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# COMPUTATIONAL APPROACHES FOR SATELLITE SYSTEMS USING NON-GEOSTATIONARY ORBIT IN RADIO INTERFERENCE ANALYSIS

**Abstract**

With the satellite projects using non-geostationary satellite orbit (NGSO) emerging in a last decade, the problem of interference analysis becomes a more pressing. The basis for an international regulatory framework which defines the obligations and requirements for the systems using NGSO to ensure their interference-free operation was established more than 20 years ago by International Telecommunication Union (ITU). At the same time, the analysis of interference potential and the methods of verification of compliance with these requirements is a developing subject. Modern satellite projects are subject to different sharing scenarios with terrestrial services, other NGSO systems and traditional systems using geostationary orbit (GSO). Some methods established through ITU-R Recommendations are based on static or analytical approaches for interference analysis. These approaches focus on identifying either hypothetical position of the satellite in interference link or a probability of locating a satellite in certain position in the sky. These methods are attractive since calculations do not require significant computational power and provide a worst-case result. With an increased complexity of interference scenarios, significant list of coordination requirements and additional characteristics required for the submissions to ITU for the coordination or recording of planned NGSO systems, these methods may not provide an efficient instrument to define rational parameters of a NGSO system. In addition, NGSO systems submissions to ITU are not always using efficiently available characteristics, such as minimum elevation angle, transmitting antenna pattern description, which could facilitate coordination in the process of obtaining international recognition. To address these challenges, the presented paper investigates an interference analysis using orbit simulation which is from one hand is employing modern parallel computation and general-purpose computing on graphics processing units (GPGPU) and on another hand explores the effect of the range of applicable characteristics of NGSO system submitted for coordination or registration to ITU. This paper considers three interference scenarios – identification of potentially affected geographic regions with a view of protecting terrestrial services, interference analysis between NGSO systems and a specific case of analysis between systems in NGSO and GSO. The analysis carried out demonstrates that in some specific cases using GPGPU may increase computation efficiency. It identifies certain limitations and requirements for different algorithmic approaches when using GPGPU. This analysis also demonstrates an advantage of properly defining certain transmission characteristics of a NGSO system.