**"Gyroskopiya i Navigatsiya" №3, 2002**

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| Since the European Commission (EC) decided to built up an own civil global navigation satellite system called Galileo, many people are asking why the EC want to built up an additional system. They say that they can use without any costs the U.S. navigation system GPS and, therefore, there is no need for the European GALILEO for the applications. But this is not really true. For some special applications GPS is not utilisable because it is no guarantee for the availability of the system. | |  |

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| We review the planned modernization of the Global Positioning System (GPS) and the development of the European Galileo system, thereby concentrating on the high-precision carrier phase and code signals eventually available to the GNSS user community for fast and precise Real-Time Kinematic (RTK) positioning.  High-precision GNSS positioning results are obtained with carrier phase measurements, once the integer cycle ambiguities have been successfully resolved using also code measurements. A geometry free and a geometry based approach for ambiguity resolution are discussed. The first approach is conceptual simple but we will show that high ambiguity success rates for a combined hybrid GPS/Galileo system can only be obtained with the second one. The reason is that all ranges are linked to the same three baseline coordinate unknowns, instead of dealing with a double difference range unknown per satellite-pair.  RTK positioning requires forming of double differences of carrier phase and code observations between two satellites, a reference station and the roving receiver. Three scenarios (short, medium and long baseline) are discussed. The categorization refers to the baseline length (<3 km, 20 km and 400 km) but more important than baseline length are atmospheric conditions which are characterized by double differenced tropospheric and ionospheric delays.  Ambiguity success rates for each scenario and for each satellite configuration are calculated as a function of time for a whole day. Each attempt to resolve ambiguities relies on data from only one epoch, i.e. we consider instantaneous ambiguity resolution. The method to calculate (instantaneous) success rates is a based on an approximation called bootstrapping, a sequential process in which ambiguities are fixed (hard-constrained) to integers one-by-one, each time accounting for the statistical correlation with the remaining ambiguities.  As a result we find a decrease of the ambiguity fail rate (i.e. one minus success rate) for a 4 frequency hybrid GPS/Galileo system compared to the dual frequency GPS system. The improvement is largest for the short baseline scenario where the fail rate decreases from 0.24 % to less than 0.000001 %. For medium baseline lengths it decreases from 63% to 6% and no improvement can be seen for long baselines. The improvement is attributed mainly to the increased number of satellites and to the improved geometry. The main performance limiting factors are the uncertainty in the ionospheric delay and to less extend the code measurement error.  The ultra high instantaneous ambiguity success rate for short baselines opens new fields of applications for RTK positioning like avionics. In that fields the high RTK positing accuracy might yield new applications of satellite based navigation | |  |

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