

Contributions to the development of navigation and communication techniques for satellite constellations

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Abstract

Future space missions require the deployment of large-scale scientific instruments distributed across multiple spacecraft. The practical approach to implement this type of technology is precision formation flying (PFF). In PFF, the satellites that form the constellation cooperate using inter-satellite links (ISL) to achieve their goals. In order to perform the virtual structure build-up required by the scientific mission, accurate information regarding the relative positioning of the satellites in terms of distance and orientation becomes mandatory. For space missions that cannot rely on the coverage of the Global Positioning System (GPS), high-precision optical or radio frequency (RF) metrology systems that can accommodate multiple satellites must be developed. Although the optical systems have higher accuracy, the RF techniques have the advantage that they do not require dedicated hardware because the ISL can also be used for the metrology. This thesis is focused on RF systems for inter-satellite communications that also perform the required metrology estimations. In the thesis state of the art solutions for both communication and metrology are presented and new methods suitable for the satellite formation flying context are developed.