3D printing in outer space: students test igus linear axes in near-zero gravity flights

Students use drylin linear units to develop a 3D printer for the cost-effective production of structural components in outer space.

When booms for solar panels or satellite antennas are transported into space in a rocket, they are exposed to very high loads. To simplify space transportation and speed up the production of these components, a student team from the Munich University of Applied Sciences, AIMIS-FYT, is researching a 3D printing process for space. In the future, it should be possible to produce certain structural parts in outer space using additive manufacturing. To conduct experimental tests in zero gravity, the students built a 3D printer. For the drive technology the printer used maintenance-free and lightweight drylin SAW linear axes by igus.

The current process for transporting equipment into outer space is inefficient and expensive, because these structural parts must be designed to withstand the high loads during the launch phase of a spacecraft and are thus overdesigned. Then these parts are oversized for the operation they are designed to perform. Due to the high costs and limited space on a launch vehicle, alternative solutions are required. The Munich-based student team AIMIS-FYT took the problem on and are now working on a 3D printing process for cost-effective manufacturing in outer space, as part of their aerospace engineering degree programme.
To do this, the students rely on photoreactive resin and UV light, where the light hardens the resin. A 3D printer had to be designed and built for experimental tests of the process in zero gravity. In their search for the right drive technology, the engineers turned to motion plastics specialist igus and found what they were looking for in the drylin linear axes. The linear modules are used in the two z-axes and the x-axis of the printer, which forms the central drive unit. The low weight of linear axes is particularly impressive as they are made of aluminium and maintenance-free sliding elements made of high-performance polymer. To reduce the clearance of the lubrication-free and dirt-resistant polymer linear slides, the budding engineers selected adjustable

bearings. To ensure that the print filament can also be rotated, a compact robolink D rotary axis with worm gear was installed in the printer.

Successful test series under real conditions

To test the printer and the process, the team applied for the FlyYourThesis! programme offered by the European Space Agency (ESA) and was accepted. The parabolic flights took place in November and December 2020. When the aircraft reaches the peak of its climb and tilts into descent, micro-gravity occurs, very similar to weightlessness in space and ideal conditions for a real-life test of the printer. "The linear axes always ran without problems in all experiments, so that we were able to print a small rod and also small framework structures for each parabola", reports Torben Schäfer from the AIMIS-FYT team.

Support from igus promotes youth engineering project

Projects such as AIMIS-FYT are supported by igus as part of the "young engineers support" (yes) programme. With the university initiative, igus wants to support pupils, students and lecturers with free samples, university discounts and sponsorships and the development of innovative engineering projects. For more information about the university support, visit www.igus.co.uk/yes.

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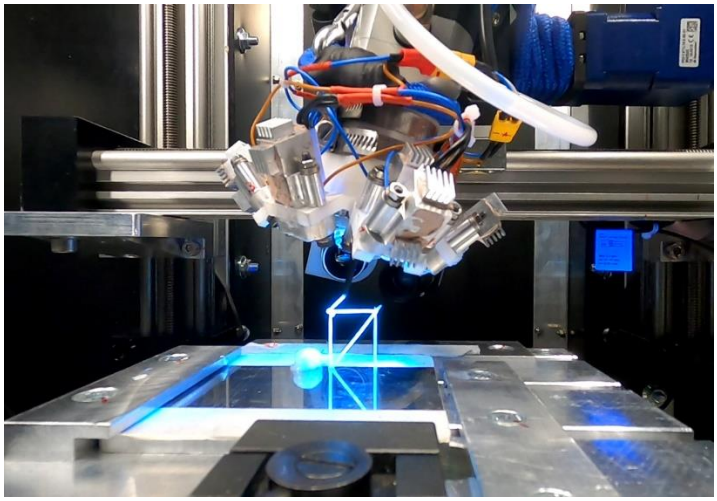
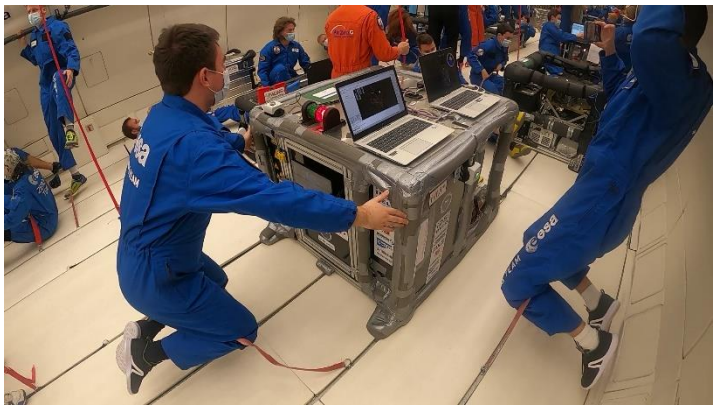


Picture PM0721-1

The maintenance-free drylin SAW linear axes are the central element of the 3D printer for space. They ensure precise printing results with adjustable bearings. (Source: AIMIS-FYT)



Picture PM0721-2

During a parabolic flight, microgravity occurs, very similar to weightlessness in space. Ideal conditions to test the 3D printer. (Source: AIMIS-FYT)