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Future robots to be muscle mimicking & self-healing: DRDO

Tessy Thomas, DRDO's Aeronautical Systems (Aero) Director General said these robots would also be able to perform a wide range of motions, adapt to dynamic environment and work cordially with the human environment

Chennai: Robots of the future would no longer be metallic objects, but made of 'soft materials' which are muscle mimicking, self-healing and with hydraulically amplified actuators, a senior DRDO official said here Wednesday.

Tessy Thomas, DRDO's Aeronautical Systems (Aero) Director General said these robots would also be able to perform a wide range of motions, adapt to dynamic environment and work cordially with the human environment.

With soft robots already developed, Thomas, known as the 'Missile Woman' of India, said robots with muscle mimicking, self-healing and hydraulically amplified actuators were being developed.

"The next generation of robots won't be metallic machines, but instead made of soft materials with a wide range of motions that react to applied electricity," she said on the sidelines of a four-day conference on 'advances in robotics' at IIT-Madras, which got underway here yesterday.

Robotics has become solutions to various challenges, right from disaster management to military safety, the DG said, adding that the involvement of number of start ups in the country with industry was the need of the hour.

"With advancements in robotics, AI, computer aided manufacturing, 3D printing and Internet of Things (IoT), the industry is estimated have Rs two lakh crore business by 2025," Thomas said.

DRDO, she said, has three labs specifically working on robotic and Artificial Intelligence (AI).

The five-day event '4th International Conference of the Robotics Society' at IIT-Madras aims at fostering industry-academia interactions.

<https://economictimes.indiatimes.com/news/defence/future-robots-to-be-muscle-mimicking-self-healing-drdo/articleshow/70058015.cms>



In Leh, Army holds continuing medical education (CME) programme

Leh: The High Altitude Medical Research Centre (HAMRC) and 153 GH conducted the 20th meeting of Research Advisory Committee (RAC) and a Continuing Medical Education (CME) program on "Health Issues at High Altitude Areas" at Leh on Wednesday, army said.

Army said that senior officers from the Indian Army, Air Force and Navy and distinguished scientists and doctors from DRDO attended the event.

"The galaxy of senior officers included Lt Gen Bipin Puri, the Director General of Armed Forces Medical Services (DGAFMS), Air Marshal M. S. Butola, Director General Hospital Services (Armed

Forces), Lt Gen Y. K. Joshi, GOC Fire and Fury Corps, Dr A.K. Singh, Director General of Life Sciences (DGLS, DRDO), Maj Gen Arvind Kapoor, Maj Gen Rakesh Kumar, Surg Radm M. S. Prakash and Maj Gen Sharad Bhatnagar,” an army statement said.

Army said that the day witnessed a unique conclave of officers not only from the Armed Forces but also from premier research institutions like DRDO and renowned doctors from Leh-Ladakh.

“It proved to be a novel platform for all stakeholders to come together and undertake concerted efforts towards the promotion of health and prevention of diseases among soldiers deployed in high altitude areas.

Welcome the address was given by Maj Gen Madhuri Kanitkar, MG Med Northern Command. The CME sessions were aimed at updating the knowledge base on high altitude related health issues and their management,” army said.

Army said that the plenary speakers were senior doctors from the Army Medical Corps and senior scientists from DRDO, with unmatched experience of having studied and worked tirelessly on terrain-specific disease conditions.

“Diseases due to hypoxia and cold environmental conditions were extensively deliberated upon.

Presence of Padmashri Dr Tsering Norboo, the Internal Medicine specialist who revolutionized public health, added intellectual splendour to the event,” they said.

The CME witnessed the sharing of ideas across distinguished minds and in the backdrop of the RAC meeting of the HAMRC, paved the way for new openings in medical research, the army said.

Army further said that this has been a significant milestone and a remarkably promising endeavour in advancing research work for the health and medical services for our soldiers.

