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ADAPTIVE INTERPOLATION TECHNIQUE FOR RAPID ANALYSIS OF COMMUNICATION INTERFERENCE BETWEEN LEO AND GEO SATELLITES

Abstract

The last decade has seen many low earth orbit (LEO) satellite networks be developed for the future global communication practices offering fixed and mobile services. The co-existence of new LEO satellite networks and existing radio communication systems such as geostationary (GEO) satellite earth stations must be assured when designing and implementing them. The International Telecommunication Union Radio (ITU-R) has thus proposed a simulation methodology based on modeling of the dynamic motion equations of the satellites, computing at every simulation time step in order to determine the interference levels. The main computation burden lies in the determination of the relative position of the satellites, considering perturbations. Though the accuracy achieved by this methodology is high, it is time-consuming to obtain statistically significant interference data on condition that the simulation interval is long or the simulation step is small. The present contribution proposes a numerical method named Adaptive Piecewise Cubic Hermite Interpolation technique to rapidly and accurately compute possible interference levels between two satellite communication systems (at least one is LEO system), taking downlink and uplink into account. Here carrier-interference-ratio(C/I) is chosen as the interference criteria. Typical interference data include interference time duration and C/I value versus the percent time that interference occurs (once the C/I value is less than a given threshold, it is considered that interference occurs) .This novel curve fitting method is introduced to approximate curve of C/I function, featured with autonomous searching for the best interpolation points to guarantee accuracy. By simplifying the non-linear function into piecewise polynomial one, the statistical information can be further analyzed by means of differential and integral calculus, polyroot operation and so on. The satellite communication systems interference scenario simulation is thus completed with acceptable accuracy and much less time. Simulation results obtained from this approach are almost the same with those from conventional point by point check method, and it is suitable for both uplink and downlink, LEO interference into GEO and GEO interference into LEO scenario. Meanwhile, this new method decreases more than 90% of computation time. It turns out to be an effective way for satellite communication systems interference analysis and may be applied into the space orbit and frequency resources coordination between international communication communities.