

On Conceptual Fundamentals of Radio Navigation

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Abstract. The current educational material and academic literature dedicated to satellite navigation describe the operating principles of the ground positioning systems and the satellite radio-navigation systems. Such terms as pseudorange and pseudodelay are used in the aforementioned sources. Pseudorange is defined as being the product of pseudodelay by light speed. The pseudodelay $\tau_{\text{пз}}$ is defined as being the $\tau_{\text{пз}} = t_r - t^{\text{tr}}$ difference between reception time t_r of the navigation signal on the receiver timescale and the signal transmission time t^{tr} on the satellite timescale. However, the aforementioned sources do not contain any explanation regarding the following issues: how does the receiver determine the value of t^{tr} , what do the terms “timescale” and “epoch on any given timescale” mean, and what is the difference between the time according to timescale and the actual wall-clock time, which is used in physics textbooks. Moreover, many aforementioned sources define the pseudodelay $\tau_{\text{пз}}$, either expressly or implicitly, as the time interval without explaining, whether it is meant to be an interval of the actual time or the time interval within any particular timescale.

Nowadays the most difficult and at the same time the most accomplished ones are the global navigation satellite systems (GNSS). Based on the critical review the contradictions have been revealed in the paradigm used in modern educational material and academic literature, which focus on the operating principles of the GNSS. The new paradigm is introduced based on defining the notions of the timescale and satellite clock time. This new paradigm eliminates the revealed contradictions. The substantial simplification of the system development of the ground positioning systems is suggested based on the newly reintroduced notions and paradigms.

Key words: GNSS, pseudorange, pseudodelay, timescale, satellite clock time