<http://brighterkashmir.com/in-leh-army-holds-continuing-medical-education-cme-programme>



Thu, 04 July 2019

World's largest combat jet deal underway as India starts process

The Indian Air Force and Navy require as many as 400 single and double-engine combat aircraft, according to the government

India moved a step closer to inviting bids for the purchase of 114 fighter jets, currently the world's largest deal in play, as Prime Minister Narendra Modi seeks to boost the capability of the country's armed forces and replace an aging combat aircraft fleet.

The deal -- valued at more than \$15 billion -- has attracted initial offers from global defence majors, including Boeing Co., Lockheed Martin Corp and Sweden's Saab AB. At least 85 per cent of production has to be in India, according to an initial document issued more than a year back.

Modernising the country's defence forces is critical for Modi, who hardly signed any new major arms deals during his first term, even as twin threats from neighbouring China and Pakistan loomed. A Pakistani F-16 jet downed an aging Soviet-era MiG 21 -- Indian Air Forces mainstay -- in a dogfight during a military confrontation earlier this year.

Evaluation Begins

The evaluation of initial bids and finalising the Air Force's requirements has begun, junior Defence Minister Shripad Naik told lawmakers in Parliament. India is also drafting initial documents to

purchase tanks and armoured vehicles, as well as asking foreign shipbuilders to show interest to manufacture submarines in India, he said.

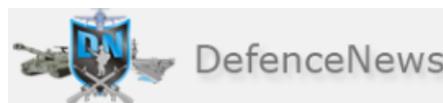
The Indian Air Force and Navy require as many as 400 single- and double-engine combat aircraft, according to the government.

Boeing is partnering with state-run Hindustan Aeronautics Ltd. and Mahindra Defence Systems Ltd. for the fighter jet deal offering its F/A-18. Lockheed will jointly bid with salt-to-software conglomerate Tata Group for its F-16 jets, and Saab teamed with billionaire Gautam Adani to offer its Gripen jets.

After scrapping an order with Dassault Aviation for 126 Rafale jets worth \$11 billion in 2015 -- a process that took nearly a decade -- Modi's administration bought 36 jets separately. Under the new tender, the winner will have to deliver the first jet within three years of securing the contract.

(By Bloomberg)

<http://www.newindianexpress.com/business/2019/jul/03/worlds-largest-combat-jet-deal-underway-as-india-starts-process-1999050.html>



Thu, 04 July 2019

Modest rise in Indian military spending likely, modernisation on hold

India is likely to stick to a modest rise in defence spending in the 2019/2020 budget due on Friday because of tight government finances, officials said, further delaying a long-planned military modernisation programme.

India's air force desperately needs hundreds of combat planes and helicopters to replace its Soviet-era aircraft while the Navy has long planned for a dozen submarines to counter the expanding presence of the Chinese navy in the Indian Ocean.

The army, a large part of which is deployed on the border with traditional foe Pakistan, has been seeking everything from assault rifles to surveillance drones and body armour.

But these plans have been on hold for years because governments have not been able to set aside large sums and most of the defence expenditure goes on salaries and pensions for a 1.4 million standing military, the world's second largest after China.

In an interim budget announced in February before national elections, the government allocated 4.31 trillion rupees (\$62.27 billion) for defence, a 6.6 percent rise over the previous year, raising concern at the time it wouldn't be enough for modernisation.

But a finance ministry official told Reuters there was unlikely to be any change to that allocation when Finance Minister Nirmala Sitharaman presents the federal budget in parliament.

"Defence is our major spending and we give it as much as the budget allows. But this year, a significant rise to what has already been allotted looks difficult," the official involved in the budget preparations said.

China, by contrast, in March announced defence spending of around \$180 billion, a 7.5% increase over 2018 and faster than the economic growth target. While China doesn't give much break-up, it is largely assumed that a substantial portion of it goes towards modernisation, helped also by a cutback in maintenance costs.

Since Chinese President Xi Jinping took office in late 2012, he has made strengthening and modernising the military a very key part of his policy platform. Part of that has been reduction in troops by about 300,000 and the money saved in this is invested in much more advanced equipment and research and development.

