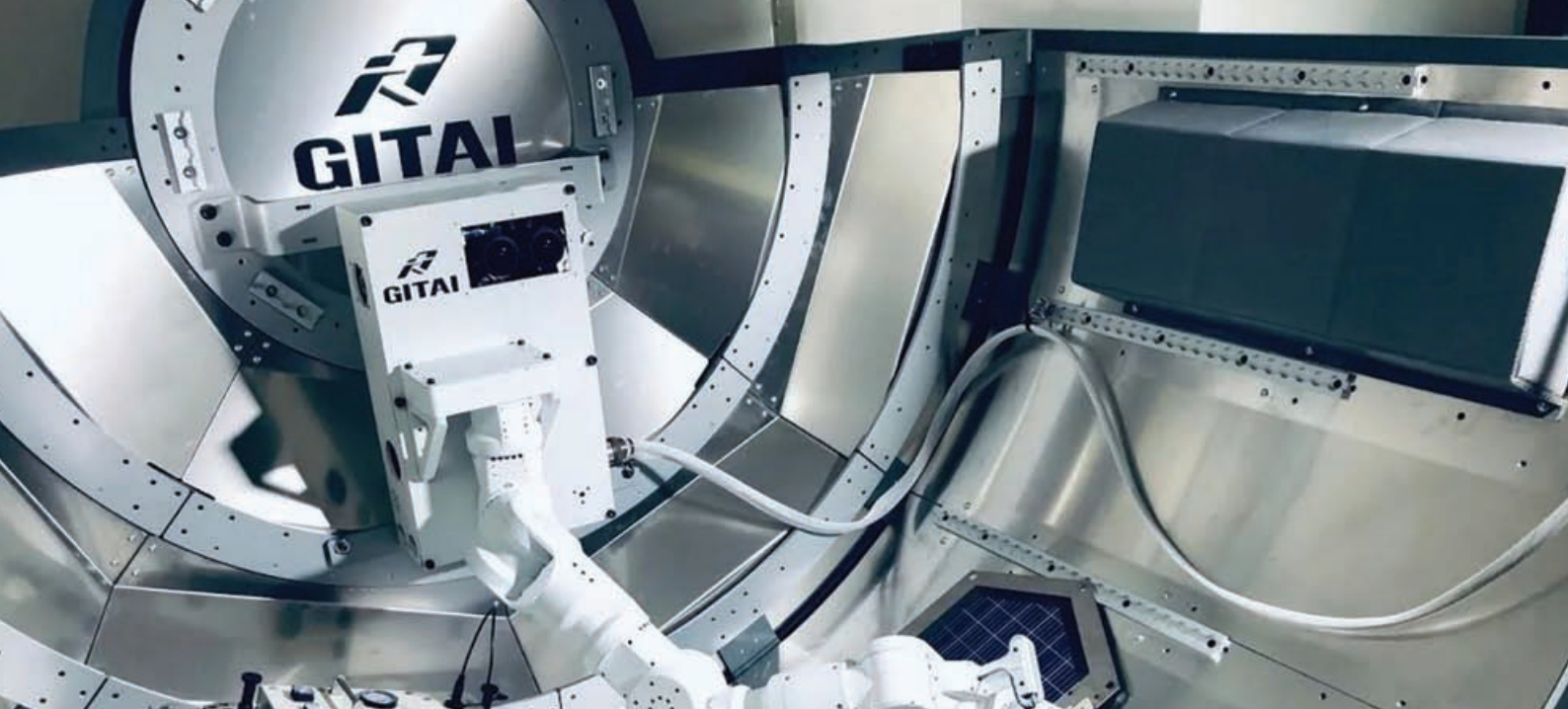




The GITAI S1 autonomous robotic arm was installed into the space station in October 2021. Photo courtesy GITAI ●●●

Space robotics are revolutionizing the stability of the NewSpace market ●●

In 2021, SpaceX overhauled their launch system, adding massive automated systems designed to streamline the vertical launch process. The Stage Zero launch tower is yet to be used outside of testing but could set a new standard for launch robotics. The system is emblematic of the heavy adoption of robotic systems in the space industry, all designed to bring operational sustainability and lowered costs to the emerging market.

Laurence Russell, Assistant Editor, Satellite Evolution Global

Among its many prestigious achievements in the ever-growing space industry, SpaceX has been hard at work pioneering in the world of robotics assisting with the process of launching and landing space vehicles.

In late October 2021 at their 'Starbase' facility in South Texas, SpaceX tested the new robotic arms of their 'Stage Zero' launch tower for the first time: A giant set of claws capable of catching reusable space vehicles and rockets returning for a vertical landing via propulsive descent.

