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HF Channel Availability under Ionospheric Disturbances: Model, Method and Measurements as Contributions

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A small group at METU has been developing data driven models in order to forecast some critical parameters, which affect the communication and navigation systems, since 1990. The background on the subjects supports new achievements in terms of theoretical and experimental basis contributing the COST 296 WG2 activities. This work mentions the representative contributions.

(i) A method has been proposed for the assessment of HF Channel Availability under ionospheric disturbances. Signal to Noise Ratio (SNR), Doppler Spread and Modified Power Delay Spread were considered. The study relates the modem performance to ionospheric disturbances.

Ionospheric disturbance was characterised by Disturbance Storm Type (DST) index. Radar data including Effective Multipath Spread, Composite Doppler Spread and SNR values were obtained from the experiment conducted between Leicester UK (52.63º N; 1.08º W) and Uppsala, Sweden (59.92º N; 17.63º E) in the year 2001. First, joint probability density function (PDF) of SNR, Doppler Spread, and Effective Multipath Spread versus DST were considered. It was demonstrated by determining the conditional PDFs, and by using Bayes' Theorem, that there were dependencies between DST and the above mentioned parameters [Sari, 2006]. Thus, it is concluded that the availability of the HF channel is a function of DST. As examples of modem characterizations, Military Standards were considered. Given a magnetic condition, the modem availability was calculated.

The model developed represents the ionospheric HF channel, and it is based on a stochastic approach. Depending on the new experimental data, the conditional PDFs could be updated continuously. The HF channel availability under various ionospheric Space Weather (SW) conditions can be determined using the model. The proposed method is general and can include other indices as well. The method can also be applied to a variety of other processes.

(ii) The effects of space weather conditions on the variation of group range and line-of-sight Doppler velocity of the HF Radar echo signal were investigated. HF radar system under ionospheric disturbances has been identified globally and some operational suggestions have been presented. It is possible for the HF radar operator to estimate the possible skip distance and possible single hop group ranges for the given frequencies of 11 MHz and 14 MHz [Buyukpabuscu, 2007].

(iii) The measurements over the HF band during the 29 March 2006 total solar eclipse in Antalya (36° N; 30° E) Turkey was conducted from the channel occupancy and atmospheric noise points of view. The whole HF band ranging from 1 to 30 MHz has been swept using 10 kHz peak and 200 Hz average detectors of a certified EMI receiver equipped with a calibrated active monopole antenna. The changes in the atmospheric noise during the eclipse were reported [Tulunay, 2006].

The model based, theoretical and experimental works mentioned are promising and have potential for future research and developments.

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