[Proceeding] The Italian software for GPS Radio Occultation: validation using COSMIC and CHAMP data

THE ITALIAN SOFTWARE FOR GPS RADIO OCCULTATION: VALIDATION USING COSMIC AND CHAMP DATA

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The GPS Radio Occultation (RO) is a remote sensing technique for the profiling of atmospheric parameters. It is based on the inversion of L_1 and L_2 GPS signals collected on-board a Low Earth Orbit (LEO) platform, when the transmitter rises or sets beyond the Earth's limb. The relative movement of both satellites allows a "quasi" vertical atmospheric scan and the profiles extracted using this technique are characterized by a high vertical resolution and a high accuracy. The RO technique is operatively applied for meteorological purposes since such observations can easily be assimilated into Numerical Weather Prediction models. Anyway it is very useful also for climatological purposes, for gravity wave observations and for Space Weather applications.

Actually, three operative satellite missions are carrying on-board GPS receivers for RO purposes: the German CHAMP satellite, the European METOP-1 mission and the USA/Taiwan COSMIC constellation. Several other missions are planned for the next future. In particular, during the 2009 Spring season, the Indian OCEANSAT-2 mission carrying on-board the Italian ROSA (Radio Occultation Sounder of the Atmosphere) GPS receiver is expected to be launched. In the framework of this opportunity, the Italian Space Agency (ASI) founded a pool of Italian Universities and Research Centers for the implementation of the overall (and state-of-the-art) RO processing chain which is called ROSA-ROSSA (ROSA-Research and Operational Satellite and Software Activities). The ROSA-ROSSA will be integrated in the operative ROSA Ground Segment by an Italian Software farm (INNOVA, located in Matera, Italy), and this ground segment will operate in Italy (at the ASI Space Geodesy Center, near Matera) and in India (at the Indian National Remote Sensing Agency, near Hyderabad) starting from the 2009 Spring season. The "Base" version of the ROSA-ROSSA software was delivered to the Industrial partner at the end of 2008 for its integration inside the Italian Ground Segment. This "Base" version implements well consolidated RO algorithms. In particular, it is actually defined by the following software modules.

- SWOrD which is the software package that fully supports the LEO orbit determination (using a dynamic approach) and the excess-phase data extraction;
- DG_BEND, DG_BDIF and DG_BISI that define the processing chain responsible for the extraction of bending angle and impact parameter profiles from carrier phases observations (using Geometric Optics algorithms), their compensation for Ionospheric effects and their optimization in stratosphere;
- DG_NREF and DG_ATMO that respectively are the software packages for the inversion of bending angle profiles into refractivity profiles (using the classical Abel inverse integral) and for the extraction of pressure, temperature and water vapour profiles (using a 1D-VAR approach based on climatology);
- DG_DELN which implements the Onion Peeling algorithm for the extraction of Electron density profiles.

The RO state-of-the-art algorithms will be implemented in the ROSA-ROSSA final release (namely the "Extended" version), that will be available in May, 2010 on a pre-operative Ground Segment. This "Extended" version will be implemented for the first time on a distributed hardware and software infrastructure exploiting a GRID computing strategy. The "Extended" version will be based on the application of more advanced orbit determination and prediction algorithms for the evaluation of both LEO and GPS orbit informations, of Physic Optics algorithms for the extraction of unambiguous bending angle profiles in the lower (and wettest) troposphere and on the initialisation of variational algorithms using local climatologies and Numerical Weather Prediction data.

This contribution deals with the validation analysis performed on the ROSA-ROSSA first release. Since no real ROSA observations were available, the ROSA-ROSSA software has been validated following two procedures. The input dataset has been defined considering one day of real observations carried out in the framework of the COSMIC and CHAMP missions. Firstly, ROSA-ROSSA products at each level have been statistically compared with the correspondent products generated by the COSMIC and CHAMP processing softwares. On the other hand, ROSA-ROSSA and COSMIC refractivity and temperature profiles have been "individually" compared on a statistical base with collocated ECMWF reanalysis (in this case the validity of different algorithm implementations can be tested against something more similar to the reality).

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