"SpaceX will try to catch largest ever flying object with robot chopsticks," Musk explained in a September tweet, helpfully supplying a clip of Mr Miyagi from 'Karate Kid' catching a fly with chopsticks. "Success is not guaranteed, but excitement is!"

Musk supplied the bemusing nickname 'Mechazilla' for the launch tower system, which is poised to be used to catch Starship's Super Heavy booster after it returns to Earth following a future launch test. The technology is intended to be used for Starship and other space vehicles as well as boosters, simplifying the incredibly delicate landing process and ensuring a minimum of damage to their landing gear.

The machinery is even intended to re-assemble launch

systems, adhering a space vehicle like Starship onto a reusable booster for a return flight, suggesting a fast turnaround from landing to relaunch. The potential for streamlining spaceport processes through automated technologies to drive efficiencies that could further reduce the cost of launch is exciting, for how it could reduce the barriers to entry for new business cases in space.

Alternatively, the expensive project could be another characteristically Muskian example of an over ambitious project more expensive than its use cases can justify, or simply too reliant on emergent, bleeding-edge technologies to be realistically reliable. Musk himself admitted success is far from guaranteed, after all, and the enterprising company has accrued a long tapestry of setbacks in its pioneering history.

ORBITAL AUTOMATION

The robotics we're starting to see on the ground have many more applications in space, where manpower comes at a premium. With automated systems capable of standing up to the harsh conditions of space, orbital applications can be performed faster and with a much greater degree of safety, safeguarding human lives.

A set of new such systems have recently found their way to the International Space Station (ISS). The GITAI S1 autonomous robotic arm was installed into the space

station in October 2021 after being launched there in late 2020, capable of performing intricate assembly tasks such as constructing solar panels and performing space station repairs. The arm has full autonomy but is naturally also capable of remote tele-operation for unforeseen processes that haven't been programmed ahead of time, allowing a human to walk the machine through an entirely new process step by step.

GITAI explains that with automation where it is, 95 percent autonomous control with five percent human judgement is the most efficient way to work. GITAI looks forward to using what they've learned aboard the ISS to develop extra-vehicular robotics (EVR), capable of docking, repair, and maintenance to serve the emerging on-orbit servicing (OOS) ecosystem.

Similarly, the ISS installed the European Robotic Arm (ERA) in late 2021 – a far larger piece of robotics for external autonomous manipulation, which can operate on the exterior systems of the space station. The ERA is capable of transferring payloads, and even astronauts, in and out of the ISS.

The arm was produced entirely in Europe thanks to a large consortium of space developers led by Airbus Defence and Space Netherlands, who designed and assembled the device for the European Space Agency (ESA).

"During ERA's operational life the robot will help demonstrate equipment and technologies key to future space adventures," explained ESA Director of Human and Robotic Exploration David Parker, "such as the robotic transfer of samples on Mars."

The ERA joins the space station's two other robotics arms 'Canadarm2,' and the Japanese Experiment Module Remote Manipulator System. ERA is unique in that it is the only arm currently capable of reaching the Russian segment of the station, which will help it perform its first task aboard the station, the installation of a large radiator in support of the Multipurpose Laboratory Module 'Nauka.'

OKLAHOMA AIR & SPACE PORT'S PERSPECTIVE

Craig Smith, Executive Director of Oklahoma Space Industry Development Authority (OSIDA), explained that: "To bring that first SpaceX rocket booster back down to the launch site after breaking atmosphere was an incredible feat and a leap forward for launch reusability, and launcher cost-effectiveness. It was a game-changer."

With such an explosive initial foray into automated launch technology, it's only natural that SpaceX felt the need to use its unprecedented wealth of taxpayer subsidies to build on their successes and further lead the field of launch reusability.

"Commonplace space travel is in our future," Smith continued, "that could look like the development of point-to-point travel, the ferrying of goods to and from orbital platforms or the Moon, rollout of space defence assets, or all of

the above. That's going to require launch technologies with highly reproducible results."

On the subject of orbital automation, Smith explained: "With servicing robotics in sustainable operation in orbit, repositioning, maintenance and deorbiting could become a lot more realistic, cementing all kinds of capabilities in the NewSpace market, for which there has been long demand."

Experts predict that robotic automation technologies will revolutionize how our economies define labour in the coming fourth industrial revolution, but as momentous as these technologies are on Earth, we may see them go on to form the backbone of our driving systems in space, normalizing mechanical assembly and repair, making the direct action of astronauts in such tasks a last resort emergency manoeuvre. In fact, these technologies could even drive a culture of holistically unmanned space businesses and exploration systems, making capital the sole resource at risk instead of human life – a dichotomy which academics have been recommending for years now. ●



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