

SCIENCE FICTION, SCIENCE FACTS

Computer vision and machine learning in science fiction

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Science fiction has a cautionary view of computer vision and machine learning.

Science fiction has generally ignored the science behind computer vision and its use of neural networks for machine learning. Robot vision, like robot intelligence, simply existed in stories; it did not have to be explained. But while the science in science fiction overlooked the “how” behind computer vision, the fiction in science fiction very quickly predicted that computer vision would be used, and abused, for marketing and surveillance.

The earliest science fiction work about computer vision appears to be the 1931 short story “The Doom from Planet 4” (1). That story described alien robots with cameras for eyes that actively moved to track the movements of an island’s two inhabitants, one the beautiful daughter of the famous explorer who had been killed discovering the infested island and the other a handsome adventurer who was part of a rescue mission. The robots’ weakness was centralized control; when communication with Planet 4 was severed, the robots ceased to function. The story implied that machine intelligence was too complex to reside in a robot body, much like today’s devices that require cloud computing for natural language understanding and computer vision processing. Although the story correctly described vision, active perception, and centralized control, it neglected the mechanics converting the signal into a symbol to enable semantic understanding.

The first work of fiction that addressed the role of the brain in transforming signals into symbols is Asimov’s 1940 short story “Robbie,” which introduced the positronic brain. The positronic brain was not based on neural networks—reasonable, given that it was written almost 20 years before the groundbreaking work of Hubel and Wiesel on the neural structure of the visual cortex. Asimov never explained how the positronic brain worked in any of his stories; instead, the brain was presented as a *fait accompli* with the implication that positrons had something to do with intelligence. *Star Trek: The Next Generation* in 1987 is the first work of popular science fic-

tion to connect neural networks to robotics—in this case, by crediting neural networks as a learning mechanism within Data’s positronic brain.

Applications for visually competent robots appeared in science fiction much earlier than neural nets, starting with Fritz Lieber’s 1953 short story, “A Bad Day for Sales.” The story is about a marketing robot, Robie, a not-so-subtle reference to Asimov’s Robbie, who strolls the streets of a major city, using its sophisticated computer vision system to identify potential customers and construe their demographics. The story describes how Robie uses blob analysis to segment out adults from children and then infer gender from the shape. The gender information triggers specific product pitches and adapts how the robot ingratiates itself to its target.

The twist of the story is that Robie is not really seeing, just exploiting social norms. It misses the cues that a nuclear bomb has suddenly exploded nearby. Despite people being, literally, on fire in front of it, the robot continues as before, trying to sell its wares. As the story continues, Robie accidentally acts in ways that are sometimes helpful and sometimes not, but the robot is oblivious to scene understanding—unable to detect that the beliefs, desires, and intentions of its potential customers have changed due to the context of nuclear war. Robie has spectacular object recognition capabilities but no true scene understanding; its ability to function as a salesman is the result of exploiting social patterns, not visual intelligence.

Later, the 1973 original *Westworld* movie by Michael Crichton revisited the theme of computer vision as a parlor trick while proffering another money-making application: entertainment. In the movie, a computer virus relaxes the restrictions on the robots, and robots, including the Gunslinger, no longer fire their guns a few seconds too late or miss their shots. Richard Benjamin’s nebbishy lawyer is able to escape only because he discovers that the Gunslinger is using a thermal camera to track him. By hiding behind torches and near fires, he effectively becomes invisible. The special

effects show the Gunslinger using blob analysis, emphasizing as with “A Bad Day for Sales” that the robot is not really seeing in an intelligent way.

Starting around 2010, the use of computer vision in science fiction shifted from relatively benign consumerism and entertainment to surveillance. In parallel, books and movies were replacing blob analysis with high-performance computing and neural networks. The TV show *Person of Interest* (2011) centered on fears of pervasive government surveillance, although it did not contain robots, whereas popular works with robots—most notably *Kill Decision* by Daniel Suarez (2012), *Autonomous* by Annalee Newitz (2017), and *The Robots of Gotham* by Todd McAulty (2018)—began to discuss artificial intelligence as the enabling technology for robot perception for police and military operations. *The Robots of Gotham* is especially interesting because it provided an accurate overview of a neural network object recognition system being used by an invading army. *Autonomous* took a different, more pessimistic, view of the science of neural networks. In that book, computer vision had stalled on a plateau of object recognition and could not achieve reliable scene understanding. As a workaround, the most advanced military robot assassins, such as the protagonist Paladin, were supplemented with a human visual cortex donated by fallen soldiers.

While science fiction’s unsettling predictions are rapidly becoming reality, it misses the benefits of computer vision for the less thrilling, but profoundly valuable, fields of robot surgery, agile manufacturing, autonomous cars, rescue robotics, and eldercare robots. Perhaps in a near future, scientific progress will cause science fiction writers to pen a future where computer vision and machine learning are unequivocal forces for good.

REFERENCE

1. J. Williamson, “The Doom from Planet 4,” in *Astounding Stories*, H. Bates, Ed. (The Clayton Magazines Inc., 1931), vol. 7, issue 1, pp. 5–19.

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