Robotics and Autonomous Systems

Lecture 15: Robotics applications and challenges

Richard Williams

Department of Computer Science
University of Liverpool

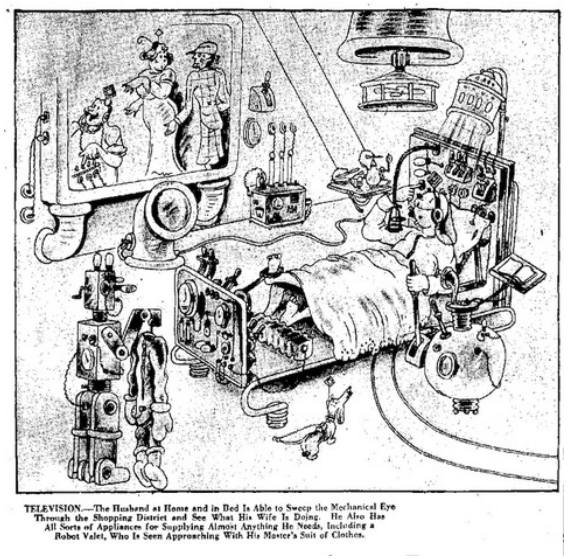
UNIVERSITY OF LIVERPOOL

Where are the robots?

Not just a slogan, but of course there is a t-shirt.

- www.noslogan-tees.com

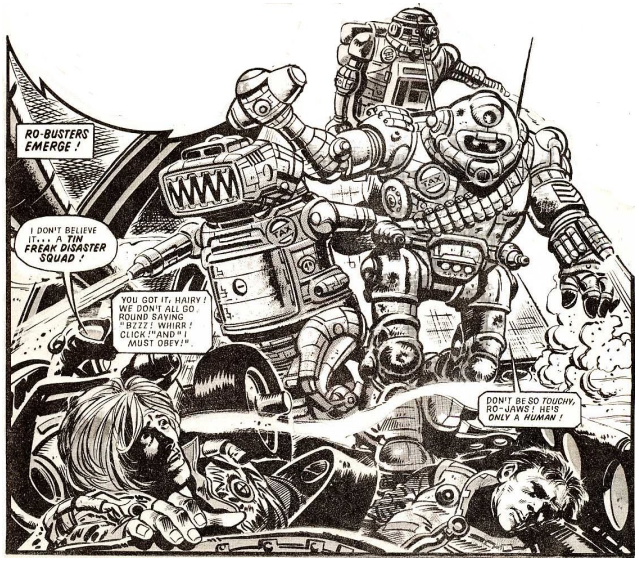
Where are the robots?



TELEVISION.—The Husband at Home and in Bed Is Able to Sweep the Mechanical Eye Through the Shopping District and See What His Wife Is Doing. He Also Has All Sorts of Appliances for Supplying Almost Anything He Needs, Including a Robot Valet, Who Is Seen Approaching With His Master's Suit of Clothes.

- 1932, www.paleofuture.com

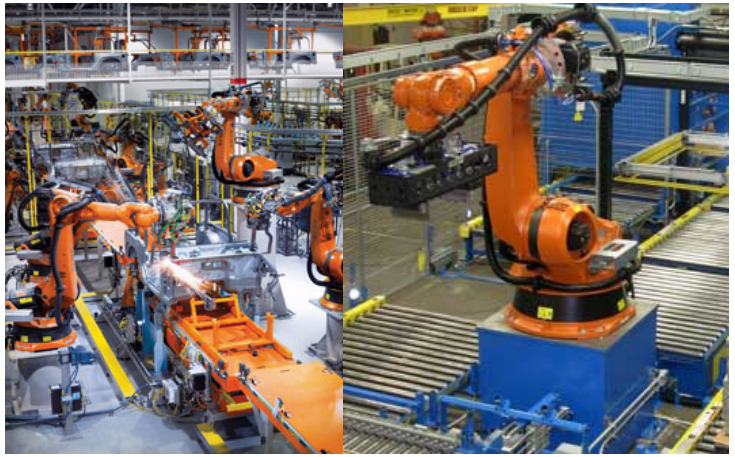
Where are the robots?



