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Using HF Noise from Electrical Grids to Calculate foF2

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1 Extended Abstract

Power lines are a well known source of high frequency (HF; 3 - 30 MHz) and very high frequency (HF; 30 - 300 MHz) noise [*Loftness*(1997), *Pakala & Chartier*(1971)]. The emission can be described as a collection of broadband bursts with pulse widths on the order of $\sim 1\mu$s. The pattern of the bursts is dictated by voltage on the lines, which oscillates at the grid operating frequency (60 or 50 Hz). The pattern of bursts repeats at twice the operating frequency since positive and negative voltage have the same effect. As these pulses are broadband, components within or below the HF band are dispersed and refracted back to earth. Figure 1 shows (top) an example HF dynamic spectra captured by the Long Wavelenth Array (LWA) radio telescope in New Mexico; multiple dispersed pulses from Albuquerque, NM can be seen between 5 and 8 MHz.

Inspired by pulsar radio astronomy we have developed a method for deriving foF2 (peak frequency) and ymF2 (width) from the copious amounts of HF grid noise in cities. Just as pulsar pulses are dispersed in frequency and time by the free electrons in the interstellar medium, the pulses from the electrical grid are dispersed by the free electrons in the ionosphere. We first make a multitude of guesses to the ionospheric state, specifically foF2 and ymF2. We then ray trace through these possibilities to derive delays as a function of frequency. We then apply these delays to broadband, beam-formed HF data, and sum over frequency. We then produce a power spectra to measure the signal at 120 Hz. When we use the correct foF2 and ymF2 we get a peak response at 120 Hz. The bottom of Figure 1 shows the power at 120 Hz as a function of foF2 and ymF2 for a full second of data.

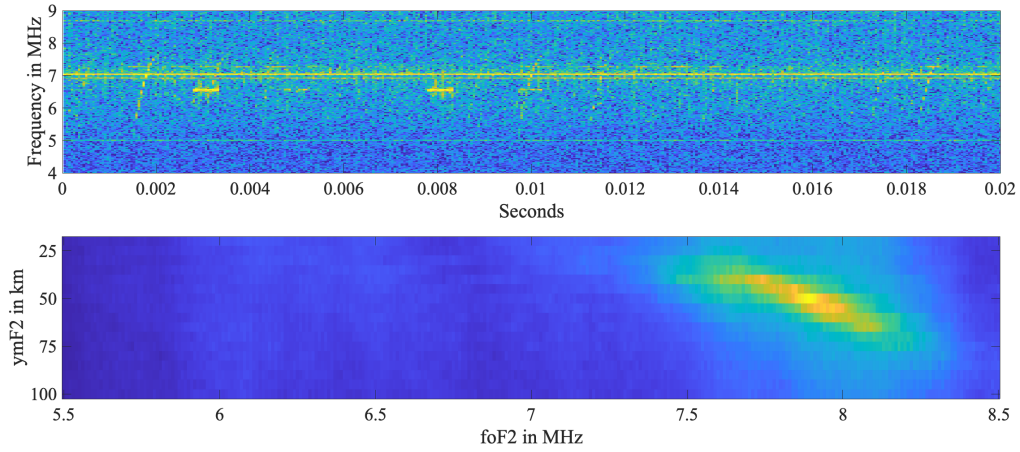

Figure 1

References

[*Loftness*(1997)] Loftness, M.O. (1997), Power Line RF Interference–Sounds, Patterns, and Myths, IEEE Transactions on Power Delivery, 12, 2, 934 - 940

[*Pakala & Chartier*(1971)] Pakala, W. E., and Chartier, V. L., (1971), Radio Noise Measurements on Overhead Power Lines from 2.4 to 800 kV, IEEE Transactions on Power Apparatus and Systems PAS-90 (3), 1155-1165.