BLOATED MILITARY

Indian military planners have also considered restructuring the forces for the last couple of years to reduce manpower costs, but have not moved fast enough. There are 2.4 million defence pensioners at the moment, with approximately 55,000 being added every year.

"We need a lot of funds but it is not very likely to come," a defence ministry official said.

Laxman Behera, a research fellow at the government-funded Institute for Defence Studies and Analyses in New Delhi, said the military's spending on pay, allowances and pensions had risen from 45% to 56% in the last four years.

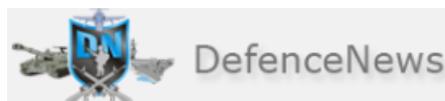
Share of capital procurement had come down to 18% from 21% during the same period. "Pensions take away a major chunk of India's defence expenditure every year," he said.

The Modi government has also tied military modernisation to its Make-in-India drive to build a domestic industry which has been slow in taking off.

Global defence companies such as Lockheed Martin and Boeing are bidding for a contract to supply the air force 114 combat planes which will be made in India in a deal estimated to be over \$15 billion.

There will be little movement on the jet contract and another on submarines if no new funds are announced, the defence ministry official said.

<http://www.defencenews.in/article/Modest-rise-in-Indian-military-spending-likely,-modernisation-on-hold-585635>



Thu, 04 July 2019

We take sovereign decisions based on threat perception: Centre on S-400 deal with Russia

In the wake of US pressure to scrap the S-400 missile deal with Russia, India on Wednesday said it takes sovereign decisions based on entire spectrum of security challenges facing the country.

The comments were made by Minister of State for Defence Shripad Naik while replying to a question on the billion dollar deal with sanctions-hit Russia.

"Government takes sovereign decisions based on threat perception, operational and technological aspects to keep the armed forces in a state of readiness to meet the entire spectrum of security challenges," he said in a written reply.

The minister was answering a question on whether countries including the US have expressed concerns on the deal and apprised India of the same.

The US has been maintaining that that New Delhi's deal to procure the lethal missile system from Moscow will have "serious implications" on India-US defence ties.

India signed an agreement with Russia last October to procure a batch of the S-400 missile defence systems at an estimated cost of Rs. 40,000 crore.

India went ahead to seal the deal notwithstanding the US's warnings against it. India believes that it meets the US waiver criteria for procuring the S-400 missile defence system from sanctions-hit Russia.

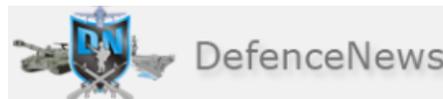
Last month, India conveyed to US Secretary of State Mike Pompeo that it will go by its national interest on the missile deal.

The US announced sanctions against Russia under the stringent Countering America's Adversaries Through Sanctions Act (CAATSA) for its alleged meddling in the American presidential election in 2016.

India wants to procure the long-range missile systems to tighten its air defence mechanism, particularly along the nearly 4,000-km-long Sino-India border.

The S-400 is an upgraded version of the S-300 systems. The missile system, manufactured by Almaz-Antey, has been in service in Russia since 2007.

<http://www.defencenews.in/article/We-Take-Sovereign-Decisions-Based-On-Threat-Perception-Centre-On-S-400-Deal-With-Russia-585632>



Thu, 04 July 2019

Army spent Rs. 1.24 crore on its dog squad in 2018-19: Centre

The Army incurred Rs. 1.24 crore on its dog squad for training, food and expenses such as medicines during 2018-19, Minister of State in the Defence Ministry Shripad Naik said on Wednesday.

In written response to a question in Lok Sabha, Mr Naik said the Army currently has 25 full dog units and two half units.

A full unit of the Army comprises 24 canines and half consists of 12.

"The total amount spent on training, food, and other expenses like medicines, excluding manpower, on the dog squads of the Indian Army during 2018-19 is Rs. 1,24,11,450," he said.

In response to a separate question, Mr Naik said in 2014-15, 0.108 per cent of the GDP was spent on research and development for defence. The number dipped slightly to 0.091 per cent in 2015-16, 0.089 per cent in 2016-17, 0.092 in 2017-18 and 0.093 per cent in 2018-19.

