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Methods of Precise Point Positioning in GNSS with Integer Ambiguity Resolution of Phase Measurements

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Abstract. The paper deals with mathematical concepts and the general theory of problem solution of precise point positioning (PPP) in GNSS with integer ambiguity resolution of phase measurements (integer PPP).
Several methods of solving these problems are known in the English-language literature. They use various empirical processing algorithms that are not related to the general theory. The existing methods are reviewed, and their peculiarities and disadvantages are stated.
The general theory can be built on the fact that mathematically the problem of integer PPP always reduces to solving a system of linearized equations, where some of the variables are evaluated as integers. This system is underdetermined, that is, it has infinitely many solutions. The methods of a vector space theory reveal a special property of such a system: the estimates of a part of variables in the infinite set of its solutions remain unchanged. These variables include corrections to the coarse coordinates of a user.
The proposed general theory of problem solution of integer PPP uses the revealed property of linear equation systems in the integer PPP problems, as well as the methods of solving systems of linear equations subject to integer constraints on a part of variables. The results of practical application of the proposed methods of PPP are given.
The authors show that for the ionosphere-free measurement model, instantaneous ambiguity resolution was achieved, since the centimeter level of error is reached from the first processing epoch. When using the measurement model at the original frequencies, the centimeter level of accuracy was achieved after 2-3 minutes of processing of 30-second measurements.
Keywords: precise point positioning (PPP), ambiguity resolution, raw measurement frequencies, phase measurements
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