- Pat Mills, patmills.files.wordpress.com

Where are the robots?

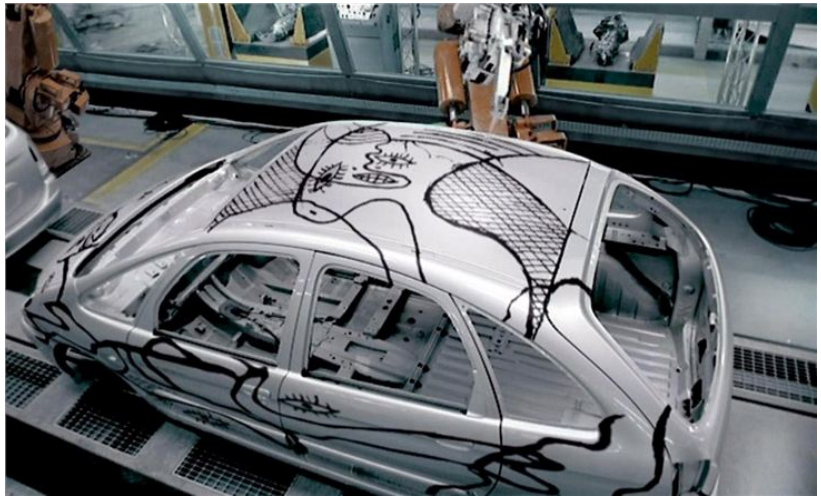
Industrial robots are old hat



Industrial robots are old hat

- 1979

Industrial robots are old hat



Though there is a new spin

What do we have in mobile robots?

- Some products that are successful.
  - Clearly work.
  - Financially successful
- Some that are close to emerging.

iRobot Roomba

Successful robotic vacuum cleaner

6 million sold by mid 2011

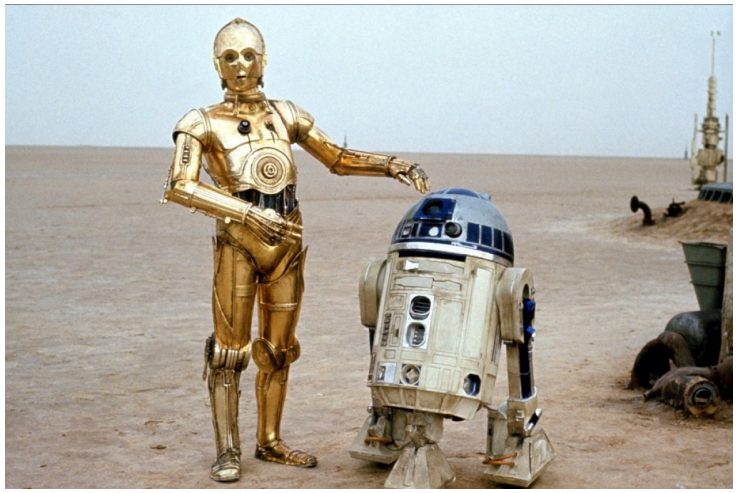
Google Car

- The only real roadblock to deployment is legislation.

Big Dog

- Still under-development, but expect to see it deployed.

But what about C3P0?

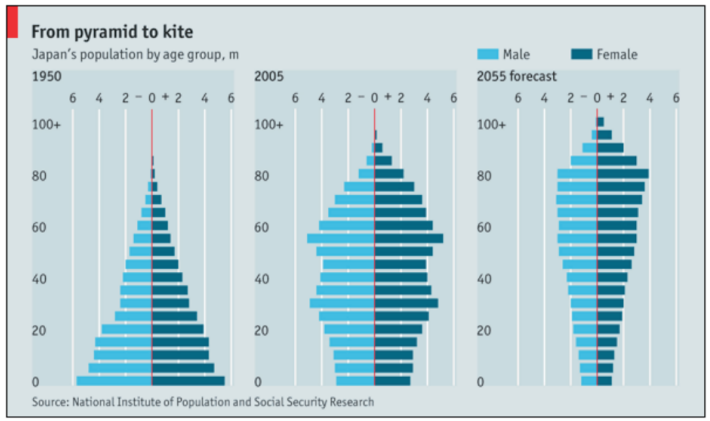


- Is the dream of the robot butler lost?