Replying to another question, he said the government has approved implementation of coastal security scheme in phases with a total cost of Rs. 2,225.91 crore to strengthen security of coastal areas and augment the capabilities of police force of coastal states, union territories for patrolling and surveillance in territorial waters, especially shallow waters close to the coast.

In response to another question, Mr Naik said in the last three financial years from 2016-17 to 2018-19, the government has accorded Acceptance of Necessity (AoN) to 113 proposals, worth Rs. 2,39,074 crore approximately under the "Make in India" initiative.

Replying to a separate question on aerospace university by Hindustan Aeronautics Ltd, a PSU under the Defence Ministry, Mr Naik the HAL board in its meeting held in February 2018 decided that HAL cannot consider setting up a private varsity, even in collaboration with other organisations such as the DRDO, private industries.

"HAL may provide initial support and secretarial assistance for facilitating the establishment of the University, on the lines of a Central University and it will have no direct role in setting up/running of the proposed varsity," he said.

<http://www.defencenews.in/article/Army-Spent-Rs-124-Crore-On-Its-Dog-Squad-In-2018-19-Centre-585630>

Thu, 04 July 2019

Israeli F-35s hoodwinked S-300 system of Iran, but won't be a problem for India's S-400

Amid reports that Israeli F-35 stealth fighter planes managed to hoodwink the S-300 air defence system of Iran and violate its airspace, Russian and Indian defence sources have allayed fears about the S-400 system that India is purchasing, insisting it will be able to detect stealth planes.

According to a report in Kuwaiti daily Al Jarida, Iranian Air Force Commander Brigadier General Farzad Ismaili, who had been in office since 2010, was fired by the country's Supreme Leader, Ayatollah Ali Khamenei, after he kept secret that Israeli Air Force F-35 stealth fighters had violated Iran's airspace.

What happened in Iran?

The Al Jarida report emphasised that it was the original media source that exposed the Israeli raids, which had taken place in March 2018. It cited senior Iranian military officials, who said only following its March report did the intelligence services of the Revolutionary Guards and the Iranian intelligence ministry begin to investigate the case, under Khamenei's direct orders.

The reports have been closely followed by the defence fraternity and enthusiasts because of Iran's S-300 air defence system. The report said the system, including its Russian radar, did not detect the entry and exit of the fighter planes, and that Ismaili hid this information from the Supreme Leader to cover his service's failure.

However, Iranian intelligence discovered that the Israeli fighter jets had carried out this sortie as a test of the possibility of an undetected attack on Iranian outposts and bases, during which they photographed those sensitive bases, evading the Russian S-300 missile system's radar.

Also read: All about Russian S-400 missiles, India's biggest defence against Pakistan and China

Fears about India's S-400

Russian sources ThePrint spoke to said they were not aware of the Iran case, but pointed out that India was buying the S-400, which has a completely different radar and system to the S-300, and which can detect the stealth planes.

Indian defence sources also told ThePrint that the S-400 could detect stealth, but did not elaborate to what extent. The sources said the S-400 had been specifically designed to overcome countermeasures and stealth. It comes equipped with powerful radar compared to an S-300.

Can S-400 shoot down stealth fighters?

While it is clearly accepted in the defence fraternity that the S-400 can detect stealth planes, questions remain on whether it can actually shoot down such fighters.

Mauro Gilli, senior researcher in military technology and international security at the Swiss Federal Institute of Technology, said an F-35, for instance, could be detected by the S-400 only when it's about 40 km away — too late given that the F-35 carries weapons that can strike both aerial and ground targets at a much longer range.

Gilli also raised concerns about the potential sale of F-35s to Turkey, which is also buying the S-400. This has led to a standoff with the US. He argued that by modulating the frequencies and angles of operations of multiple S-400 systems, one could find the weak spots of the F-35 and, more importantly, its unique radar returns.

