Robo*cs | Ethics

What is Ethics?
• Moral principles that govern a person’s or group’s behavior
• What is right and wrong behavior?
• Golden Rule
  – One should treat others as one would like others to treat oneself.
• Human rights
  – How should societies treat one another?

Ethics in science in general
• What is right and wrong behavior for scientists?
• What must be considered when assessing the ethics of scientific research?
  – The consequences for human research subjects
  – The intended and unintended uses of the research?
  – The source of funding for the research?

Human Research Protections
• Historical background
  – Nazi experiments on prisoners
  – Nuremberg war crimes trials
  – Tuskegee experiments
• Requirements for research on humans
  – Minimize harm
  – Informed consent
  – Protected populations: prisoners, children, mentally incompetent

Do Animals Have Rights?
• If so, what rights?
• Which animals?
  – Chimps (lab closures)
  – Dolphins (in defense of dolphins)
  – Cats and Dogs
  – Cows, chickens, rats, birds, reptiles, octopi?
  – Mosquitos, bacteria?
• Do animals have responsibilities?

DoD Funded Research?
• Great contributions: AI, internet
• Not for everybody – not Ben Kuipers
  – A researcher must decide “what my research life is for, and who I am willing to have pay for it.”
  – “the goal of the military is to settle international conflict through violence.”
  – There are ” signs that the professional military is reaching a clearer understanding than civilian policy-makers of the weaknesses of violence, and the strengths of non-violent approaches to conflict resolution.”
Robots and Society

Why Robotics is HOT now

1. Sensors, effectors, and bodies are becoming very sophisticated. We are creating the most complex robots yet, with bodies that mimic biological form and attempt to model biological function.
2. Computers are faster and cheaper than ever before. This means robot brains can be more sophisticated than ever, allowing them to think and act efficiently in the real world.
3. Wireless communication is everywhere. This means robots can communicate with other computers in the environment, so they can be better informed, and therefore smarter.

Robotics in the Present

- Factory Automation
  - Genetic research (scientific breakthroughs)
  - Auto factory (job losses)
- Consumer Robotics
  - Roomba (important because of mass exposure)
- Robotic vehicles

Mars Rover Control:

a really challenging problem of temporal coordination

Playing with rover in the “sand box”

Hard and soft technologies: Scientific Operations Meeting
Working on Rover time
The activity of the rovers is synchronized with the Martian day/night cycle.
Scientists working with a rover get up and go to bed on a Martian schedule.
The Martian day is 24 hours plus 39 minutes (earth time) long.
This means that after three weeks, Martian sunrise, for example, has moved 13.65 earth hours.
A scientist who started out getting up at 8am (PST, in Pasadena), will be getting up a bit before 10 pm three weeks later.
Some scientists commissioned the construction of special “Mars Time” watches.

Two Rovers, Three time frames
• Spirit is in Gusev Crater
• Opportunity is on Meridiani Planum.
  – That is about half a revolution or 12hr19min (earth time) away.
• So, even if you are on Mars time, there is a different Mars time for the two Rovers.
• Most scientists work with only one rover team, but some work with both.
• Some scientists were observed wearing THREE watches. One for each rover and one for California’s time zone on earth.

Adapting the technology
• Special purpose watches
• Heavy blinds
• Rest facilities
• Food service

Science is hard (but we love it!)

Human-Robot Interaction
• Problems
  – facial recognition
  – facial expression recognition
  – language understanding
  – intent inferencing
  – proxemics
  – mood sensing

Assistive Robotics
• Assistive robotics refers to robot systems capable of helping people with special needs, such as individuals convalescing from an illness, needing rehabilitation following an accident or trauma, learning or training in a special setting, or aging at home or in a managed care facility.
Ethical Implications

• Safety
• Privacy
• Attachment
• Trust
• Accountability!

The Future of Robotics?

• Autonomous cars
  – http://www.nytimes.com/2013/05/31/technology/self-driving-cars-for-testing-are-supported-by-us.html?pagewanted=1&hpw
  – Reinventing the aircraft wheel
• Robotic weapons systems
  – UN resolution on lethal robots
  – http://www.nytimes.com/2013/05/31/world/europe/united-nations-armed-robots.html?_r=0

Autonomous Automobiles

http://recode.net/2014/05/27/googles-new-self-driving-car-ditches-the-steering-wheel/

Aircraft Automation

• Crew requirement
  – Pilot
  – Copilot
  – Flight engineer
  – Navigator
  – Radio operator

Modern airplanes as robotic systems

• Systems management
  – Pressurization
  – Fuel
  – Toilets
• Autoflight
  – Speery autopilot (1914)

Autoflight

• Sensors
  – Airspeed, AoA, barometric pressure, temperature
  – IRU, GPS.
• Effectors
  – Rudder, Ailerons, elevator, pitch trim, thrust, speed brakes and wheel brakes (on landing)
• Processor
  – Flight Management Computer System (FMCS)
• Interfaces
  – MCP, CDU ...
Complex control loop

• Sensors, set points, effectors. PID controllers.
• Set points. Route specification, performance factors. Constraints on set points.
• Planning in advance to avoid situations where the control system cannot achieve desired goals.
• Descent planning. Top of descent determination.
• Autoland, Auto-Go-Around.

