Data analysis software for SAMEER-DU Ionospheric Radar

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For real time and near real time forecasting of ionospheric events, accurate and automatic scaling of ionograms recorded by digital ionosonde becomes very crucial. The details of the data analysis software including the auto-scaling module developed for the new SAMEER-Dibrugarh University Ionospheric Radar and the preliminary results of performance analysis are reported in this work. The MATLAB based software and the Graphical User Interface provides the tools for visualization and analysis of the ionospheric data in a easy to use manner. Currently auto-scaling of F layer parameters like foF2, $h^/$F2,hmF2, foF1, MUF as well as foEs, foE etc are possible. In addition, batch mode operation to auto-scale large data sets and real height analysis by ionograms profile inversion using POLAN is also possible. The auto-scaling module is primarily based on identifying the ionospheric layer traces from the regular (interference) and spurious noise signal in the data plan by using the idea of inter-connectedness of trace signals. The performance of the auto-scaling module is evaluated by comparison with manual scaled values and doing a statistical analysis of data spanning different season and geophysical conditions. The performance of module is found to be encouraging in case of few parameters like foF2.

Introduction:
Ionosphere of the earth can influence RF propagation and thereby the communication systems utilizing trans-ionospheric propagation (GPS) or reflection (HF band). Therefore the variability and characteristics of the ionosphere is studied using RF frequency RADAR called Ionosonde. The data recorded by ionosonde called ionograms and driftgrams needs to be scaled according to a set of rule given by UAG23 document or analysed by visual inspection to obtain the useful informations. The process of manually scaling is time consuming, tedious and dependant on human perception. Therefore, the data analysis software of modern digital ionosondes tries to utilize the computing power of PC to provide a method for automatically obtain these data. In this paper, we present the development and the performance of the data analysis software developed for the new SAMEER-Dibrugarh University Ionospheric Radar system the details of which are reported in another abstract submitted to the conference.

System description:
The data analysis software is developed in MATLAB programming language in modular form. A graphical user interface is developed which is then integrated with various modules like auto-scaling foF2, MUF or batch scaling, real height analysis etc. The algorithm for the main module of auto-scaling the foF2 is shown in Fig.1 The GUI and the auto-scaling process schematic is shown in Fig.2.

Results:
The performance of the module for auto-scaling the foF2 is shown below in Table 1. The performance is calculated by comparing the auto-scaled foF2 with the manually scaled foF2 for different local time, season and noise conditions. A deviation of more than 0.5MHz is considered as failure. As we can see, in 83% of cases the module successfully scaled the foF2.

Table 1. The performance of the foF2 module.

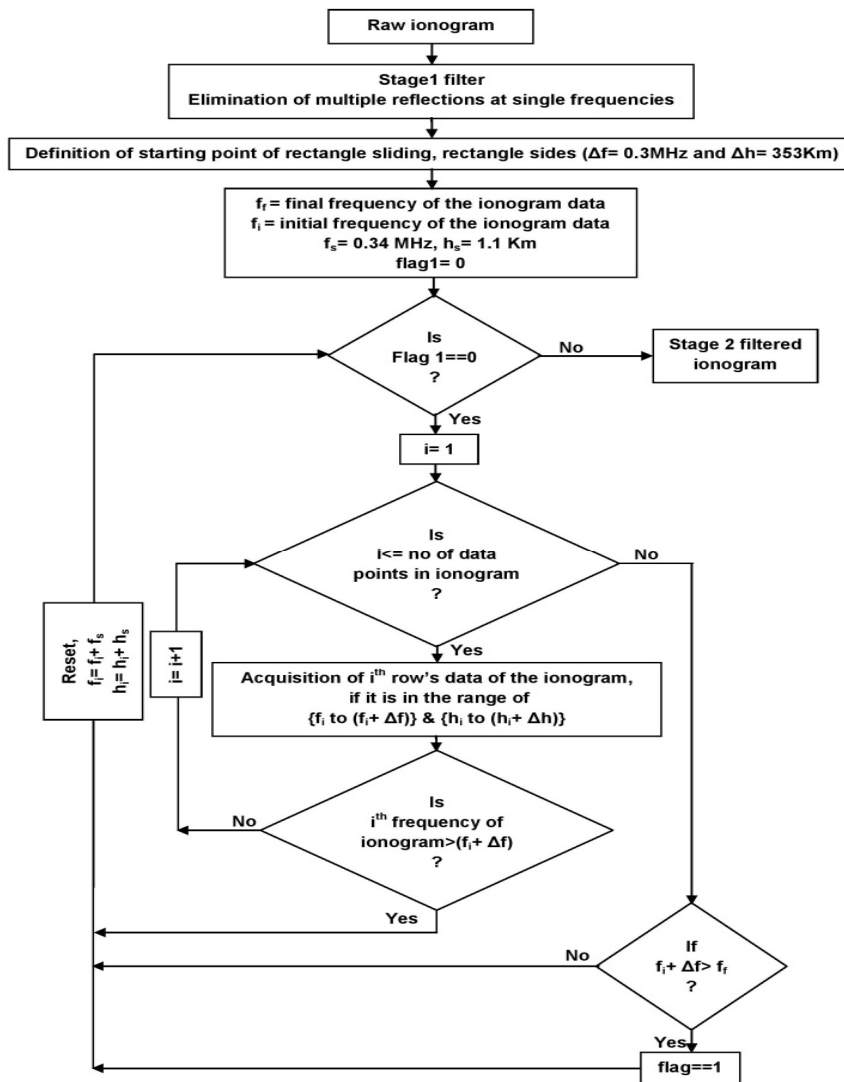| Parameter	Total ionogram considered	Acceptably Scaled	Acceptability
foF2	500	421	83.2%