Humanoid robots

- In Japan, in particular, there is a lot of interest in human-like robots.

Humanoid robots

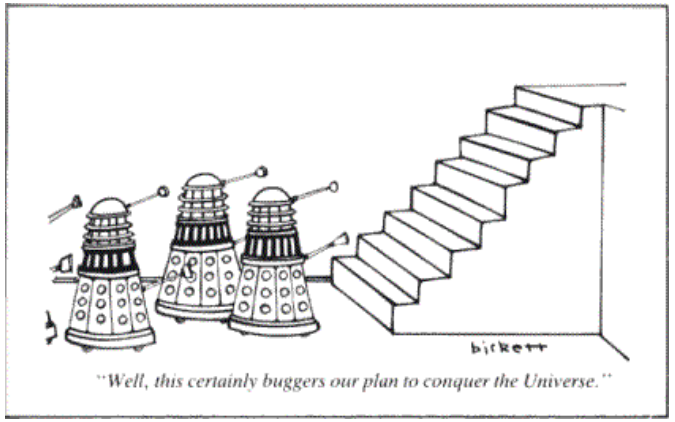


- Why?

Eldercare


- Humanoid robots are a good fit for human environments.

Eldercare



- Peter Birkett

Eldercare

- Much more that can be done in eldercare.
- Robot technology, rather than robotics, can increase the independence of older people.
- Help needs to be balanced with privacy.

Humanoid robots

- Kawada HRP3, capable of complex manipulation tasks

Humanoid robots

- Yaskawa Motoman SDA10 is similarly capable.

And, of course

- The PR2 can famously fold laundry.

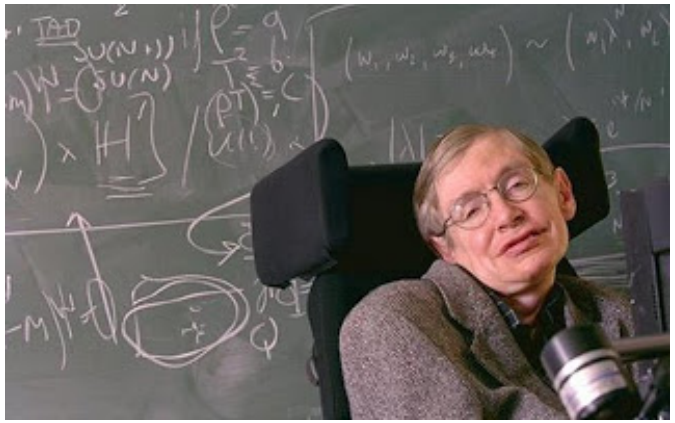
Humanoid robots

- Increasingly robots can take on tasks that currently require humans.
- Prototypes cost hundreds of thousands of dollars.
  - PR2 cost is $\approx \$400,000$
- Will costs fall?

Mobile, dual-manipulator platforms

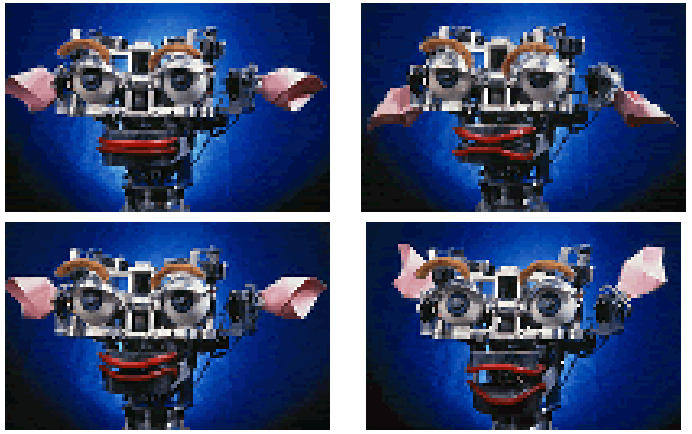
Also along this line

- How can we get robots to interact better with people.



