An investigation of interval and set-based uncertainty representation for GNSS navigation

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Introduction

Uncertainty modeling and bounding are of vital importance for high-integrity GNSS applications. All contributing observation and system errors should be adequately assessed to ensure safety operations of navigation. Classical approaches are mostly developed in a stochastic manner with probabilistic assumptions. However, the exact error distribution is often unknown, and remaining systematics may persist, so that a purely stochastic modeling of all error sources will not be adequate, and alternative uncertainty bounding and propagation should be studied. Intervals and sets, i.e., zonotope and polytopes, can be seen as natural ways to represent unknown-but-bounded uncertainty. They are not linked with any probabilistic assumptions, therefore, are deterministic [1,3]. Subsequently, a linear uncertainty propagation is applied instead of the quadratic variance propagation.

In this contribution, we report the interval and set-based uncertainty methods that we have applied in the context of GNSS range-based positioning and discuss its feasibility in future integrity applications.

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References

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