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PPP-RTK by means of S-system theory: revisiting the undifferenced, uncombined network model and a case study

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A synthesis of two prevailing Global Navigation Satellite System (GNSS) positioning technologies, namely the precise point positioning (PPP) and the network-based real-time kinematic (NRTK), results in the emergence of the PPP-RTK. This new concept preferably integrates the typical advantage of PPP (e.g. flexibility) and that of NRTK (e.g. efficiency), such that it enables single-receiver users to achieve high positioning accuracy with reasonable timeliness through integer ambiguity resolution (IAR). The realization of PPP-RTK needs to accomplish two sequential tasks. The first task is to determine a class of corrections including, necessarily, the satellite orbits, the satellite clocks and the satellite phase (and code, in case of more than two frequencies) biases at the network level. With these corrections, the second task, then, is capable of solving for the ambiguity-fixed, absolute position(s) at the user level. In this contribution, we revisit three variants (geometry-free, geometry-fixed, and geometry- and satellite-clock-fixed) of undifferenced, uncombined PPP-RTK network model and discuss their implications for practical use. We carry out a case study using multi-day, dual-frequency GPS data from the Crustal Movement Observation Network of China (CMONOC), aiming to assess the (static and kinematic) positioning performance (in terms of time-to-first-fix and accuracy) that is achievable by PPP-RTK users across China.