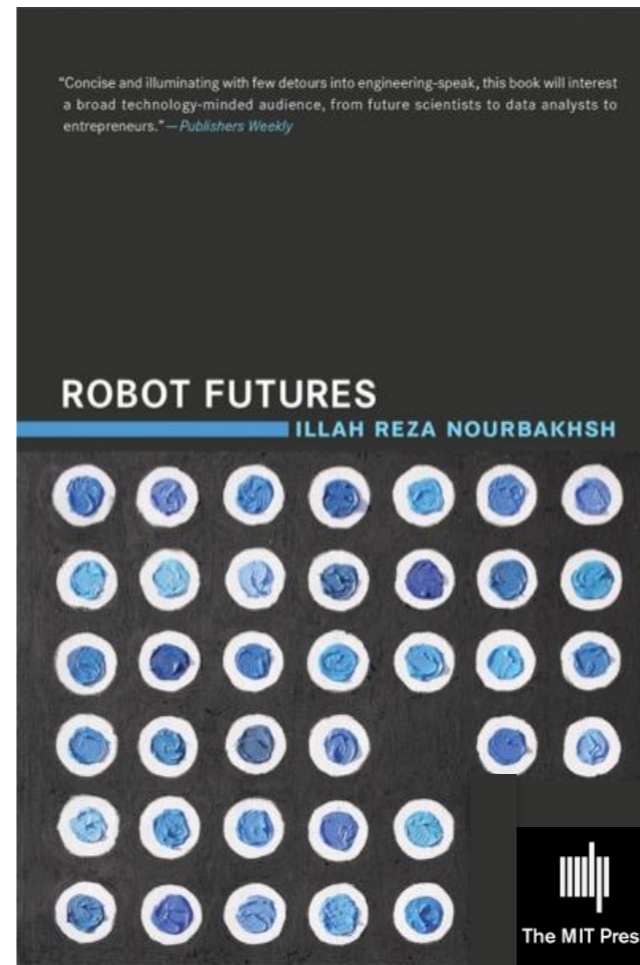
[Neal Stephenson, 2011]



“Using fiction to teach ethics allows students to safely discuss and reason about difficult and emotionally charged issues without making the discussion personal.”

[Judy Goldsmith, 2018]

Ethics education and dissemination based on science fiction



“It is the relationships that we have constructed which in turn shape us”

