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Exploitation of the Inter-Satellite Link in precise orbit determination

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This research aims at evaluation of advantages of the Inter-Satellite Link (ISL) in Global Navigation Satellite System, with particular consideration of the Galileo, as a contribution to precise orbit determination. The ISL provides precise range and range rate measurements between satellites in specific constellation which is one of the key requirements for improving reliability of positioning. The ISL might contribute to autonomous navigation, which allows the space segment to operate with limited ground segment support. Cross-links between satellites may also provide continuous on-board information to compute new ephemeris data for GNSS constellations as well as contribute to atmospheric tomography.

The first part of the study is focused on detailed analysis of the various Inter-Satellite Link schemes considering the major technical possibilities and limitations. Then, the selected results of ranging will be presented in terms of the precise orbit determination (POD) based on weighted least squares adjustment. Since there is no GNSS constellation currently equipped with fully operational ISL, the analysis is based on simulated measurements. Input data is generated using software being developed at Space Research Centre Polish Academy of Sciences, which allows for analysis of the potential second generation Galileo constellation consisting of more satellites including those on geostationary and inclined geosynchronous orbits. The most promising routing schemes (organisation of the inter-satellite connections) will be collated due to influence on POD performance. Results will be compared with respect to precision, stability and quality.

This research perfectly follows the Galileo second generation evolution scheme currently proposed and realised by European Space Agency. Performed analysis aims to bring closer the ISL technique and to make an attempt to include ISL technology into POD, which is very promising additional value for future generation of Galileo and other satellite navigation systems. The performed analysis will also pave the way to more advanced processing including modifications of the current POD approach and development of the algorithms for the ISL system.