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CURRENT STATUS AND FUTURE TRENDS IN RADIO LINK INTERFERENCE RESEARCH FOR THE PLANNING OF SUSTAINABLE GEOCENTRIC SATELLITE CONSTELLATIONS

Abstract

Interference in satellite communications has been a concern for decades. However, the development of new Low Earth Orbit (LEO) mega constellations has intensified the discussion and consequently stimulated research on the matter. New LEO constellations planned by companies such as SpaceX, OneWeb, Amazon, Samsung, Boeing, and Huawei will add thousands of satellites to the already crowded orbits near Earth. In addition, the number of satellites in the Medium Earth Orbit (MEO) region is also increasing due to growing satellite constellation projects such as O3b (from SES) and Viasat. This increase in satellite radio links deepens the problem of orbit congestion and crowding in radio frequency bands, while also enabling innovative technologies that exploit the greater availability of signals.

This paper reviews the current state of the art for inter- and intra-satellite interference management considering geocentric constellations in LEO, MEO, and Geostationary Earth Orbit (GEO); and identifies the major challenges for the sustainable planning of Earth orbit constellations with respect to interference. The potential opportunities the plethora of signals can bring for certain satellite services are also considered.

Research ranges from older analyses of interference scenarios and orbit characteristics, to more recent studies proposing novel approaches to ensuring communications performance in the current era of satellite constellations. Techniques for detection, classification, cancellation and mitigation of interference are considered key drivers for the development of new constellations and are at the center of this survey. Insights into new approaches to addressing interference are included through the description of techniques based on cognitive radio, adaptive power control and artificial intelligence.

This review reveals different solutions and approaches for better Earth orbit constellation planning, with consideration for the negative effects of intersystem interference as well as the opportunities an abundance of satellite signals can provide to certain satellite services.