Space Missions

The whole world is now testing technologies that will enable increasingly complex and automated expeditions

by Marco Fosci





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NASA scientists celebrating the success of the New Horizons mission. After a nine-and-a-half year journey covering five billion miles, the New Horizons probe reached its point of contact with Pluto.

The successful completion of the New Horizons mission represents the end of an era in space exploration. The Mariner exploration program, begun in the early sixties, laid the groundwork for the New Horizon's probe that recently broadcast high-definition images from the surface of Pluto and its largest moon, Charon. With these images, the program has achieved its goal - the complete exploration of the planets that orbit the sun.

The New Horizons probe, which was launched by the US-based National Aeronautics and Space Agency (NASA), has also finally enabled us to put a face to a heavenly body that was first spotted in the 1930s. Until these most recent images were acquired, we had seen nothing more than low-resolution coloured blotches, mostly obtained from Hubble telescope images.

In August 2006, just a few months after New Horizons was launched from the Kennedy Space Center on Cape Canaveral, Pluto's planet status was revoked by the International Astronomical Union. It is now ranked alongside the many other large bodies floating in the Kuiper belt, a region populated by asteroids external to the solar system.

However, when on 14 July, at a speed of around 50,000 km, the US probe made its closest approach to the Pluto-Charon binary system, Pluto's non-planet status did not dull public interest or the attention shown by the scientific community, especially regarding the more complex stages of the mission.

The rendezvous has proven to be one of the most astonishing feats ever accomplished by human engineering. It was the crowning achievement of a project first conceived in 2001, with a price tag of $700 billion (€629bn), that relied on highly accurate calculations for a probe that travelled through space for over nine and a half years. Just a few months earlier, a similar level of excitement had been aroused during the critical stages of another mission that boasted an extreme degree of technical complexity. Having cost the European Space Agency (ESA) €1.4 billion, the Rosetta probe reached its primary objective, the 67P/Churyumov-Gerasimenko comet, in August 2014, after a ten-year journey and having travelled 6.4 billion km.

Within just a few weeks, through a series of very delicate manoeuvres controlled from Earth, the probe had settled into a stable orbit just 30km away from the comet's nucleus. On 12 November of last year, it then released the Philae lander onto the comet's surface, a tricky task that was followed with great trepidation in all corners of the world thanks to the fascinating images broadcast on the web by mission control.

"Our ambitious Rosetta mission has secured a place in the history books", claimed Jean-Jacques Dordain, the managing director of ESA, underlining how analysis of the data from the comet could unlock many secrets regarding Earth's origins and foster a better understanding of the future of humanity.

Thanks to Rosetta and New Horizons, our knowledge of the solar system and its heavenly bodies has never been more vivid. What stands out most about these missions is the complexity of the equipment involved and the technological stimulus provided by space exploration. The NASA Spirit and Opportunity rovers, which landed on Mars in 2003 and 2004, are emblematic of this phenomenon.

Both devices have been pleasant surprises - readily adapting to an alien world and exceeding all mission expectations. In fact, the second rover is still operational: from Pasadena, California, scientists continue to pilot Opportunity on Martian soil and guide its explorations. The knowledge acquired from Spirit and Opportunity has had a deep impact on robotics here on Earth and has also enabled the construction of a more sophisticated rover, Curiosity, which joined its predecessors on the Red Planet in 2012.

Many fields benefit from the research linked to space exploration: electronics, though increasingly small and sturdy circuit boards, capable of withstanding extreme temperatures and hostile environments; engines and energy generators which, developed for these conditions, must be very efficient and light; sensors and the complex instrumentation linked to the exploration phase; not to mention the on-board computers that now integrate extremely sophisticated self-diagnosis and self-repairing systems.

"Satellites used to signal that something was wrong and would just switch over to SAFE mode, interrupting all scientific observation", said Marco Zambianchi, an analyst for ESA's Gaia Mission, stressing how hours, if not days, were lost putting things right again. "Apart from very extreme cases, these days satellites look after themselves and just send a report of what they've done down to Earth. They no longer ask for help".

But perhaps the technologies with the most immediate impact on everyday life are those that concern astronaut support and monitoring. Zambianchi, who as President of the Italian Space and Aeronautics Association (ISAA) closely monitors the progress of space-related activities, makes this argument:

"In the Futura mission on the International space station, 80-90% of experiments carried out by the Italian astronaut Samantha Cristoforetti concerned human physiology", he said, noting that long stays in orbit have effects on the body that are similar to those of ageing.

"Bone decalcification, muscle atrophy, hearing and balance problems, sight loss; when astronauts return from their missions they have to undergo a rehabilitation program that lasts weeks".

While in orbit, astronauts take medicines to stem calcium loss, complete a two-hour workout every day and are supervised from Earth by a medical team using computer managed monitoring systems - the same kind of bracelets and sensors that are now being used in hospitals and sold in fitness stores. Perhaps New Horizons has truly signalled the end of the era of solar system mapping, but a closer look indicates that a new era is now dawning - one in which engineering enables us to manoeuvre extremely sophisticated machinery beyond our atmosphere and develop an understanding of our own physiology that, in the future, may enable human beings to travel to other worlds.

In the near term, Mars is the destination for two new missions: in March NASA will launch its InSight lander and ESA, in collaboration with the Russian Roscosmos Agency, will send up ExoMars, an orbiter and lander that in 2018 will also be joined by a rover. ■

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