- Emotion
- Expressiveness.

Kismet

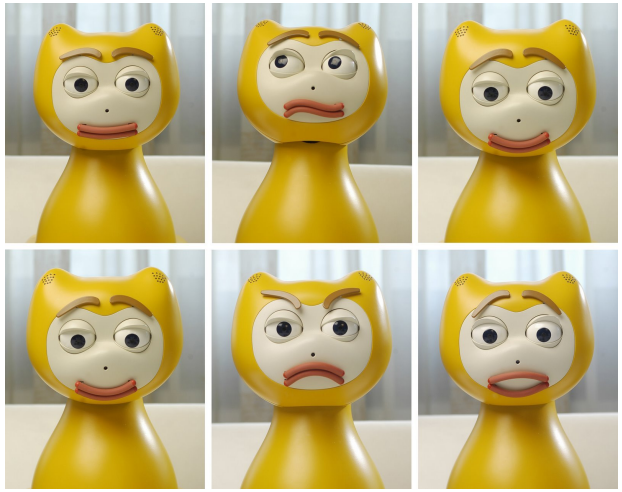


- Kismet was designed to study the expression of emotion, an important aspect of human-robot interaction.

Leonardo

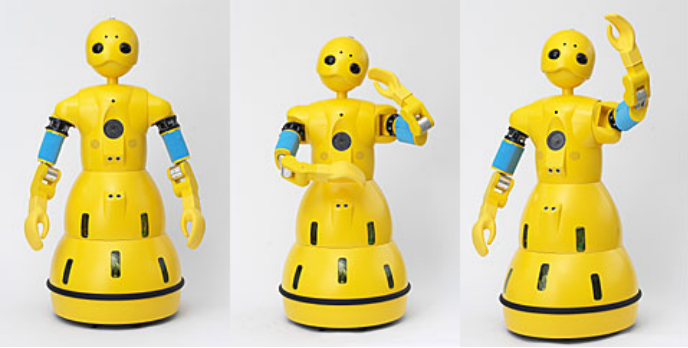
- Leonardo is a move towards a complete expressive robot.

iCat



- iCat is a commercially available platform for this kind of research.

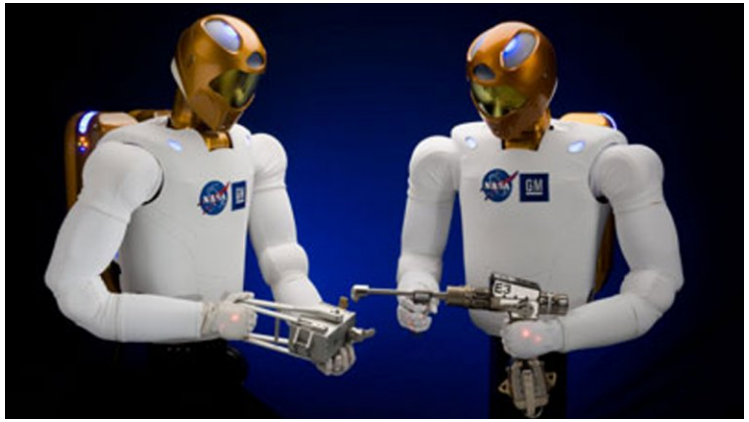
Wakamuru



- Wakamuru is an early attempt to sell such robots to a wider audience.