<http://www.defencenews.in/article/Israeli-F-35s-hoodwinked-S-300-system-of-Iran,-but-won%e2%80%99t-be-a-problem-for-India%e2%80%99s-S-400-585621>

Egyptian, Indian Naval Forces conduct drills in Mediterranean Sea

Cairo: The Egyptian and Indian Naval forces carried out Wednesday drills in the Mediterranean Sea with the participation of India's ship Tarkash and Egypt's frigate Damietta.

The exercises included security measures during maritime missions, protection of navigation routes as well as management of defense and attack operations. Navy helicopters were used in the training.

The Indian naval ship, Tarkash, arrived in Alexandria, Egypt on June 28 for a three-day visit to participate in the Western Fleet Overseas Deployment training program, according to a statement issued by the Indian Navy.



The statement added that the visit demonstrates India's commitment to its ties with Egypt in light of the bilateral agreements for cooperation and cultural exchange between the two countries; the visit also stresses the Indian Navy's increasing footprint and operational reach.

The geo strategic location of Egypt grants it the unique advantage of being at the crossroads of Africa, Asia and Europe, where crucial sea lines of communication pass through the Red Sea into the Mediterranean through the country's Suez Canal.

The drills come as part of a plan by the Armed Forces General Command to enhance and beef up military cooperation with all friendly countries.

In 2018, Egypt and Pakistani naval forces also carried out drills in the Mediterranean Sea.

<http://www.egypttoday.com/Article/1/72386/Egyptian-Indian-naval-forces-conduct-drills-in-Mediterranean-Sea>

Business Standard

Myanmar Commander-in-Chief (Air) meets Chiefs of Indian Army, Air Force

New Delhi: Maung Kyaw, the Commander-in-Chief (Air) of Myanmar, Wednesday met Indian Army Chief Gen Bipin Rawat and Air Force chief B S Dhanoa and discussed ways to strengthen defence cooperation.

Maung also paid visit to the National War Memorial here.

"#Cooperation Visit Chairman COSC & the CAS, ACM BS Dhanoa met General Maung Maung Kyaw, Commander-in-Chief (Air), Republic of the Union of Myanmar at Air HQ. On arrival, General

Maung Maung Kyaw was presented a Guard of Honour. Later he paid tribute at the National War Memorial," the Indian Air Force tweeted.

"General Maung Maung Kyaw, Commander-in-Chief (Air), Republic of the Union of Myanmar called upon and interacted with General Bipin Rawat #COAS. Discussed issues of mutual & strategic concern," the Army tweeted.

The armies of India and Myanmar carried out a three-week-long coordinated operation from May 16 in their respective border areas, targeting several militant groups operating in Manipur, Nagaland and Assam.

Myanmar shares a 1,640-km border with a number of north-eastern states of India, including militancy-hit Nagaland and Manipur.

(This story has not been edited by Business Standard staff and is auto-generated from a syndicated feed.)

https://www.business-standard.com/article/pti-stories/myanmar-commander-in-chief-air-meets-chiefs-of-indian-army-air-force-119070301485_1.html



Thu, 04 July 2019

Indian Air Force Plans Major Drills In J&K Involving Large Contingent Of Fighters, Warns Pakistan Against

New Delhi: The Indian Air Force has planned a major exercise in Jammu and Kashmir. This is to check responses by IAF in case neighbouring Pakistan plans any other misadventures along the lines of what happened on February 27 when a squadron of its most advanced fighter jets were repulsed and driven back by India in a fierce air-battle in the Nowshera skies.

The Pakistani Air Force had attempted an attack on Indian Army positions on February 27, 2019. Earlier on February 26, Indian Air Force had targeted non-military positions across the LoC in the state. The drill will check response time of the fighter aircraft fleet and the fleets will carry out an extensive drill over entire Jammu and Kashmir and Ladakh divisions. Squadrons of Su-30MKi from Punjab and Haryana and Mirage 2000 aircraft will take part in the drills. The actions will take place in coordination with the air defence units of the Army deployed along the border and other combat elements of ground forces.

