**KEY INGREDIENTS:** A glass pane [left] carries a sensor that samples street noise; an array of speakers [right] emits the corresponding antinoise signal.

placed in a window, together with a sensor, can generate an antinoise signal strong enough to cut the room's noise, as perceived by the human ear, by 10 adjusted decibels, or dBA. That's about the difference between the sound of heavy traffic 60 meters away (60 dBA) and a quiet moment in a city (50 dBA).

It's a striking achievement to make wave and antiwave cancel out perfectly throughout an entire room. The key is that the noise all comes through a relatively small aperture—the "window," explains Bhan Lam, an electrical engineer and the leader of the research group.

"In a way, we are treating the window opening as the noise source," Lam tells *IEEE Spectrum*. "Effective control of the noise source will result in noise control everywhere in the room." Lam adds that, according to simulations, the technique ought to work no matter how big the room is.

It's worth noting that there are two engineering trade-offs at play here. First, as you move the speakers further apart, the highest frequency they can cancel goes down. And as you make the speakers smaller, you reduce their maximum output power and their bass response. But if you really want to make the most of today's speaker technology, Lam says, you can enlarge the window so that it can accommodate bigger speakers.

How far can we take this? Years ago, noise from airliners flying overhead so ruffled people at the U.S. Open tennis tournament, in Queens, N.Y., that the city arranged to reroute air traffic to and from nearby LaGuardia Airport for the duration of the event. Why can't antinoise do that job instead?

We're not there yet. "In an open space, if the noise source is far away—say, from an aircraft—it becomes a challenging problem," Lam explains. "This type of control is termed as spatial active noise control, and the research is still in the fundamental stage; only simulations have been reported thus far." —PHILIP E. ROSS

*A version of this article appears in our Tech Talk blog.*

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# CAN AI HIRING SYSTEMS BE MADE ANTIRACIST?

## Makers and users of AI-assisted recruiting software reexamine the tools' development and how they're used

**Two years ago, Amazon** reportedly scrapped a secret artificial-intelligence hiring tool after realizing that the system had learned to prefer male job candidates while penalizing female applicants—the result of the AI training on resumes that mostly male candidates had submitted to the company. The episode raised concerns over the use of machine learning in hiring software that would perpetuate or even exacerbate existing biases.

Now, with the Black Lives Matter movement spurring new discussions about discrimination and equity issues within the workforce, a number of startups are trying to show that AI-powered recruiting tools can in fact play a positive role in mitigating human bias and help make the hiring process fairer.

These companies claim that, with careful design and training of their AI models, they were able to specifically address various sources of systemic bias in the recruitment pipeline. It's not a simple task: AI algorithms have a long history of being unfair regarding gender, race, and ethnicity. The strategies adopted by these companies include scrubbing identifying information from applications, relying on anonymous interviews and skill-set tests, and even tuning the wording of job postings to attract as diverse a field of candidates as possible.

One of these firms is GapJumpers, which offers a platform for applicants to take "blind auditions" designed to assess job-related skills. The startup, based in San Francisco, uses machine learning to score and rank each candidate without including any personally identifiable information. Cofounder and CEO Kedar Iyer says this helps reduce reliance on resumes, which, as sources of training data, are "riddled with bias." This method also avoids unwittingly replicating and propagating such biases through the scaled-up reach of automated recruiting.

That deliberate approach to reducing discrimination may be encouraging more companies to try AI-assisted recruiting. As the Black Lives Matter movement gained widespread support, GapJumpers saw an uptick in queries from potential clients. "We are seeing increased interest from companies of all sizes to improve their diversity efforts," Iyer says.

Another lesson from Amazon's gender-biased AI is that paying close attention to the design and training of the system is not enough: AI software will almost always require constant human oversight. For developers and recruiters, that means not blindly trusting the results of AI-powered tools;

knowing they need to understand the processes behind these tools and how different training data affects their behavior; and monitoring for bias.

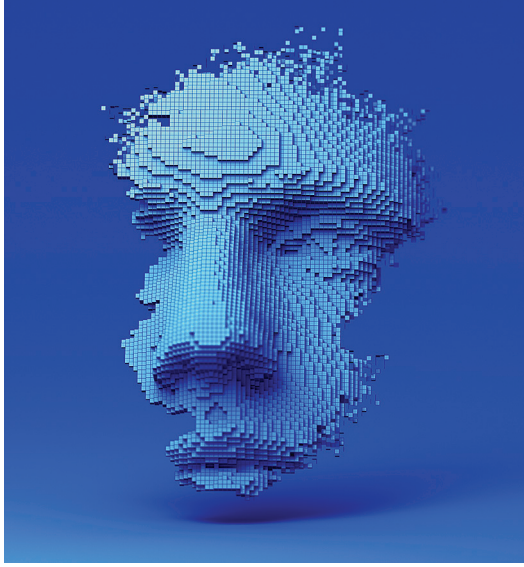
"One of the unintended consequences would be to continue this historical trend, particularly in tech, where [underrepresented] groups such as African Americans are not within a sector that happens to have a compensation that is much greater than others," says Fay Cobb Payton, a professor of information technology and analytics at North Carolina State University, in Raleigh. "You're talking about a wealth gap that persists because groups cannot enter [such sectors], be sustained, and play long term."

