

C - CONTRIBUTED PAPER

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We present an inverse theoretic approach to the estimation of ionospheric parameters from incoherent scatter radar data. The method consists of removing the range smearing of ionospheric autocorrelation function across the range via a set of 1-D deconvolutions, and performing nonlinear least-squares fitting on retrieved autocorrelation functions. Unlike full-profile analysis, which attempts to estimate ionospheric parameters at all altitudes simultaneously, the new method estimates the parameters at individual altitudes, and hence reduces the burden of computation significantly. Moreover, due to dimension reduction of search space, this approach prevents the least-squares routines from obtaining suboptimal estimates, and therefore it provides more reliable estimation results than full-profile techniques. Additionally, while this approach yields comparable computational cost to height-by-height analysis method, it performs superiorly in terms of the resolution of estimated parameter grid. Further computational efficiency can be obtained by considering only variances of lag-profile error estimates and ignoring the correlations, causing correlation between parameters across altitudes. Thus, in order to maintain high speed of computation, and while achieving high accuracy, we utilize two amplitude modulated pulses in F-region incoherent scatter radar experiments. These two pulses are designed so that they permit to obtain more precise deconvolved lag-profiles. The coding scheme also decreases the correlations between lag-estimate errors. This reduction in correlation justifies using only variances of the error in nonlinear least-squares fitting routines. Application of the proposed method on simulated and actual data, obtained by transmitting these amplitude modulated pulses in an F-region experiment, conducted at Arecibo Observatory, shows a reduction of about 50 percent in errors of estimated parameters.

Abstract Submission Form

2006 National Radio Science Meeting

Abstract: nikoukar19971

Date Received: November 22, 2005

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