Will robots take over the world?

July 30 2013

Robots can do a lot for us: they can explore space or they can cut our toenails. But do advances in robotics and artificial intelligence hold hidden threats? Three leaders in their fields answer questions about our relationships with robots.

The origins of robotics go back to the automata invented by ancient civilisations. The word robot entered our vocabulary only in 1920 with Czech writer Karel ?apek's play R.U.R (Rossum's Universal Robots).

Over the past 20 years robots have been developed to work in settings that range from manufacturing industry to space. At Cambridge University, robotics is a rapidly developing field within many departments, from theoretical physics and computing to engineering and medical science.

Lord Martin Rees is Emeritus Professor of Cosmology and Astrophysics at the University of Cambridge. He holds the honorary title of Astronomer Royal. Lord Rees is co-founder of the Centre for the Study of the Existential Risk, an early stage initiative which brings together a scientist, philosopher and software entrepreneur. Kathleen Richardson is an anthropologist of robots. She took her PhD at Cambridge and recently completed a postdoctoral fellowship at UCL. She is writing a book that explores the representational models used by scientists and how they influence ideas we have about robots as potential friends or enemies. Daniel Wolpert is a Royal Research Society Professor in the Department of Engineering. His expertise lies in bioengineering and especially the mechanisms that control interactions between brain and body. The focus of his research group is an understanding of movement, which he believes is central to all human activities.

What can robots do for us?

Martin Rees: I think robots have two very different roles. The first is to operate in locations that humans can't reach, such as the aftermaths of accidents in mines, oil-rigs and nuclear power stations. The second, also deeply unglamorous, is to help elderly or disabled people with everyday life: tying shoelaces, cutting toenails and suchlike. Moreover, if robots can be miniaturised, they can perhaps be used inside our bodies for monitoring our health, undertaking surgery, and so forth.

Kathleen Richardson: Some of the roles that robots are expected to play are because we cannot do them as humans - for example, to explore

outer space. Space exploration is an area where robots are helpful. Robots can be remote and act as extended 'eyes' for humans, enabling us to look beyond our visual experience into terrains that are inhospitable to us. Other roles that robots are expected to perform are roles that humans can play, such as helping the elderly or the infirm. Unfortunately these roles are not best suited to machines, but to other people. So the question is: why would we prefer a machine do them for us?

Daniel Wolpert: While computers can now beat grandmasters at chess, there is currently no robot that can match the dexterity of a five-year-old child. The field of robotics is similar to where computers were in the 1960s - expensive machines used in simple, repetitive industrial processes. But modern day robotics is changing that. Robots are likely to become as ubiquitous as the smartphone computers we all carry - from microscopic robotics for healthcare and fabrication to human-size robots to take on our everyday tasks or even act as companions.

How soon will machine intelligence outstrip human intelligence?

MR: Up till now, the advances have been patchy. For at least the last 30 years, we've been able to buy for a few pounds a machine that can do arithmetic faster than our brains can. Back in the 1990s IBM's 'Deep Blue' beat Kasparov, the world chess champion. And more recently a computer called 'Watson' beat human challengers in a verbal quiz game on television. But robots are still limited in their ability to sense their environment: they can't yet recognise and move the pieces on a real chessboard as cleverly as a child can. Later this century, however, their more advanced successors may relate to their surroundings (and to people) as adeptly as we do. Moral questions then arise. We accept an obligation to ensure that other human beings, and indeed some animal species, can fulfil their 'natural' potential. So what's our obligation

towards sophisticated robots? Should we feel guilty about exploiting them? Should we fret if they are underemployed, frustrated, or bored?

KR: As an anthropologist, I question the idea of 'objective' human intelligence. There are just cultural measures about what intelligence is and therefore machines could outstrip 'human intelligence'. When that happens will depend on what we decide is the measure of intelligence. Each generation makes a new definition of what it means to be human and what is uniquely a human quality, then a machine comes along and meets it and so many people despair that humanity is on the brink of its own annihilation. This fear of machines is not something inherent in them, it is a consequences of the modes of mimesis (copying and representation) used in the making of robots. This could be seen as a modern form of animism. Animism is a term to describe the personification of nature, but I believe we can apply it to machines. Human beings personify just about everything: we see faces in clouds, mystical impressions in Marmite and robots as an autonomous threat. The human fear of robots and machines arguably has much more to say about human fear of each other rather than anything inherently technical in the machines. However, one of the consequences of thinking that the problem lies with machines is that as a culture we tend to imagine they are greater and more powerful than they really are and subsequently they become so.

DW: In a limited sense it already has. Machines can already navigate, remember and search for items with an ability that far outstrips humans. However, there is no machine that can identify visual objects or speech with the reliability and flexibility of humans. These abilities are precursors to any real intelligence such as the ability to reason creatively and invent new problems. Expecting a machine close to the creative intelligence of a human within the next 50 years would be highly ambitious.

