Instantaneous Multi-Baseline Ambiguity Resolution with Constraints

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INTRODUCTION
In this paper we will explore methods for the combination of both relative positioning and attitude determination for moving platforms, each having multi-antennas with known baseline lengths. The objective of this research is to develop a method that optimally makes use of all the information available (the integeress of the ambiguities and the known baseline length of the constrained baselines) to determine the relative position and orientation of a multi-antenna system with unconstrained and constrained baselines. In order to obtain more insight into the problem we will investigate a number of strategies theoretically (using numerical and statistical properties) and analytically (preliminary experimental results) and will discuss the results in this paper. The paper begins with some background information on potential applications and the presently applied separate approaches for relative positioning and attitude determination.

BACKGROUND
Currently precise relative navigation using GNSS is under development for a large number of applications on land, on the water, in the air and even in space. For formation flying of air- and spacecraft, obviously this kind of technique is required for a swarm of Unmanned Aerial Vehicles (UAV), but also for swarms of manned vehicles it could be beneficial. If the vehicles have multiple antennas, potentially GNSS could be used for determination of the attitude of the vehicle(s). Traditionally the relative positioning and attitude determination problem are treated as independent.

AMBIGUITY RESOLUTION
High-precision positioning and attitude determination requires the use of the very precise GNSS carrier phase observations, which however are ambiguous by an unknown integer number of cycles. For ambiguity resolution we make use of the LAMBDA (Least-squares AMBiguity Decorrelation Adjustment) method and its recently developed baseline constrained extension [1]. This method will briefly be discussed and applied to the most challenging cases, namely that of single epoch ambiguity resolution for relative positioning and attitude determination.

BASELINE CONSTRAINED MULTI-ANTENNA AMBIGUITY RESOLUTION
Precise relative positioning of two moving platforms usually requires dual-frequency phase data, whereas – due to the baseline length constraints - single-frequency phase data may suffice for the precise determination of platform attitudes [2-4]. These two GNSS problems, relative positioning and attitude determination, are usually treated separately and independent from one another. In this contribution, however, we will combine the two problems and discuss different processing strategies for solving them. As such the problem becomes a multi-antenna ambiguity resolution problem of which some of the baseline lengths are constrained. The different strategies discussed range from the uncoupled approach to a fully integrated approach [5]. Insight in the numerical and statistical properties of these different approaches will be given together with experimental results.

REFERENCES