Wakamuru in Uniqlo

Robonaut

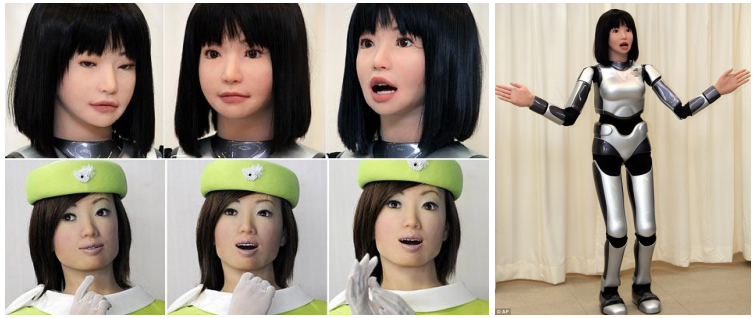


- NASA built Robonaut to demonstrate the usefulness of this kind of robot in space.

Humanoid robots

- Seems like that robots will get more human over time.

Humanoid robots



- Frankly, the results are a bit weird at times.

Search and Rescue

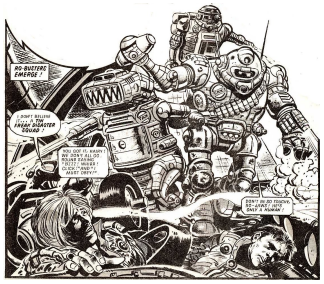
- Send robots into places that are dangerous for humans.

Search and Rescue

- Following the Fukushima nuclear accident

Search and Rescue

- A long way to go before robots can operate in this scenario autonomously.

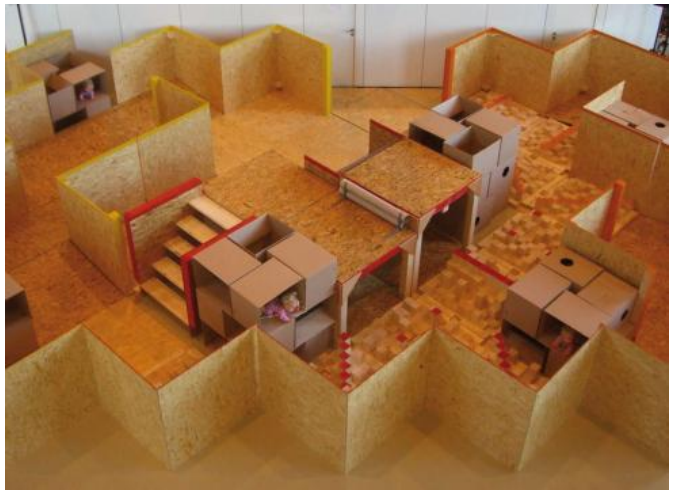


- Problems that are hard for robots in structured environments are much harder in unstructured environments.
- Map-building.

Robocup Rescue

- Standard test arena

Robocup Rescue

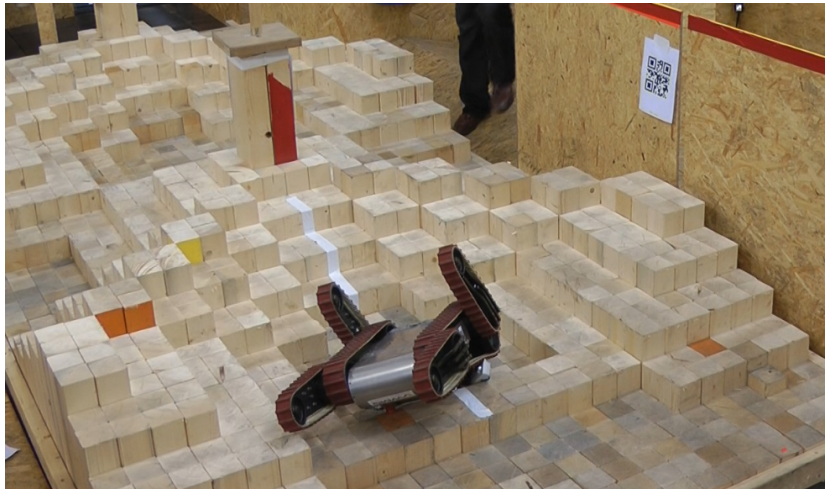


- Colour-coded areas of graded difficulty.

