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Online Filtering for Radar Detection of Meteors

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The penetration of a meteor on Earth's atmosphere results on the creation of an ionized trail, able to produce the forward scattering of VHF electromagnetic waves. This fact inspired the RMS (Radio Meteor Scatter) technique, which consists in the meteor detection using passive radar. Considering the characteristic of continuous acquisition inherent to the radar detection technique and the generation of a significant amount of data, composed mainly of background noise, an online filtering system is very attractive. Therefore, this work addresses the development of algorithms for online automatic detection of these signals. In time-domain, the optimal filtering technique is applied. The model assumes that the received signal is masked by additive noise and both signal and noise statistics are used to design a linear filter that maximizes the signal-to-noise ratio. This filter is known as the matched-filter, as detection is performed by correlating the incoming signal with replicas of the target signal components in the receiver end. In frequency-domain, two possibilities are being studied using Short-time Fast Fourier Transform: a narrowband demodulation, which basically consists in performing demodulation in filtered data in order to obtain only the envelope of the signal, and cumulative power spectrum analysis. Demodulation is attractive, as phase delays are produced by the reflection of VHF wave to the various points in the meteors trails and the different paths the traveling wave finds between the transmitting and receiving antennas. The cumulative spectral power is obtained from integrating the power spectral density function, which drastically reduces the noise effect. Sets of experimental data are being analyzed and preliminary results of these techniques with their current status of development will be shown.

Summary

This work addresses the development of algorithms for online automatic detection of meteors using radar technique. In time-domain, the optimal filtering technique is applied. In frequency-domain, two possibilities are being studied using Short-time Fast Fourier Transform: narrowband demodulation and cumulative power spectrum analysis.

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