ATMOSPHERIC TEMPERATURE, PRESSURE AND DENSITY PROFILE RECONSTRUCTION FROM REFRACTIVE ANGLE MEASUREMENTS IN STELLAR OCCULTATION

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Stellar occultation instruments have high pointing accuracy and they follow point-like sources. These two features allow accurate measurements of the refractive angle in the limb viewing geometry. The problem of determination of the stratospheric density and temperature profiles from the refractive-angle measurements which can be performed by the pointing system of stellar occultation instruments is considered.
The procedure of temperature reconstruction consists of the following steps. First, refractivity is reconstructed from refractive angle measurements using the inversion of Abel-type integral. Refractivity is connected with air density via Edlen formula. Then the pressure profile is calculated using the hydrostatic equation. Finally, the temperature profile is determined from density and pressure data using the state equation of an ideal gas. The error analysis was performed by the Monte-Carlo simulations with additive Gaussian noise.
Main error sources are detected and sensitivity of the inverse procedure to them is studied. It is shown that both the sampling frequency and instrumental noise are very important for the reconstruction while the influence of scintillation effect and chromatic smoothing vanishes. It is shown that the temperature profile can be obtained with accuracy of 1-2 K and vertical resolution of 1-2 km for altitudes up to 25 km with the present design of stellar occultation instruments.