Payton and her colleagues highlighted several companies that take an "intentional design justice" approach to hiring diverse IT talent in a paper published last year in the journal *Online Information Review*.

According to the paper's authors, there is a broad spectrum of possible actions that AI hiring tools can perform. Some may just provide general suggestions about what kind of candidate to hire; others may recommend specific applicants to human recruiters; and some may even make active screening and selection decisions about candidates. But whatever AI's role in the hiring process, humans cannot abdicate theirs: evaluating these systems' decisions and possibly overriding them.

"When we talk about bias, there are so many nuances and spots along this talent-acquisition process where bias and bias mitigation come into play," says Lynette Yarger, a professor of information sciences and technology at Pennsylvania State University and lead author on the paper with Payton. She added that "companies that are trying to mitigate these biases are interesting because they're trying to push human beings to be accountable."

Another example highlighted by Yarger and Payton is a startup called Textio that has trained its AI systems to analyze job advertisements and predict their ability to attract a diverse array of applicants. Textio's "Tone Meter" can help companies offer job listings with more-inclusive language. Phrases like "rock star" that attract more male job seekers could be swapped out for the software's suggestion of "high performer" instead.



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"We use Textio for our own recruiting communication and have from the beginning," says Kieran Snyder, CEO and cofounder of Textio, which is based in Seattle. "But perhaps because we make the software, we know that Textio on its own is not the whole solution when it comes to building an equitable organization–it's just one piece of the puzzle."

Indeed, many tech companies, including those that develop AI-powered hiring tools, are still working on inclusion and equity. Enterprise software company Workday, founded by former PeopleSoft executives and headquartered in Pleasanton, Calif., has more than 3,700 employees worldwide and clients that include nearly half the Fortune 500. During a company forum on diversity and racial bias in June, Workday acknowledged that Black employees make up just 2.4 percent of its U.S. workforce versus the average of 4.4 percent for Silicon Valley firms, according to SearchHRSoftware, a human-resources-technology news site.

Another challenge for AI-powered recruiting tools is that some customers expect them to provide a quick fix to a complex problem. James Doman-Pipe, head of product marketing at Headstart, a recruiting software startup based in London, says any business interested in reducing discrimination with AI or other technologies will need that to be the aim of the organization from the top down.

Headstart's software uses machine learning to evaluate job applicants and generate a "match score" that shows how well the candidates fit with a job's require-

ments for skills, education, and experience. "By generating a match score, recruiters are more likely to consider underprivileged and underrepresented minorities to move forward in the recruiting process," Doman-Pipe says. The company claims that in tests comparing its AI-based approach to traditional recruiting methods, users of its software saw significant improvements in the diversity makeup of new hires.

Still, a major obstacle AI-powered recruiting tools face before they can gain widespread trust is the lack of public data showing how they help—or hinder—efforts to make tech hiring more equitable.

"I do know from interviews with software companies that they do audit, and they can go back and recalibrate their systems," says Yarger, the Penn State professor. But the effectiveness of efforts to improve algorithmic equity in recruitment remains unclear. She explains that many companies remain reluctant to publicly share such information because of liability issues surrounding equitable employment and workplace discrimination. Companies using AI tools could face legal consequences if the tools were shown to discriminate against certain groups.

For North Carolina State's Payton, it remains to be seen whether corporate statements about addressing diversity and racial bias will have a broader and lasting impact in the hiring and retention of tech workers—and whether or not AI can help to create an equitable workforce.

"Association and confirmation biases and networks that are built into the system—those don't change overnight," she says. "So there's much work to be done."

—JEREMY HSU

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NEWS

# STAY-AT-HOME TECH'S STAR TURN

## Even technophobes rely on consumer tech now

**Remember March, when stay-at-home orders** and advisories first went into effect in many U.S. states and other places around the world? That month is generally not a big time for consumer electronics sales; gadgets may fly off shelves during the December holiday season, but then there's a bit of a lull.

But things have been different during the pandemic. Peloton, which makes an Internet-connected exercise bike, reported first-quarter revenues up by two-thirds, as stay-at-home orders kept people from their normal exercise routines. Webcams sold out just about everywhere. And good luck finding a pharmacy with a pulse oximeter in stock. Some services also saw a huge boom. The videoconferencing platform Zoom, previously a tool used mostly by businesses, became a household word, and by April it was clocking 300 million daily participants—up from 10 million before the pandemic. Instacart, the so-called Uber for groceries, saw sales of US $700 million per week in April, up 450 percent from December.

Those are just a few examples of gadgets and services that the pandemic made more attractive to a lot of consumers. But will this pandemic effect continue, and bring a long-term boost to the consumer electronics industry?

Mojo Vision, a California startup aiming to bring augmented-reality contact lenses to the masses, commis-