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Reliable Real-time PPP Ambiguity Resolution in the Presence of Extreme Weather Event

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High precision fast Real-time PPP (Precise Point Positioning) applications rely on the successful carrier phase integer ambiguity resolution. On the one hand only when carrier phase ambiguities are estimated as the correct integer values, they can act as highly precise range observations, and on the other hand fast (i.e. instantaneous or near instantaneous) precise positioning is only feasible if the ambiguities are fixed. Therefore solving PPP model is generally based on three steps. First obtain the standard least squares solution by ignoring the integer nature of the ambiguity, the so-called float solution. Second, the float ambiguity solution is computed to its integer counterpart, and finally, the estimated parameters are adjusted to the integer solution.

Thereby the assumption is that the float solution is unbiased. However, any mis-specification in the functional model will usually lead to biases in the least squares estimator and thus in the float solution of the ambiguities. One of these model errors could be caused by the tropospheric delay, as it is known to be a dominant error source in high accuracy GNSS applications. The effect of this kind of delay will be increased during extreme weather events because current troposphere models are not capable of considering the complex atmosphere around the receiver during situations like typhoons, storms, heavy rainfall, etc.

The focus of this contribution is on the model errors caused by the tropospheric delay and its effect on the Real-time PPP ambiguity resolution. First, a real-time recursive Detection, Identification and Adaptation (DIA) procedure is applied to detect the model errors caused by the weather events and an unbiased model is therefore proposed. Then the maximum allowable biases of integer ambiguity resolution for the biased model are identified in an analytical manner since with more parameters, the strength of the unbiased model would be reduced. The underlying model strength is also a critical factor which affects the success rate of the integer ambiguity resolution except for the model biases. In this case, whether an unbiased model is used for ambiguity resolution should be depending on the size of the bias.