Performance Testing and Runtime Optimisation of an Independent NeQuick-G Implementation

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Abstract

Single frequency GNSS observations require an ionospheric correction model to eliminate ranging errors caused by the ionospheric delay. The NeQuick-G algorithm is an algorithm prescribed by the Galileo GNSS system to eliminate ranging errors caused by the ionospheric delay. Compared to the Klobuchar algorithm, which is prescribed by the GPS, the NeQuick-G algorithm provides more accurate ionospheric delay estimates, at the cost of increased computational effort.

In this research we propose, implement, and test an independent, runtime optimised version of the NeQuick-G algorithm. The implementation is performed in *C*, with the goal of running on embedded hardware. The main optimisation applied is caching of intermediate results, to avoid repeated integral computations.

The NeQuick-G implementation is compared to two independent reference implementations [1] [2], both following the Galileo NeQuick-G algorithm specification [3]. The ionospheric delay estimates are shown to be identical to those of the reference implementations to within 10^{-10} TECU. This difference is attributed to rounding errors at machine level. The impact of result caching on the ionospheric correction quality is determined to be negligible: the average difference between non-caching and caching (30 s) TEC delay estimates is approximately 1 cm. Finally, the runtime performance of the implementation is compared to the reference implementation on modern PC hardware as well as for representative embedded hardware (Cyclone5).

The independent implementation shows comparable performance to the reference algorithms. A significant runtime reduction is achieved with 30 s caching as specified in the Galileo NeQuick-G documentation. The performance measured on Cyclone5 embedded hardware suggests that the caching algorithm can be run without issues up to 50 Hz or beyond. More aggressive optimisation and caching, allowing for minor degradation of the results, is in progress and will be presented.

Keywords

Galileo, Ionospheric correction, NeQuick-G, Optimisation

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