A fast implementation of the backpropagation and canonical transform methods for GPS occultations

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Backpropagation (BP) has been shown to be an effective method for improving the vertical resolution of occultation retrievals and for resolving multipath ambiguity in the determination of bending angles. In typical implementation, the field at each point on the BP plane is obtained through the numerical integration of the measured data convolved with the free-space Green's function. In order to avoid cycle slips in the BP phase, the field must be sampled sufficiently finely on the BP plane. Thus a large number of integrations is required, which makes BP processing rather time consuming. We describe a FFT-based implementation of BP that reduces its computation time by an order of magnitude. Unlike previous works that are limited to simulated data computed over straight trajectories, our implementation is applicable to real data collected over the curved trajectories of the low earth orbiter. Since BP is used as an intermediate step in the canonical transform (CT) method, the fast implementation shown here will also speed up CT processing dramatically. The efficiency of this method makes it ideally suited for the operational processing of the large number of occultations that will be collected daily by COSMIC and other satellites.