



New technologies will improve the overall experience of space-travel for Astronauts. Photo courtesy of NASA ●●●

2020 space trends

2019 marked the 50th anniversary of the Apollo 11 spaceflight that landed the first two people on the Moon. The progress in space exploration since then has been vast, but what developments can we expect in the industry in 2020? Ossi Saarela, Space Segment Manager at MathWorks provides some thoughts.

Autonomy abounding: The next generation of autonomy for crewed spaceflight is nearing certification. In terms of your average space flight, this will mean that humans onboard a spacecraft won't even need to touch the controls. For a normal flight from Earth to the space station the flight will be completely autonomous. In fact, compared to driverless technology that is being developed for use on Earth, it is more likely that we will see it become a reality for space travel first. After all, there are no pedestrians to jump in front of the space station to complicate the situation!

The Mars 2020 mission will launch this year. This spacecraft will also push the boundaries of autonomy. As part of the mission, a precise landing is planned whereby upon entry and descent, the spacecraft will use a technique called Terrain Relative Navigation (TRN) to take pictures of the terrain and compare those to maps it already has access to. By comparing the images and analysing the terrain, the vehicle will be able to compute its position more precisely than ever.

That said, there absolutely needs to be a business case there for autonomous technology and AI to become the norm. There is understandably an attitude that if a mission is possible using traditional techniques then there is no need

to change them – by introducing new techniques this will only increase the risk level of a mission, which is already fairly hazardous.

Monster mega-constellations

While some prototypes have already been launched, satellite mega-constellations are due to become common and there are organisations around the world ploughing investment into these projects. The benefits of having these mega-constellations closer to Earth is that it enables lower latency for communications, whereas geostationary satellites don't allow low latency. Furthermore, and although it seems obvious, it is easier to observe the Earth's surface when you are closer to it. For companies selling satellite imagery to analysts and companies in agriculture, mining, finance and other industries, a higher level of image accuracy means that more reliable conclusions can be made off the back of this information.

These constellations will also have a huge role to play in the progression of 5G services. There is a current need to increase the bandwidth to carry data around the globe, and satellites are an excellent way to carry that traffic.

However, regulation of this technology will inevitably impact its success as well as technology that can track other satellites and debris that could cause a fatal collision. The risk of a single collision could impact the pollution of lower orbit.

"I'll have any satellite, as long as it's black"

With new technologies such as 3D printing and artificial intelligence lending themselves to the improvement of the manufacturing process, we could be about to witness an emergence of a production line-type assembly process for satellites. Historically, satellites were built as a one-off design – customised and handmade. But with whole constellations

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being planned for launch, space companies are looking at how to stamp out identical satellites using the latest design tools in the same way as Henry Ford did with his cars in at the beginning of the last century.

Re-usable rockets are changing launch vehicle engineering processes as well. Unlike rockets that are used once and then discarded, re-usable spacecraft require maintenance and refurbishing. Techniques for predictive maintenance applied to on-board sensor data from previous flights, potentially using new techniques like machine learning, have a chance for spreading from the aircraft industry into the space industry.

Additionally, in the development phase, space companies will use simulated data to test their designs on a more frequent basis. Using this method means reducing the need to do expensive hardware testing. What's more, ongoing advances to mathematical computing will enable faster design and simulation.

For engineers, that means that they will be able to accomplish more in a narrower period of time, allowing design of more complex systems in a shorter timeframe.

Dedicated small satellite launch

We might see a continued increase in smaller satellites as more and more small rockets, that have been designed by the likes of Rocket Lab and Virgin Orbit, enter operations increasing the capacity for dedicated small satellite launch. While the initial uses for Earth sensing and communications are clear, it will be interesting to see what other technologies smaller satellites will enable. Some investors believe that these constellations and small affordable satellites have similarities with the birth of Internet. At inception, people in the technology industry knew that the Internet would be a game changer, even without fully understanding all its

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possible uses, and they are starting to think of small satellites in the same way.

Dashboards get a redesign

The next generation of autonomous spacecraft will also be accompanied by an upgrade of the user interface. In the past, the dashboard consisted of a variety of switches and knobs, but new designs will see a more technology-driven cockpit which is even more computerised, offering a user-friendly experience for today's astronauts. That said, it cannot be fully digital – there needs to be some manual switches remaining for emergencies, for example, in case the digital system fails! As space tourism becomes a more common, it's likely that other improvements to the entire 'space experience' will follow.

Inspire the next generation

Of course, all of the aforementioned ideas will ultimately rely on the people facilitating them, yet the engineering skills gap persists. Increased autonomy and complexity will leverage higher levels of AI. Fortunately, the creation of new modelling and design tools will make the evolving role of an aerospace engineer more accessible by bringing the latest AI and machine learning capabilities into familiar engineering environments. Additionally, the flurry of media stories about the space industry this year will hopefully help revive interest in the sector and inspire the next generation of engineers, who may be the ones who can design and build a spacecraft that takes humans to Mars.



The potential of satellites to unlock new technologies both in space and on the ground is keenly followed by investors ●●●

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