A similar exercise by the Indian Air Force was carried on March 14. The Force carried out a major readiness exercise over Punjab and Jammu in which a large number of fighter aircrafts participated.

During the exercise, Indian Air Force (IAF) jets, including frontline aircraft, flew at supersonic speeds in the border districts including Amritsar in Punjab, as per sources.

The reason for carrying out the combat drill was to be prepared for thwarting any misadventure by the Pakistan Air Force (PAF) to intrude into the Indian air space, the sources said.

The IAF was on a high alert then since it carried out air strikes on a Jaish-e-Mohammed terrorist camp in Balakot town of Pakistan's Khyber Pakhtunwa province on February 26.

Foreign Secretary Vijay Gokhale said announced in a press conference in February about the attack, "India on Tuesday carried out air strikes at a massive JeM camp in Balakot in Pakistan's Khyber Pakhtunhwa Province, eliminating a large number of terrorists, including top commanders."

<http://universalnewstimeline.com/indian-air-force-plans-major-drills-in-jk-involving-large-contingent-of-fighters-warns-pakistan-against>

ISRO talks of self-tracking: India to have its own GPS?

Indian Space Research Organisation (ISRO) is in talks with two chipset manufacturers to create desi GPS for various purposes. This will be incorporated in cell phones

Bengaluru: Global Positioning System or GPS is a technology that helps immensely in navigation. It is owned by the United States of America, but the service is available for all.

Imagine one such critical tool, designed and owned by India. As fantastic as it sounds, Indian Space Research Organisation (ISRO) is in talks with two chipset makers – Qualcomm (US based) and Broadcom (Singapore based) to incorporate mobile phones with NavIC, India's own version of GPS.

A Times of India report quoted ISRO chairman K Sivan saying, "There are ongoing discussions. There is nothing conclusive so far. This will be a gamechanger, but you must understand that we are still in the process."

In this regard, the ISRO has launched eight satellites, called the Indian Regional Navigation Satellites (IRNS).

Not just cell phones, even advertisers can make use of this technology to improve their business.

In the report K Sivan went on to say, "We are looking at NavIC in autorickshaws carrying advertisements in the future. Advertisers currently do not know if an ad is reaching the target audience or not and how many places the auto goes. With this technology, they will have the exact details."

The paper also quoted a chipset analyst, Shobhit Srivastava saying, "India's smartphone market has huge potential in terms of numbers because of a lot of new users. In the context of Make in India and Design in India, the government will push firms to design and make the chipsets in India. There are more than 650 million mobile users in India. Even basic phones now come with LTE and these chips can be inserted in them too."

<https://www.mynation.com/india-news/chennai-after-fridge-explosion-now-ac-blast-injures-couple-pu29q1>



NASA tests launch-abort system for its moon mission

It aims at evacuation of astronauts under real-life conditions

Washington: NASA carried out a successful test on Tuesday of a launch-abort system for the Orion capsule designed to take U.S. astronauts to the Moon.

The three-minute exercise at Cape Canaveral in Florida aimed to test in almost real-life conditions the evacuation of astronauts from the capsule in the event of an explosion or rocket booster failure.

In the test, an unmanned Orion capsule was launched by a mini-rocket — a repurposed first stage of an intercontinental ballistic missile. Fifty-five seconds after the launch, at an altitude of 9,500 m, a

rocket-powered tower on top of the crew module ignited its engines to quickly pull the Orion away from a hypothetical rocket experiencing problems.

In just 15 seconds, the capsule gained two miles of altitude. Then the tower reoriented the capsule to prepare it for descent and disengagement from the tower.

In real-life conditions, parachutes would open to ease the manned capsule's fall toward the Atlantic Ocean.

<https://www.thehindu.com/sci-tech/science/nasa-tests-launch-abort-system-for-its-moon-mission/article28276346.ece>



Thu, 04 July 2019

Artificial gravity breaks free from science fiction

By Daniel Strain

Artificial gravity has long been the stuff of science fiction. Picture the wheel-shaped ships from films like 2001: A Space Odyssey and The Martian, imaginary craft that generate their own gravity by spinning around in space.

