Application of atmospheric correction algorithm to enhance the accuracy of on-orbit geometric calibration

Guangfeng Xiang[a,b,*], Tangyu Sui[a,b,c], Bihai Tu[a,b], Xuefeng Lei[a,b], Binghuan Meng[a,b], Zhenhai Liu[a,b], Donggen Luo[a,b], Zhenwei Qiu[a,b], and Jin Hong[a,b]

[a] *Anhui Institute of Optics and Fine Mechanics, Hefei Institutes of Physical Science, Chinese Academy of Sciences, Hefei 230031, China*
[b] *Key Laboratory of Optical Calibration and Characterization, Chinese Academy of Sciences, Hefei 230031, China*
[c] *University of Science and Technology of China, Hefei, Anhui 230026, China*

[*] *Presenting author: Guangfeng Xiang (gfxiang@aiofm.ac.cn)*

On-orbit geometric calibration is crucial for enhancing the quality of remote sensing data from space-borne optical instruments, directly influencing the quality of application products. However, both traditional on-orbit geometric calibration methods based on high-precision ground control point information and autonomous on-orbit geometric calibration methods without ground control points rely on high-accuracy remote sensing image matching algorithms. The quality of remote sensing images directly affects the precision of the matching algorithm and the number of successfully matched homologous points, thus influencing the accuracy of geometric calibration. Atmospheric scattering and absorption are key factors that lead to reduced contrast in remote sensing images, especially in bands that are significantly influenced by the atmosphere. Therefore, enhancing image quality through atmospheric correction algorithms will effectively improve the accuracy of on-orbit geometric calibration for space-borne optical instruments.

The focus of this study is the Directional Polarization Camera (DPC) [1] carried by China's Gaofen-5 02 satellite, which is designed for cloud and aerosol detection. This instrument is equipped with multiple atmospheric-sensitive bands. However, strong atmospheric signals significantly reduce the contrast of remote sensing images in these characteristic bands and obscure ground target features, posing significant challenges for on-orbit geometric calibration. Therefore, based on the previously proposed autonomous on-orbit geometric calibration method [2], this study employs the Second Simulation of the Satellite Signal in the Solar Spectrum (6S) [3, 4] radiative transfer model for atmospheric correction to further improve the application accuracy of the autonomous on-orbit geometric calibration method in atmospheric-sensitive bands. The aerosol information required for the atmospheric correction algorithm is derived from DPC data, and the Generalized Retrieval of Atmosphere and Surface Properties (GRASP) [5] algorithm is used for simultaneous inversion. Finally, the significant improvement in DPC geolocation accuracy and multi-dimensional data registration performance demonstrates that atmospheric correction can enhance the on-orbit geometric calibration accuracy.

References

[1] Li Z. Q., Hou W. Z., Hong J., et al., 2018: Directional Polarimetric Camera (DPC): Monitoring aerosol spectral optical properties over land from satellite observation. *J. Quant. Spectrosc. Radiat. Transf.* **218**, 21-37.

[2] Xiang G. F., Meng B. H., Tu B.H., et al., 2022: On-Orbit Autonomous Geometric Calibration of Directional Polarimetric Camera. *Remote Sens*. **14(18)**, 4548.

[3] Vermote E. F., Tanre D., Deuze J. L., et al., 1997: Second Simulation of the Satellite Signal in the Solar Spectrum, 6S: an overview. *IEEE Trans. Geosci. Remote Sens.* **35(3)**, 675-686.
[4] Kotchenova S. Y., Vermote E. F., Levy R., et al., 2008: Radiative transfer codes for atmospheric correction and aerosol retrieval: intercomparison study. *Appl. Opt.* **47**, 2215-2226.
[5] Dubovik O., Herman M., Holdak A., et al., 2011: Statistically optimized inversion algorithm for enhanced retrieval of aerosol properties from spectral multi-angle polarimetric satellite observations. *Atmos. Meas. Tech.* **4**, 975-1018.

Preferred mode of presentation: Oral/Poster