

Application of identification theory and stochastic modelling on GPS and GALILEO

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INTRODUCTION

In this abstract we sketch the idea for a 4-year study, in which a more robust and more accurate positioning for the future will be achieved with the use of carrier phases of GPS and GALILEO. We believe that if we have the appropriate stochastic models to describe the error sources within GNSS and if we build the right estimator, our aim will be achieved.

METHOD

We will analyse all GNSS error sources such as atmospheric disturbance, ambiguity, clock errors, ephemeris errors, multipath,... while we consider both their deterministic as their stochastic part.

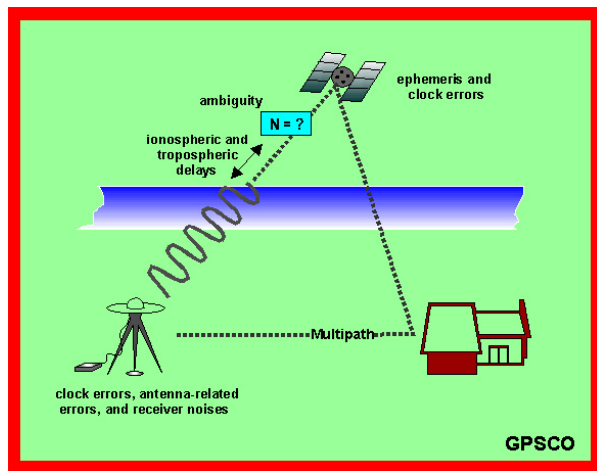


FIG. 1. GNSS biases and errors

The deterministic part can be eliminated by known first order models, double differencing and/or linear combinations of frequencies. Atmospheric models will improve, since with the new European GALILEO system and modernised GPS, we will have more data. Moreover, extra frequencies from modernised GPS and GALILEO can be used for better ambiguity resolution and data combination.

Existing approaches for the stochastic model are dependent on elevation-angle, signal-to-noise ratio or carrier-to-noise-power-density and/or least-squares adaptation. Considerable simplifications are made assuming that all carrier phases have the same variance and are statistically



FIG. 2. GALILEO constellation

independent. For double differenced measurements, temporal correlations are mostly absent. But we know that in reality there are correlations, so the use of an adequate stochastic model in data processing is very important if we want to obtain correct results.

That's why in our study we will analyse the impact of each error source and define an appropriate variance-covariance matrix that takes into consideration all variances and correlations without any simplifications. We analyse how every error source contributes to the global error and use all the information in the measurements to obtain the best variance-covariance matrix. After this we construct an efficient and consistent estimator for the X,Y,Z coordinates, that uses the a priori information about the error sources to make the right weighing.

CONCLUSION

We may conclude that combining data from the future GALILEO constellation with the modernised GPS system, we will obtain a very accurate position if we use an appropriate stochastic model, a numerically stable algorithm and a good estimating framework. Moreover, as an extra benefit, this approach will give us also the uncertainty of this estimated position.

REFERENCES

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