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Measuring the Effects of LEO Satellites on Ground-based Radio Astronomy: Results from the Onsala Twin Telescope

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The increasing number of low Earth orbit (LEO) satellites, or mega-constellations, such as Starlink and OneWeb, have the potential to greatly impact ground-based radio telescopes and radio astronomy observations[1][2]. Strong downlink transmissions from these mega-constellations can disrupt radio astronomy telescope observations or obscure astronomical signals[3]. In this paper, we present the results of our ongoing efforts to assess the impact of these satellites on radio telescope observations using the Onsala Twin Telescopes (OTTs) at the Onsala Space Observatory in Sweden[4].

The Onsala Twin Telescopes are part of the VLBI Global Observing System (VGOS) and consist of two 13.2 meter paraboloids, located 75 metres apart. They are designed to be able to observe together as an interferometer or as independent single dishes. They are able to move at up to 12 degrees per second in azimuth and 6 per second in elevation, and have pointing residuals of < 16 arcsec, making them suitable to monitor fast-moving LEO satellites. The reflector surfaces are accurate to < 100 μm RMS [5] making the antennas efficient to at least 25 GHz. Each telescope has its own dual linear-polarisation receiver system. One uses an Eleven Feed covering a frequency range of 2.2 to 14 GHz while the other has a Quad-Ridge Flared Horn which covers the range from 3 to 18 GHz [6].

Our project includes a comprehensive measurement and characterisation of the level of in-band and out-of-band transmissions from mega-constellations, including the collection of occupancy and signal statistics. Additionally, we plan to measure the character of the emission from these satellites by tracking a few of them using the OTTs, potentially as an interferometer.

The results of our study provide valuable insights into the potential impact of mega-constellations on radio astronomy, and can be used to inform the development of guidelines and regulations to minimise this impact.

References

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