Antennas for lighter, more economic communications satellites

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A telecommunications engineer at the NUP/UPNA-Public University of Navarre has designed two antenna prototypes for communications satellites; they offer more lightweight solutions, are less bulky than the ones used conventionally and constitute considerable savings for the space industry, which has already expressed an interest in them. The ESA-European Space Agency, among others, has collaborated in her work.

As the engineer Amagoia Tellechea explained, "the space industry is increasingly seeking lighter antennas because these aspects considerably reduce the cost of launching the satellites". Recent years have seen significant advances in this field thanks to the development of various technologies, such as antennas based on partially reflective surfaces (PRS) or ultrathin antennas based on metasurfaces (artificial structures designed to display features that are not found in nature).

So in her thesis the researcher used PRS-based technology to optimise an antenna for a satellite intended for tracking, telemetry and control. This system is crucial in enabling other satellites to function properly, such as, for example, GPS systems located in a medium orbit at a distance of about 20,000 km from the Earth. "The main functions of the tracking, telemetry and control systems are linked to the monitoring of the subsystems of the satellites, such as switching the engines on and off, the deployment of solar panels, etc. They are also responsible for controlling the orbital parameters of the satellites and oversee communication with the control centres on Earth to detect possible faults and implement

solutions," said Tellechea, who wrote up her thesis in the NUP/UPNA's Antenna Research Group.

A flat, lightweight, cost-effective solution

The prototype developed using this technology is a flat, lightweight, cost-effective solution comprising a metallic ground plane with a radiating element in the middle and a reflective surface above. The design generates a resonant cavity that increases gain. This antenna can be used instead of a much more complex, bulkier conventional system comprising 27 patch antennas.

In the second part of her thesis the author designed a satellite antenna based on the emerging metasurface technology for applications such as TV, Internet or radar that operate on the Ku band (portion of the non-visible electromagnetic spectrum located in the microwave range of frequencies). The work was conducted in collaboration with the Applied Electromagnetism Group at the University of Siena, experts in the field of metasurfaces, and has for the first time included theoretical modelling, the implementation and manufacturing details of a metasurface antenna capable of providing dual circular polarisation. This hitherto unheard-of design produced by the engineer has an innovative metasurface antenna capable of providing radiation diagrams with both right and left circular polarisation, thus ensuring robust, versatile communications between the satellites and the earth stations.

The proposed antenna comprises a material with lower electrical conductivity (known as dielectric), which has enabled a configuration with a thickness of only one millimetre to be achieved. The solution has been experimentally validated and it has been shown to have the potential for use in replacing two different antennas currently used for applications in the above-mentioned Ku band. The adding of antennas of this type to satellite systems constitutes a huge saving for the space

industry. That is why national and international companies have displayed great interest in solutions of this type.

Provided by Elhuyar Fundazioa

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