Automation Philosophies: Airbus vs Boeing

Airbus
• Humans make mistakes, they get tired, automation does not.
• Hard flight envelope protections: PALS
• Pitch, Angle of Attack, Load, Speed

Boeing
• Authority must be commensurate with authority.
• Bend the airplane if necessary.
• Soft flight envelope margins

Automation assisted aviation accidents

• American Airlines at Cali, Columbia
• Air Inter at Strausbourg, France
• Air China at Nagoya
  – Airbus A300 on final approach
  – FO flying
  – FO inadvertently touches the switch on thrust levers to activate Go-Around mode
  – Airplane (robot) begins the go-around maneuver
    • Takeoff thrust
    • Pitch up by changing trip of the horizontal stabilizer.
  – Pilot fights the autopilot, pushing the stick forward (elevator control) to stay on the glide path and pulling the thrust levers back to reduce speed.

The outcome

– Pilot is flying away from the specified flight path
– Autopilot wins!
  • Horizontal stabilizer has more aerodynamic force than elevator.
  • Airplane pitches up
  • Airplane Stalls (loss of lift on the wings)
  • Falls out of the sky

Who should be held responsible?

– The pilots? For making the mistakes that killed them (and their passengers)
– The airline (Air China)? For failing to properly train the pilots and working them too hard.
– The maker of the airplane (Airbus)? For selling an unsafe product.
– The designer of the user interface? For making an interface that allowed the action slip.
– The engineer who wrote the autoflight code?
– The autopilot robot for fighting the pilot?
Asimov’s three rules

1. A robot may not injure a human being or, through inaction, allow a human being to come to harm.
2. A robot must obey the orders given to it by human beings, except where such orders would conflict with the First Law.
3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws.

Three levels of autonomy in weapons systems

- **Human-in-the-Loop Weapons**: Robots that can select targets and deliver force only with a human command;
- **Human-on-the-Loop Weapons**: Robots that can select targets and deliver force under the oversight of a human operator who can override the robots’ actions; and
- **Human-out-of-the-Loop Weapons**: Robots that are capable of selecting targets and delivering force without any human input or interaction.

The appeal of robotic weapons

- Militaries value these weapons because they require less manpower, reduce the risks to their own soldiers, and can expedite response time.

Losing Human Judgment

“fully autonomous weapons would lack the human qualities necessary to meet the rules of international humanitarian law. These rules can be complex and entail subjective decision making, and their observance often requires human judgment.”

Losing the protection of human compassion

- “Robots would not be restrained by human emotions and the capacity for compassion, which can provide an important check on the killing of civilians.”

Reducing the cost of war

- “Second, although relying on machines to fight war would reduce military casualties—a laudable goal—it would also make it easier for political leaders to resort to force since their own troops would not face death or injury. The likelihood of armed conflict could thus increase, while the burden of war would shift from combatants to civilians caught in the crossfire.”
Losing accountability

- Finally, the use of fully autonomous weapons raises serious questions of accountability, which would erode another established tool for civilian protection. Given that such a robot could identify a target and launch an attack on its own power, it is unclear who should be held responsible for any unlawful actions it commits. Options include the military commander that deployed it, the programmer, the manufacturer, and the robot itself, but all are unsatisfactory.

- Can a robot be punished?

Recommendations to states

- Prohibit the development, production, and use of fully autonomous weapons through an international legally binding instrument.
- Adopt national laws and policies to prohibit the development, production, and use of fully autonomous weapons.
- Commence reviews of technologies and components that could lead to fully autonomous weapons. These reviews should take place at the very beginning of the development process and continue throughout the development and testing phases.

Recommendations to roboticists

- Establish a professional code of conduct governing the research and development of autonomous robotic weapons, especially those capable of becoming fully autonomous, in order to ensure that legal and ethical concerns about their use in armed conflict are adequately considered at all stages of technological development.

A final question

- How will co-existing with robots influence human societies?