Should we be scared by advances in artificial intelligence?

MR: Those who should be worried are the futurologists who believe in the so-called 'singularity', when robots take over and themselves create even more sophisticated progeny. And another worry is that we are increasingly dependent on computer networks, and that these could behave like a single 'brain' with a mind of its own, and with goals that may be contrary to human welfare. I think we should ensure that robots remain as no more than 'idiot savants' - lacking the capacity to outwit us, even though they may greatly surpass us in the ability to calculate and process information.

KR: We need to ask why fears of artificial intelligence and robots persist; none have in fact risen up and challenged human supremacy. To understand what underscores these fears, we need to understand science and technology as having a particular and exclusionary kind of mimesis. Mimesis is the way we copy and imitate. In creating artificial intelligence machines and robots we are copying the human. Part of what we copy is related to the psychic world of the maker, and then the maker is copying ideas, techniques and practices into the machine that are given by the cultural spirit (the science, technology, and life) of the moment. All these factors are fused together in the making of artificial intelligence and robots. So we have to ask why it is also so frightening to make this copy? Not all fear a robotic uprising; many people welcome machine intelligence and see it as wonderful opportunity to create a new life. So to understand why some fear and some embrace you really have to know what models of mimesis go into the making of robots.

DW: We have already seen the damaging effects of simplest forms of artificial self-replicating intelligence in the form of computer viruses. But in this case, the real intelligence is the malicious designer. Critically,

the benefits of computers outweigh the damage that computer viruses cause. Similarly, while there may be misuses of robotics in the near future, the benefits that they will bring are likely to outweigh these negative aspects. I think it is reasonable to be concerned that we may reach a time when robotic intelligence outstrips humans' and robots are able to design and produce robots more advanced than themselves.

Should robots be used to colonise other planets?

MR: By the end of the century, the entire solar system—planets, moons and asteroids—will be explored and mapped by flotillas of tiny robotic craft. The next step would be mining of asteroids, enabling fabrication of large structures in space without having to bring all the raw materials from Earth. It would be possible to develop huge artefacts: giant telescopes with gossamer-thin mirrors assembled under zero gravity, collectors of solar energy, and so forth. I think this is more realistic and benign than the so-called 'terraforming' of planets - which should be preserved with a status that is analogous to Antarctica here on Earth (at least until we are sure that there is no form of life already there).

KR: I am not happy with the word 'colonise' for humans or robots. Europeans colonised other peoples' lands and left a long legacy of enslavement, problems, disease and, for many, suffering. I think whether we do something on Earth or on Mars we should always do it in the spirit of a genuine interest in 'the-Other', not to impose a particular model, but to meet 'the-Other'. Robots could help us to go to places we cannot physically go ourselves, but these robots cannot interpret what they are seeing for us.

DW: I don't see a pressing need to colonise other planets unless we can bring resources back to Earth. The vast majority of Earth is currently inaccessible to us. Using robots to gather resources nearer to home would seem to be a better use of our robotic tools.

What can science fiction tell us about robotics?

MR: I sometimes advise students that it's better to read first-rate science fiction than second-rate science—more stimulating, and perhaps no more likely to be wrong. Even those of us who don't buy the idea of a singularity by mid-century would expect sustained, if not enhanced, rate of innovation in biotech, nanotech and in information science. I think there will be robotic entities with superhuman intellect within a few centuries. Post-human intelligence (whether in organic form, or in autonomously-evolving artefacts) will develop hyper-computers with the processing power to simulate living things, even entire worlds. Perhaps advanced beings could use hyper-computers to surpass the best 'special effects' in movies or computer games so vastly that they could simulate a world fully as complex as the one we perceive ourselves to be in. Maybe these kinds of super-intelligences already exist elsewhere in the universe.

KR: Fiction and science fiction is so important for everyday life. In Western culture we tend to think there is reality on the one hand, and fiction and fantasy on the other. This separation does not exist in all cultures, but science and technologists made this deliberate separation because they wanted to carve out the sphere of their work. In doing this they denigrated lots of valuable knowledge, such as myth and metaphor, that might be important in developing a richer model. But the divide is not so clear cut and that is why the worlds seem to collide at times. In some cases we need to bring these different understandings together to get a whole perspective. Perhaps then, we won't be so frightened that something we create as a copy of ourselves will be so threatening to us.

DW: Science fiction has often been remarkable at predicting the future - from Arthur C Clarke's idea of satellite communication to Star Trek's communicators which now look old fashioned compared to modern mobile phones. Science fiction has painted a vivid spectrum of possible futures, from cute and helpful robots (Star Wars) to dystopian (I Robot)

robotic societies. Interestingly, almost no science fiction envisages a future without robots.

Provided by University of Cambridge