Now, a team from CU Boulder is working to make those out-there technologies a reality.

The researchers, led by aerospace engineer Torin Clark, can't mimic those Hollywood creations—yet. But they are imagining new ways to design revolving systems that might fit within a room of future space stations and even moon bases. Astronauts could crawl into these rooms for just a few hours a day to get their daily doses of gravity. Think spa treatments, but for the effects of weightlessness.

The group hopes that its work will one day help keep astronauts healthy as they venture into space, allowing humans to travel farther from Earth than ever before and stay away longer.

But first, Clark's team will need to solve a problem that has plagued proponents of artificial gravity for years: motion sickness.

"Astronauts experience bone loss, muscle loss, cardiovascular deconditioning and more in space. Today, there are a series of piecemeal countermeasures to overcome these issues," said Clark, an assistant professor in the Ann and H.J. Smead Department of Aerospace Engineering Sciences. "But artificial gravity is great because it can overcome all of them at once."

Strange sensation

Clark tests it out himself in a room on campus not much bigger than an ordinary office.

The engineer lies down on a metal platform that looks like a hospital gurney, part of a machine that engineers call a short-radius centrifuge. After a quick countdown, the platform begins to rotate around the room, first slowly and then faster and faster.

Nicholas Dembiczak, an undergraduate student studying aerospace engineering and research assistant in the lab, watches Clark's progress from a computer monitor in the room next door.

"You're coming on 15 rotations per minute now," he announces over a microphone.

Clark, however, doesn't seem to mind. "It's fun," he says.

It's also the closest that scientists on Earth can get to how artificial gravity in space might work.

Clark explained that the angular velocity generated by the centrifuge pushes his feet toward the base of the platform—almost as if he was standing under his own weight.

But there's a problem with this kind of gravity, one that's familiar to anyone who has visited an amusement park. If Clark turned his head to either side while spinning, he would experience a

sensation known as the "cross-coupled illusion"—a disruption of the inner ear that makes you feel like you're tumbling.

"It's a very strange sensation," said Kathrine Bretl, a graduate student in Clark's lab.

So strange that, for decades, engineers considered that kind of motion sickness a deal-breaker for artificial gravity.

Clark and Bretl, however, had other ideas.

Taking it slow

In a series of recent studies, the pair and their colleagues set out to investigate whether queasiness is really the price of admission for artificial gravity. In other words, could astronauts train their bodies to tolerate the strain that comes from being spun around in circles like hamsters in a wheel?

The team began by recruiting a group of volunteers and tested them on the centrifuge across 10 sessions.

But unlike most earlier studies, the CU Boulder researchers took things slow. They first spun their subjects at just one rotation per minute, and only increased the speed once each recruit was no longer experiencing the cross-coupled illusion.

"I present at a conference and everyone says, 'she's the one who spins people and makes them sick,'" Bretl said. "But we try to avoid instances of motion sickness because the whole point of our research is to make it tolerable."

The personalized approach worked. By the end of 10th session, the study subjects were all spinning comfortably, without feeling any illusion, at an average speed of about 17 rotations per minute. That's much faster than any previous research had been able to achieve. The group reported its results in June in the *Journal of Vestibular Research*.

Clark says that the study makes a strong case that artificial gravity could be a realistic option for the future of space travel.

"As far as we can tell, essentially anyone can adapt to this stimulus," he said.

In ongoing research, the researchers also bumped up the number of training sessions to 50, finding that people could spin even faster with more time.

But they also have a lot more questions to answer before you might see an artificial gravity room perched on top of the International Space Station: How long do the effects of training last, for example, and how much gravity would an astronaut need to offset the loss of muscle and bone?

Bretl, however, hopes that the research will begin to convince scientists that artificial gravity isn't just for summer blockbusters.

"The point of our work is to try to get more people to think that maybe artificial gravity isn't so crazy," she said. "Maybe it has a place outside of science fiction."

<https://phys.org/news/2019-07-artificial-gravity-free-science-fiction.html>