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THE KEY ROLE AND ADVANTAGES OF GNSS PRECISE RELATIVE POSITIONING IN SPACECRAFT FORMATION FLYING MISSIONS DESIGN, ANALYSIS AND OPERATIONS

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The paper focuses on a specific space application of the satellite-based navigation Global Navigation Satellite System (GNSS), namely its use for the precise relative positioning and navigation of formation flying satellites. The paper describes GNSS advanced data processing methods using software tools for the precise relative positioning of formation flying satellites and its use, key role and advantages in their missions design and operations. Precise relative navigation is an essential aspect of spacecraft formation flying missions, both from an operational and a scientific point of view. One of the fundamental issues of spacecraft formation flying is the determination of the relative state (position and velocity) between the satellite vehicles within the formation. Knowledge of these relative states in (near) real-time is important for operational aspects. In addition some of the scientific applications, such as high resolution interferometry, require accurate post-facto knowledge of these states instead. Therefore a suitable sensor system needs to be selected for each mission. As commonly known precise relative positioning between GNSS receivers in geodetic networks is exercised on a routine basis. Furthermore GNSS receivers are already frequently used on-board satellites to perform all kinds of navigational tasks, are suitable for real-time applications and provide measurements with a 3-dimensional nature. Therefore they are often considered as the primary instrument for relative navigation in future satellite formation flying missions. The paper describes the most recent GNSS Data Processing Techniques and Algorithms used for the estimation of the initial carrier phase ambiguities with the highest level of accuracy possible for the determination nearly in real-time of the relative baseline between two GNSS Receivers installed on-board two Low Earth Orbit (LEO) satellites in formation flying.