PHASE TRANSFORM ALGORITHM FOR RADIO OCCULTATION PROCESSING

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The Global Navigation Satellite Systems Radio Occultation Receiver for Atmospheric Sounding (GRAS) Instrument is one of the instruments carried by the ESA / EUMETSAT METOP satellites (METOP A, B & C). Data from GRAS, in conjunction with other data, is used to estimate atmospheric temperature, pressure and humidity profiles, for numerical weather prediction, and also to investigate ionospheric total electron content (TEC). An advanced processing algorithm, the Phase Transform Algorithm, for estimating neutral bending angles from the GRAS data is described and derived.

The first part of the GRAS data processing involves the reconstruction of the carrier phase received on a given channel at the antenna phase centre (for that channel) from the data produced by the instrument. This involves adding back the signals removed by fixed down conversions and by the track loop or law-based final down conversion. The resulting signal is called the regenerated signal. This signal is corrected for instrument characteristics, general relativistic delay and clock drifts prior to application of the Phase Transform Algorithm.

The classical geometric optics algorithm can be used to recover neutral bending angles as a function of impact parameter provided no multi-path propagation occurs in the atmosphere. If multi-path propagation occurs, a more sophisticated algorithm is required to recover the neutral bending angle as a function of impact parameter, namely the Phase Transform Algorithm. The Phase Transform Algorithm is described and discussed in this paper. The Phase Transform Algorithm is essentially a matched filter that selects from the signal received by the GRAS receiver that portion of the signal associated with a specific impact parameter. The phase transform algorithm thus allows the bending angle to be recovered in the presence of multi-path provided the atmosphere is (locally) spherically symmetric. The use of the phase transform algorithm is a significant advance with respect to the well known geometric optics and wave optics algorithms which were used to process data from previous radio occultation missions observing the Earth's atmosphere.