



Fear of robots overlooks their limitations, and potential.

ROBOTICS

Countering singularity sensationalism

Ken Goldberg reviews three books that probe the nexus of people and robots.

In the late nineteenth century, the United States was awash with the racist term ‘yellow peril’. Fears spread that Chinese immigrants working in the country’s mines and building its railways would seize more jobs from the citizenry. Today, there is a similar collective fear, this time about a ‘singularity’ in which artificial intelligence (AI) and robots surpass human abilities. In May 2014, for instance, physicists Stephen Hawking, Frank Wilczek and Max Tegmark, with computer scientist Stuart Russell, warned in the newspaper *The Independent*: “Success in creating AI would be the biggest event in human history. Unfortunately, it might also be the last”.

Surprising advances are being achieved, for example in ‘deep learning’ — a method for approximating complex functions using thousands of numerical parameters. And robots are evolving, with advances in 3D sensing and mapping. But progress is not nearly as steady as some claim. Three books explore the topic from different perspectives. All suggest that robot superiority faces a formidable obstacle: human psychology.

In *Machines of Loving Grace*, reporter John Markoff of *The New York Times* highlights

Machines of Loving Grace: The Quest for Common Ground Between Humans and Robots

JOHN MARKOFF
Ecco: 2015.

Rise of the Robots: Technology and the Threat of a Jobless Future

MARTIN FORD
Basic: 2015.

Our Robots, Ourselves: Robotics and the Myths of Autonomy

DAVID A. MINDELL
Viking: 2015.

the compelling contrast between AI and intelligence amplification (IA). He chronicles the fascinating and often antagonistic evolution of these fields since 1956, when both terms were coined.

Markoff has been interacting with leading researchers for the past 20 years. As he shows, despite early optimism, creating AI has turned out to be extremely difficult. Robotics remains challenged by Moravec’s paradox: tasks that are tough for humans, such as precision spot welding, are easy for robots, whereas tasks that are easy for humans, like reliably clearing a dinner table,

remain extremely hard for robots. This is mostly attributable to the inherent complexity of friction, collisions and contact mechanics. It is much easier to calculate the precise trajectory of a comet than to predict that of a coffee mug pushed across a tabletop.

The term IA was preferred by Douglas Engelbart, who worked on the potential of computers to amplify human abilities. This evolved into the field of human–computer interaction, which brought us the mouse and graphical interfaces. Markoff recounts the stories of pioneers such as computer scientist Terry Winograd and augmented-reality expert Gary Bradski. Both recognized the limitations of AI, and became advocates of IA. Markoff’s book makes a strong case that the success of AI will depend on advances in IA.

Rise of the Robots by software entrepreneur Martin Ford proclaims that AI and robots are about to eliminate most jobs, blue- and white-collar. A close reading reveals the evidence as extremely sketchy. Ford has swallowed the rhetoric of futurist Ray Kurzweil, and repeatedly asserts that we are on the brink of vastly accelerating advances based on Moore’s law, which posits that computing power increases exponentially with time. Yet some computer scientists rue this exponential fallacy, arguing that the success of integrated circuits has raised expectations of progress far beyond what historians of technology recognize as an inevitable flattening of the growth curve.

Nor do historical trends support the Luddite fallacy, which assumes that there is a fixed lump of work and that technology inexorably creates unemployment. Such reasoning fails to consider compensation effects that create new jobs, or myriad relevant factors such as globalization and the democratization of the workforce. Ford describes software systems that attempt to do the work of attorneys, project managers, journalists, computer programmers, inventors and musicians. But his evidence that these will soon be perfected and force massive lay-offs consists mostly of popular magazine articles and, in one case, a conversation with the marketing director of a start-up.

In *Our Robots, Ourselves*, teleroboticist David Mindell points out that autonomous systems are not new. Since the 1970s, they have been in daily use at very low and very high altitudes, for deep-sea and space exploration and in almost all aircraft. Drawing on extensive experience, Mindell explains that although such systems have evolved, many experts continue to mistrust them. For example, there is a persistent school of thought that oceanographers must experience the murky depths directly to understand the wonders lurking there. Yet robotic submarines, tele-operated through fibre-optic cables, are much more agile, are able to explore for longer and do not require expensive certification for every modification.

Mindell recounts a telling scene. In 1977, oceanographer Robert Ballard of the Woods Hole Oceanographic Institution in Massachusetts and microbiologist Holger Jannasch descended in a submersible. They came across a sea-floor vent field. As Ballard looked through the glass portal at the “crab gradient” near the fissure’s source, he realized that Jannasch had his back to it. When asked why, Jannasch replied that the view was “better here”, indicating the television image relayed from the craft’s camera. In an ‘aha’ moment, Ballard realized that the view will always be better at the surface, where high-resolution video from below can be viewed in comfort. Yet many continue to argue otherwise.

