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卫星模型散射FDTD计算的共形边界研究

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摘要 根据卫星模型太阳能帆板平面相对卫星主体较大的特点，提出了共形边界的概念，即总场边界、外推边界和吸收边界的几何形状与目标外形轮廓相同. 并把它应用在卫星模型时域有限差分(FDTD)计算中，以减少FDTD计算及存储量. 首先讨论了FDTD方法中3种边界的共形处理方法，特别针对270° 拐角处吸收边界的处理进行了详细分析. 通过电偶极子辐射验证共形吸收边界具有良好的吸收外行波的性能. 最后给出卫星模型远区后向散射时域波形，与常规长方体边界FDTD计算结果相符，验证了共形边界理论在FDTD计算应用中的正确性. 卫星模型采用共形边界后节省内存约40. 7%，缩短了计算时间，改善了计算性能.

关键词 共形边界 时域有限差分(FDTD)方法 卫星模型

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Conformal boundary scheme in FDTD computation of satellite model scattering

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Abstract

Based on the large dimension of the solar panel compared with the main body in the satellite model, the conformal boundaries are implemented, i.e., the outlines of the total field boundary, near-to-far field extrapolation boundary and absorbing boundary are the same as that of the target. This scheme is applied to the FDTD analysis for satellite model scattering to reduce memory space and computation time. Firstly, the three conformal boundaries in FDTD are considered. The boundary condition at the 270°corner is particularly analyzed in detail. Then the electric dipole radiation is computed to test the applicability of conformal absorbing boundaries, which demonstrates the efficiency in absorbing the outward wave. Finally, the back scattering by the satellite model is computed by using conformal boundaries. The far-zone time domain waveform obtained is in good agreement with that calculated by FDTD of conventional rectangular boundaries, which validates the presented scheme. The FDTD calculation performance is improved using the conformal boundaries in the satellite model. It saves the memory about 40. 7% and shortens the computation time.

Key words conformal boundary FDTD method satellite model

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