Robocup Rescue

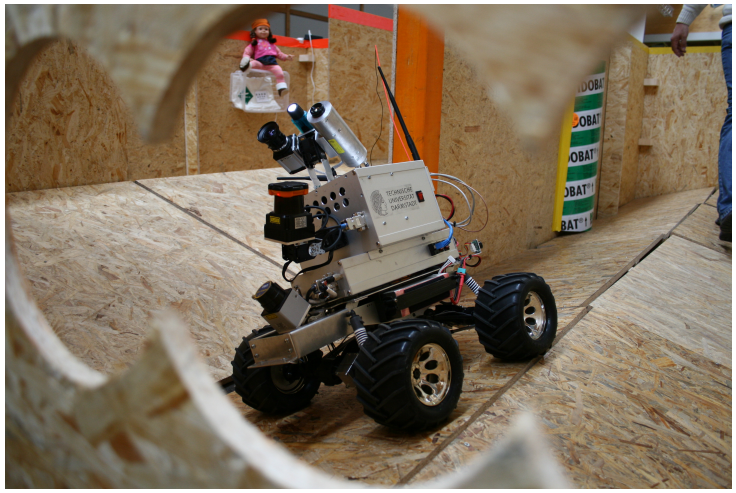
- Colour-coded areas of graded difficulty.

Robocup Rescue



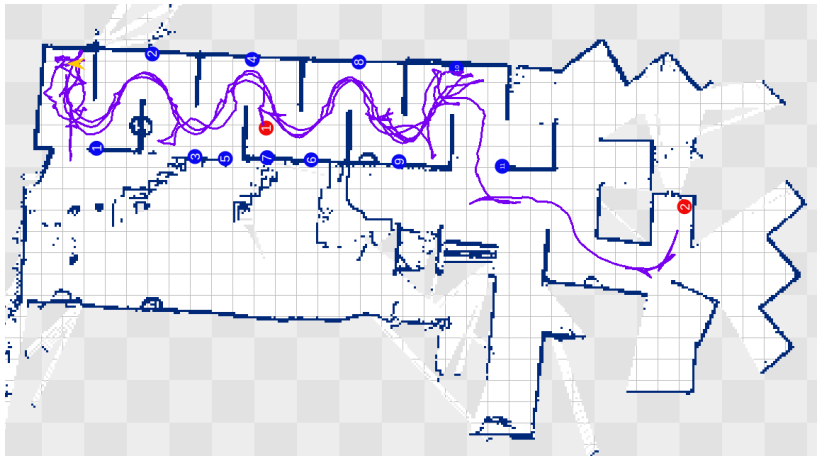
- Big test of robot agility.

Robocup Rescue



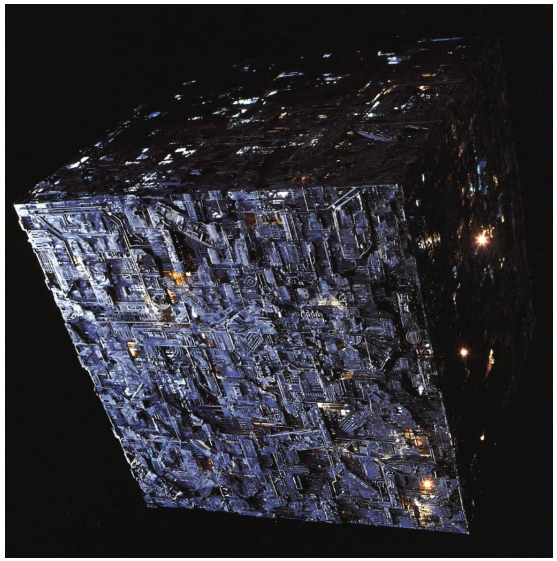
- Robot from TU Darmstadt.