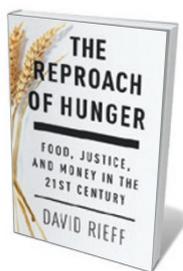
Mindell looks at the compelling historical, cultural, political, psychological, philosophical and public-relations justifications for keeping people in control. A recent example is the July 2015 international petition to ban autonomous weapons, signed by almost 3,000 researchers. Consider, for instance, Google’s announcement that it had found the most unreliable component in its autonomous cars: human drivers trying to take over. Its response was to remove the steering wheel. Mindell explains why this is a mistake. In what he calls the “myth of full autonomy”, he points out that a machine may operate on its own for intervals, but that no machine works entirely independently: human intentions, assumptions and parameters are built into all machines. Mindell’s experience leads him to a similar conclusion to Markoff’s: the essential (and most difficult) challenge is designing the interfaces that keep humans in the loop.

Technological progress is not deterministic. There have been several cycles of irrational enthusiasm followed by disappointment and the evaporation of research and development funding, known as AI winters. The latest round of expectations feels similarly exaggerated.

Alarmist writing may hasten the next slump and distract attention from a more realistic and important development, which we might call multiplicity. Multiplicity characterizes an emerging category of systems in which diverse groups of humans work together with diverse groups of machines to solve difficult problems, consistent with the points made by Markoff and Mindell. Multiplicity thrives at the intersection of AI and IA, combining the wisdom of crowds with the power of cloud computing. As designer and computer scientist John Maeda has put it, it is not us versus the machines; it is us and the machines. There is much to gain by joining forces. ■

Ken Goldberg is professor of engineering and director of the People and Robots Initiative at the University of California, Berkeley.
e-mail: goldberg@berkeley.edu

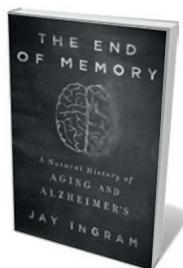
Books in brief



The Reproach of Hunger: Food, Justice and Money in the 21st Century

David Rieff VERSO (2015)

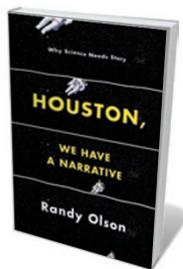
As refugee crises fill the news, David Rieff reminds that hunger is a war not won. Rieff, a veteran thinker on development issues, spent six years researching the nexus of population, food commodification and persistent poverty for this critical analysis. Scathing about the alarmist or over-optimistic pronouncements of development officials, agribusiness multinationals and philanthropic nabobs, he notes that any issue involving billions of humans cannot be neatly engineered. Thoughtful, trenchant and bracingly sceptical.



The End of Memory: A Natural History of Aging and Alzheimer's

Jay Ingram THOMAS DUNNE (2015)

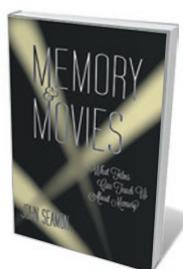
Alzheimer's disease affects 5.3 million US citizens, and has so far eluded cure. In this deft overview, science writer Jay Ingram unravels the complexities of the science past and present. He examines the legacy of neurology pioneers such as Aloisius Alzheimer and Frederic Lewy; the biology of ageing and shifts in episodic and autobiographical memory; and the protein plaques and neurofibrillary tangles associated with the disease. And there is more, from the ongoing Nun Study of Aging and Alzheimer's Disease (begun by neurologist David Snowden in 1986) to the idea of Alzheimer's as “type 3 diabetes”.



Houston, We Have a Narrative: Why Science Needs Story

Randy Olson UNIVERSITY OF CHICAGO PRESS (2015)

Whether synthetic biology or exoplanet hunting, science told well can carry a thriller-like punch. Marine biologist turned filmmaker Randy Olson argues that narrative skill is central not just to science communication but also to research reportage, preventing false positives, yawn-worthy delivery and more. Olson prescribes the Hollywood formula “and, but, therefore” as the backbone of story, introducing momentum, conflict and resolution. He has packed his solid primer with analyses of how it is done, from James Watson's 1968 *The Double Helix* (Atheneum) to exemplary scientific abstracts.



Memory and Movies: What Films Can Teach Us about Memory

John Seamon MIT PRESS (2015)

Cinema has long exploited the dramatic potential of memory. Here, John Seamon exploits film's potential for elucidating neuroscience. Inspired by Christopher Nolan's 2000 *Memento* (which hinges on anterograde amnesia), Seamon trains a cinematic lens on aspects of memory from facial recognition to dementia. Philip Kaufman's 1978 *Invasion of the Body Snatchers*, for instance, mirrors Capgras' delusion, in which people believe that their acquaintances are doppelgängers; while Robert Redford's *Ordinary People* (1980) dissects post-traumatic stress disorder with exquisite precision.



Ornithological Photographs

Todd Forsgren DAYLIGHT (2015)

Photographer Todd Forsgren has spent years capturing images of birds, from hummingbirds to toucans, caught in mist nets — a tool widely used by ornithologists for ring-banding and data collection. Some may find the sight of immobilized birds in this collection disturbing. But Forsgren's book uniquely showcases the birds' individuality while testifying to the painstaking, ongoing work of field researchers striving to understand the ecology, population flux and more of wild birds. **Barbara Kiser**