AN AUTOMATIC SELECTION AND SOLVING METHOD FOR RATIONAL POLYNOMIAL COEFFICIENTS BASED ON NESTED REGRESSION

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Abstract: As the development of high-resolution satellites, the rational function model (RFM) consisting of 78 rational polynomial coefficients (RPCs) is widely used to replace physical sensor models in photogrammetry and remote sensing. However, the correlation between the coefficients of RFM makes it difficult to solve the RPCs. In this paper, the problem of solving RPCs is converted into a problem of multiple linear regressions with serious multicollinearity, and a novel method based on nested regression is propose to automatically select the proper RPCs. The significant coefficients of RFM are selected one by one according to the evaluation criteria of goodness of fit, while the redundancy coefficients are cast out, and the selected RPCs can be solved using ordinary least square method. Several satellite images including Quickbird P2AS, ALOS PRISM 1B2, SPOT5 HRG 1A and Landsat5 L2 are used in the tests, and the test results show that various numbers of RPCs are selected for those satellite images. Generally speaking, geometric correcting accuracy using the new rational function model with no more than 20 selected line (row) RPCs is no worse than using the original model with 39 line (row) RPCs and ridge estimation (L-curve method), and the new model is hardly ill-conditioned. When the number of ground control points (GCPs) is less than 39, traditional RFM cannot be applied to geometric correction, while stable and accurate RPCs can also be obtained by utilizing the proposed method, and the geometric error of the result is less than 1 pixel.