An End-to-End Simulation Tool for Navigation Systems like GPS or the European GALILEO

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Abstract

In the paper the DLR-NAVSIM tool is presented. This tool was developed for simulating actual and future civil navigation satellite systems like GPS, Glonass or the European Galileo. The need of simulation tools increased in the last few years, because the built-up of such systems is very expensive and nobody supports the realisation if the success isn't guaranteed.
The major problem of simulating navigation systems is the handling of the small time variations in the behaviour of satellite tracks, user movements etc. and the high sampling rates required for the large physical transmission bandwidth at signal level (Fig. 1). If all effects would be simulated at the same high signal sampling rate on chip level, this would result in extremely long simulation times. However, the great differences in the time-scale of the reproduced mean influences of a navigation system like pulse shaping, atmosphere or satellite orbit pave the way for a simulation tool design using an two-layer approach. Such an approach guarantees the detailed description of the physical layer on the one hand and allows simulations over a long time period on the other hand.
The upper layer of the DLR-NAVSIM tool deals with the influences of ionosphere, troposphere, orbit constellation and with the effects of the generation and behaviour of the system time and satellite clocks, while the lower layer is a full-featured navigation signal simulator able to simulate additive white Gaussian noise channels as well as statistical multipath channels. By applying a new method for the simulation of multipath channels, the lower layer is able to simulate all channels close to real time.

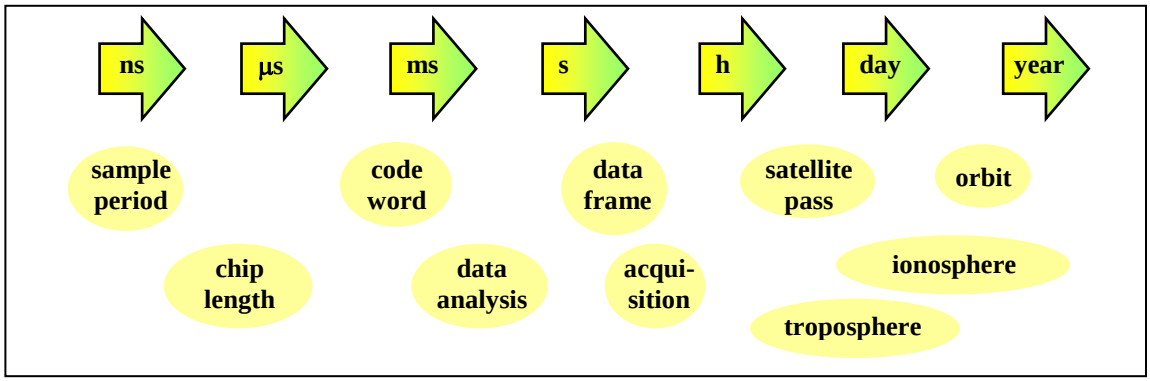

Fig. 1 Time-scales for different aspects in a navigation satellite system.

In the introduction the aim, the problems, and the set-up of the simulation tool are described.
In the second chapter a detailed description of the two different levels is presented. Chapter two also figures out the mean influences on a navigation system, which are realised within this tool in one of the two levels. The third chapter presents some preliminary simulation results in order to demonstrate the capacity of the DLR-NAVSIM tool.

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