

ABSTRACT

The increasing utilization of Low Earth Orbit (LEO) satellites demands accessible yet accurate design tools beyond costly professional software. This project developed a comprehensive web-based LEO Satellite Orbit Design Application integrating orbit propagation, constellation design (Train and Walker-Delta), coverage analysis, and link budget calculations with interactive 2D/3D visualization.

Rigorous validation against theoretical calculations and NASA GMAT confirmed high accuracy across all modules. Orbit propagation achieved ± 0.78 km error over one hour with 31.8 km RMSE compared to GMAT's numerical integrator. Constellation placement demonstrated zero positional error for Train and Walker-Delta configurations. Coverage calculations showed 0.05 km accuracy at 2,000 km altitude. Link budget analysis achieved perfect agreement (0.00 dB difference) with manual calculations, yielding 31.87 dB uplink and 18.76 dB downlink margins. Ground station access predictions matched theoretical schedules exactly (11 passes/24h, 8.55-minute average duration). User interface testing achieved 100

The application successfully bridges the gap between complex professional software and educational needs, providing a valid, reliable, and accessible tool for preliminary LEO satellite mission design. It meets all objectives by combining high computational accuracy, comprehensive features, and web-based accessibility without licensing costs, making satellite orbit design more accessible for educational and initial technical assessment purposes.

Keywords : LEO, Satellite Orbit Design, Constellation, Orbit Simulation, Link Budget, Web Application