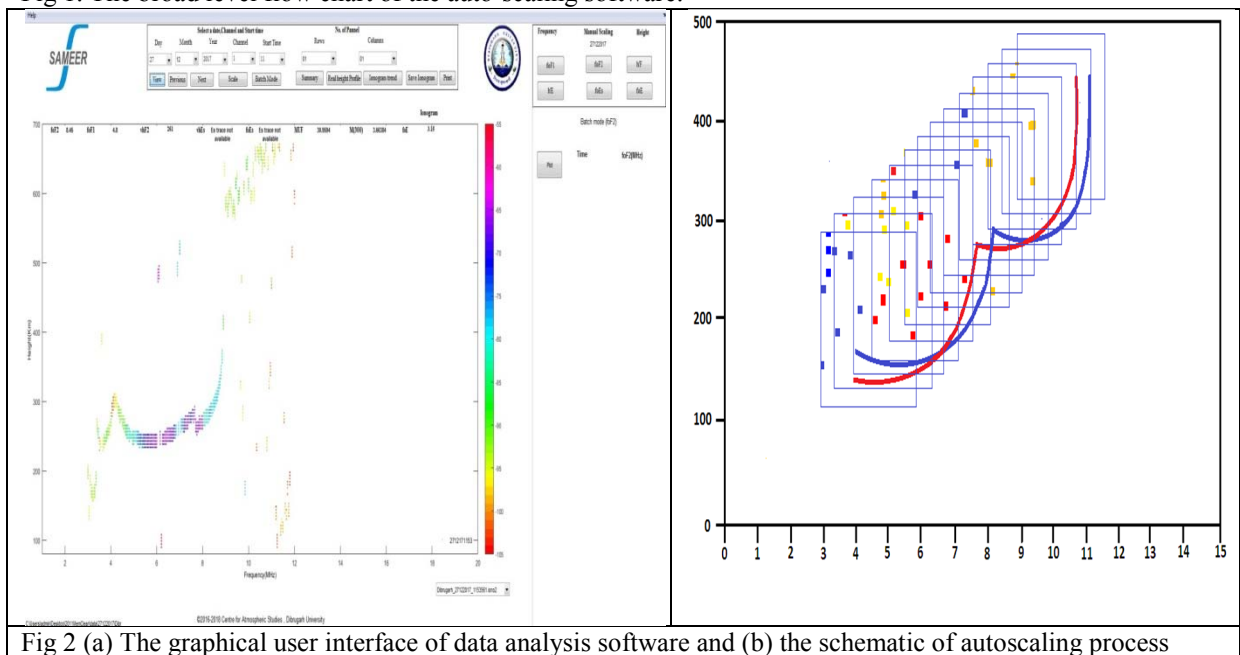Fig 1. The broad level flow chart of the auto-scaling software.

Fig 2 (a) The graphical user interface of data analysis software and (b) the schematic of autoscaling process