

# 基于 OPNET 的卫星通信系统下行干扰建模与仿真研究

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**摘 要:** 卫星多波束天线旁瓣带来的小区间同频干扰是卫星通信系统网络规划与工程设计的重要依据. 针对多波束天线旁瓣带来的干扰问题, 首先, 在系统频率规划和下行同频干扰产生机理分析的基础上, 得到多波束卫星通信系统下行同频干扰模型; 其次, 根据 ITU-R S.672-4 建议书给出的天线辐射特性设计卫星单波束天线模型; 然后, 根据单波束天线模型以及多波束天线覆盖地面的要求, 通过几何分析运算得到多波束天线的覆盖参数; 最后, 利用 OPNET 网络仿真软件, 利用 ema 编程机制对卫星单波束天线建模, 并通过位于同一经线上间隔  $1.2^\circ$  的 109 个移动数据接收器的移动统计, 得到卫星多波束天线覆盖下, 东、西经  $80^\circ$  且南、北纬  $64.8^\circ$  的矩形区域内, 卫星多波束天线的辐射特性以及 7 小区同频和 3 色复用方式下的下行同频干扰特性. 仿真结果显示, 提出的建模方案能较为准确地计算出卫星多波束天线覆盖下任意经纬度的载干比和全网的载干比强度图.

**关键词:** 干扰; 多波束天线; 载干比; OPNET

## Research on modeling and simulation of downlink interference

### in satellite communication system based on OPNET

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**Abstract:** Inter-cell co-interference caused by side lobes of satellite multi-beam antenna is an important basis for network planning and engineering design of satellite communication system. Aiming at the interference problem caused by the side lobes of multi-beam antennas, firstly, based on the analysis of system frequency planning and downlink co-channel interference generation mechanism, the downlink co-channel interference model of multi-beam satellite communication system is obtained. Secondly, the satellite single beam antenna model is designed according to the antenna radiation characteristics given in Recommendation ITU-R S.672-4. Then, according signal beam antenna model and the requirements of the multi-beam antenna covering the ground, the coverage parameters of multi-beam antenna are obtained through geometric analysis. Finally, using the OPNET network simulation software, the satellite single beam antenna is modeled by the ema programming mechanism, and in a rectangular area of  $80^\circ$  east and west longitude and  $64.8^\circ$  north and south latitude, radiation characteristics of multi-beam antennas and downlink co-channel interference characteristics of 7-cell co-frequency and 3-color multiplexing are obtained through the mobile statistic of 109 mobile data receivers located at  $1.2^\circ$  apart on the same meridian. The simulation results show that the proposed model can accurately calculate the carrier

interference ratio of any latitude and longitude under satellite multi-beam antenna coverage and carrier interference noise ratio intensity map of the whole network.

**Key words:** interference; multi-beam antenna; carrier interference ratio; OPNET

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