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The rigorous datum transformation with considering all coordinate errors of both datums

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With extensive applications of space geodesy, three-dimensional datum transformation model has been necessarily used to transform the coordinates in the different coordinate systems. Its essence is to predict the coordinates of non-common points in the second coordinate system based on their coordinates in the first coordinate system and the coordinates of common points in two coordinate systems. Traditionally, the computation of seven transformation parameters and the transformation of noncommon points are individually implemented, in which the errors of coordinates are taken into account only in the second system although the coordinates in both two systems are inevitably contaminated by the random errors. Moreover, the coordinate errors of non-common points are disregarded when they are transformed using the solved transformation parameters. Here we propose the seamless (rigorous) datum transformation model to compute the transformation parameters and transform the non-common points integratively, considering the errors of all coordinates in both coordinate systems. As a result, a nonlinear coordinate transformation model is formulated. Based on the Gauss-Newton algorithm and the numerical characteristics of transformation parameters, two linear versions of the established nonlinear model are individually derived. Then the least-squares collocation (prediction) method is employed to trivially solve these linear models. Finally, the simulation experiment is carried out to demonstrate the performance and benefits of the presented method. The results show that the presented method can significantly improve the precision of the coordinate transformation, especially when the non-common points are strongly correlated with the common points used to compute the transformation parameters.