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THE FUTURE OF BATTERIES: 3D PRINTING...

While most technologies have surged forward in recent years, that undergirding batteries has noticeably lagged behind the times. New devices now benefit from the ability to have malleable battery structures capable of being stretched or compressed during use. However, traditional manufacturing techniques are still limited. That may soon change, though. Researchers in Singapore and China are using 3D printers to produce a "quasi-solid-state" battery capable of 60% compression while retaining a high energy density and the ability to be recharged and used numerous times. According to Hui Ying Yang, a materials science researcher at the Singapore University of Technology, "our synthetic strategy not only provides an effective method for manufacturing of compressible batteries by 3-D printing, but also promote[s] future applications for stress-tolerant flexible/wearable electronics devices." Yet, although the technology is already scalable, the 3D printed battery does have its limitations - for instance, it is not as efficient as traditional non-compressible variants. (*EP&T*, August 3, 2020)

...AND NUCLEAR-POWERED GEMSTONES

The Internet of Things and increased use of sensors in remote locations has heightened the need for smaller, longer-lasting batteries that need to be replaced infrequently. Traditional batteries, like lithium-ion or alkaline, disperse power via a chemical reaction, provide high power in short intervals, and decay rapidly over time. However, nuclear batteries are capable of operating at lower power intervals for potentially hundreds or even thousands of years. Researchers at a company named Arkenlight have been developing a new nuclear battery using the carbon-14 isotope, which is a byproduct of graphite blocks in nuclear reactors, and injecting it on a diamond-shaped lattice, thereby creating a highly efficient energy-dispersing structure. If successful, the diamond batteries could help reduce nuclear waste and be used to power products ranging from pacemakers to RFID tags in satellites. Arkenlight has set out to commercialize the technology and distribute it by the year 2024. (*Wired*, August 31, 2020)

HOW AI IS GAMING WARGAMES

The Pentagon's defense research shop, the Defense Advanced Research Project Agency (DARPA), is now working to harness artificial intelligence to strengthen wargaming tools. DARPA's Gamebreaker program uses AI to identify, target, and exploit the weaknesses of modern strategy games. According to Joshua Bernstein, director of advanced intelligent systems at Northrop Grumman, "Gamebreaker seeks a methodology for finding 'broken states' in games – situations in which one player in the game can gain unexpected advantages over a competitor... In these applications AI finds asymmetrical conditions in a system (eg, the game or a real-world scenario) and communicates these conditions to stakeholders, such as military planners." Ostensibly, the AI will be able to provide genuine outside-the-box thinking that will then be used to help humans train for the unpredictable in real world conditions, as well as to allow warfighters to gain trust in AI systems. (*Breaking Defense*, August 18, 2020)

ISRAEL'S ANSWER TO INCENDIARY BALLOONS

For years, Israel has garnered accolades for the high success rate of its Iron Dome missile defense shield. The system has its limitations, however - the most prominent of which is that, while highly effective, Iron Dome's interceptors are expensive relative to the cheaper rockets they aim to destroy. In order to positively alter that prohibitive cost ratio, Israeli defense planners have invested in a laser defense system, known as "Lahav Or" ("blade of light"") to complement Iron Dome and shoot down aerial targets with laser beams (See *Defense Technology Monitor* no. 50).

Now, the new system has faced its first significant test. Incendiary balloons launched by the militant Hamas movement have long wreaked havoc on Israeli territory, igniting destructive fires and causing extensive damage. In late August, the "Lahav Or" laser system successfully intercepted and disarmed 32 balloons. The system reportedly boasts a success rate of 90% in such engagements. (*The Algemeiner*, August 20, 2020)

AI: THE FUTURE OF FIGHTER JETS?
The results of the Pentagon's AlphaDog challenge, pitting man against machine in a virtual dogfight, have become rather predictable. After winning out against other private companies, Heron Systems was chosen to deploy its AI algorithm in a virtual dogfight against a human fighter pilot. The AI beat the fighter pilot 5-0 - though by the last round, the pilot altered his technique and greatly extended the duration of the fight. Despite the AI's success, Timothy Grayson, director of the Strategic Technology Office at DARPA, believes humans should not relinquish control to machines. He stated, "I think what we're seeing today is the beginning of something I'm going to call human-machine symbiosis... Let's think about the human sitting in the cockpit, being flown by one of these AI algorithms as truly being one weapon system, where the human is focusing on what the human does best [like higher order strategic thinking] and the AI is doing what the AI does best." (*Defense One*, August 20, 2020)