Robocup Rescue

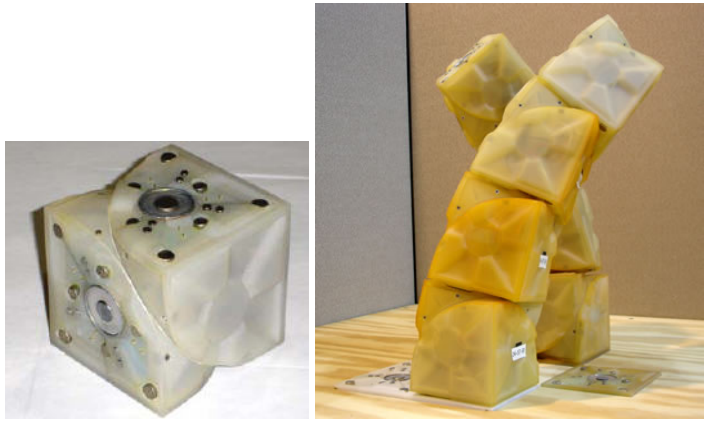


- Current robots don't just traverse the space.

Self-replicating robots



Self-replicating robots



Self-replicating robots

- From the lab of Hodd Lipson at Cornell.

Robot Ethics

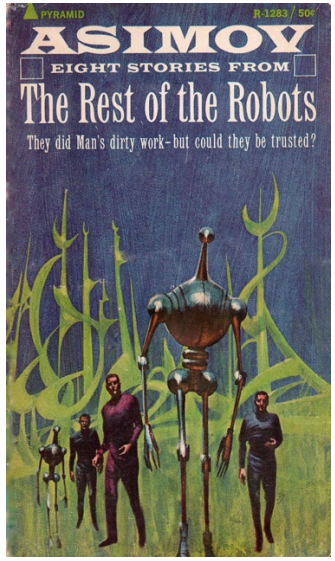
- Increasingly the limits of robotics are defined by what robots should do rather than what they can do.
- (Though lots of technical problems still need to be solved)
- Robot ethics is becoming important.

Robot Ethics

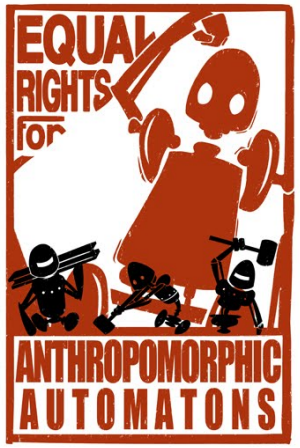
- Especially important given the domains some robots will operate in.

Robot Ethics

- Haven't got much further than Asimov's three laws.



Robot Rights



- `www.aspcr.com`
- “Robots are people too. Or at least they will be.”

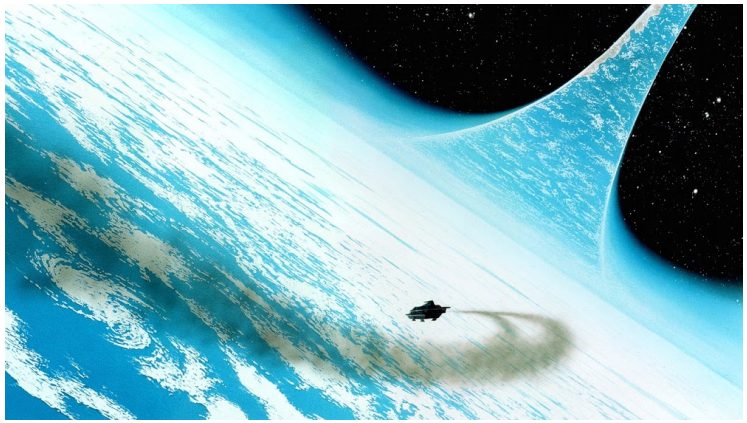
Robot Rights

Robot Rights

Robot Rights

Robot Rights

Robot Rights



- Iain Banks

Summary

- Today rounded out the robotics section of this module by looking at some of the open issues in robotics.
- We looked at three lines of research.
  - Humanoid/social robots.
  - Robot search and rescue
  - Robots and the law.

- The first two are places where we can expect applications and products.
- The last needs a lot of development before robots walk among us.