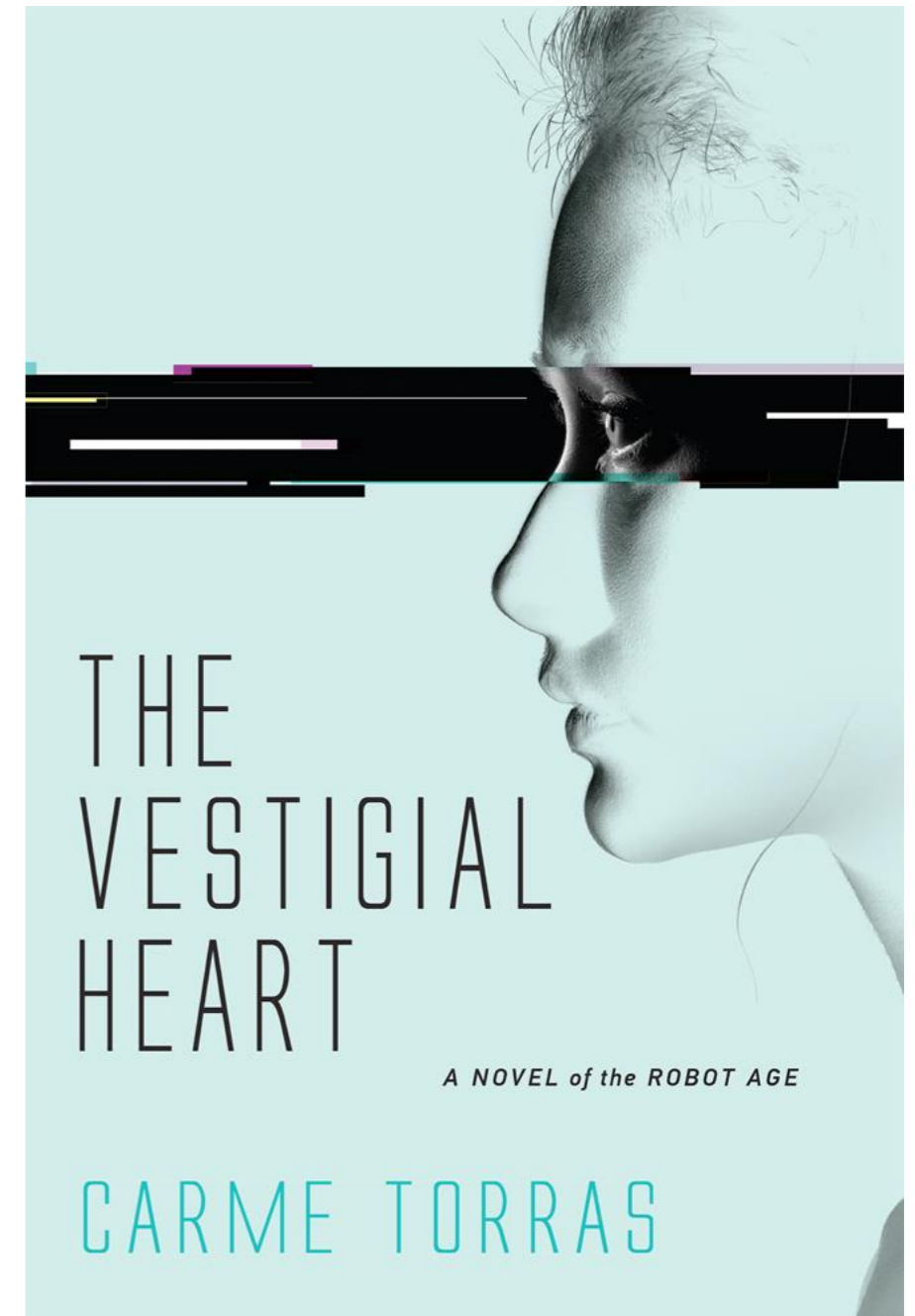
Robert C. Solomon

“The Passions”

Course on Ethics in Social Robotics and AI

Four items:

- A **novel** about a future society in which people rely on personal-assistant robots to navigate daily life.
- An **appendix** with 24 ethics questions raised by the novel, as well as hints to trigger a debate.
- An **online teacher's guide** for 6-8 sessions on "Ethics in Social Robotics and AI" following the chapters in the novel and including scholarly references for further reading.
- A **100-slide presentation** that teachers can use and extend as desired.



<https://mitpress.mit.edu/books/vestigial-heart>

Teaching materials

Ethics in Social Robotics and AI

0. Overview and background
1. **Designing** the “perfect” assistant
2. Robot **appearance** and emotion
3. Robots in the **workplace**
4. Robots in **education**
5. Human-robot **interaction** and human dignity
6. Social **responsibility** and robot morality
7. Bibliography and initiatives to follow up



Teaching materials

Ethics in Social Robotics and AI

5. Human-robot interaction and human dignity

5.1. Highlights from *The Vestigial Heart*

5.2. Ethical Background and Discussion:

- Four questions
- Hints for a debate on each question

5.3. Revisiting Issues

5.4. Scholarly References for Further Reading



Human-robot interaction and human dignity

5.2. Questions

5.A - Could robot decision-making undermine human freedom and dignity?

5.B - Is it acceptable for robots to behave as emotional surrogates? If so, in what cases?

5.C - Could robots be used as therapists for the mentally disabled?

5.D - How adaptive/tunable should robots be?
Are there limits to human enhancement by robots?



C. Torras. Assistive robotics: Research challenges and ethics education initiatives. *DILEMATA: International Journal of Applied Ethics*, 30: 63-77, 2019.



Amazing future perspectives

What role will the **human** and the **robot** play in this “pas de deux” in which we are irremissibly engaged?