Lab Assignment #2

ECE 597UU/697UU, Fall 2009

(Posted on the course website on Mon, 7 Dec; due at the beginning of the Final Exam)

Diurnal variations of amplitudes and spectral densities of microbaroms

Microbaroms are pulses of atmospheric infrasound originating from ocean surface waves. Microbaroms have frequencies of typically 0.2 Hz and amplitudes on the order of one microbar (0.1 Pa). Because of their very long wavelength, there is very little attenuation, such that microbaroms can travel over hundreds, even thousands of kilometers. Therefore, microbaroms can be detected even in the middle of the continents.

Task 1: Download the .mat file, the .jpeg file and the GRL paper by Willis *et al.* (2004) from the Lab #2 webpage. The .mat file contains 24 h of pressure data (sampling rate 2 Hz) collected in North Amherst from 2000 EST on 6 Nov 2009 through 2000 EST on 7 Nov. The .jpeg file shows a spectrogram of the data, covering frequencies up to the Nyquist frequency (1 Hz, that is, half the sampling frequency). Spectra were estimated for each 30-min segment. $S_{11}(f)$ is the one-sided power spectrum of the air pressure. Read the Willis *et al.* paper.

Task 2: Explain qualitatively and quantitatively what you see in the spectrogram.

Task 3: Plot the entire 24-h time series $p(t)$. Describe the graph qualitatively and quantitatively.

Task 4: Select and plot three 10-min long segments of the pressure data: the first one starting at 0000 EST, the second one starting at 0800 EST, and the third one starting at 1400 EST. Explain qualitatively and quantitatively what you see in the three time series plots, also with view on the spectrogram.

Task 5: Calculate and plot one-sided frequency spectra $S_{11}(f)$ from the three 2-h long segments starting at 0000 EST, 0800 EST and 1400 EST, respectively. (Hint: Use and modify the spectral estimation routines provided for HW #8. Set $L = 100$ and change other parameters as necessary.) Explain qualitatively and quantitatively what you see in the three spectra, also with view on the spectrogram.

Grading: The Lab #2 report will be graded according to the following criteria: (a) **readability**, conciseness and logical flow of the text, (b) neatness, clarity and correctness of **figures** including axis labels, choice of colors and symbols, and readability of the figure captions, (c) correctness and completeness of **mathematical equations** including the **verbal definitions** of the symbols in those equations, (d) qualitative and quantitative **understanding** of the measurements. – I will grade each of the four items on a scale from 5 (very bad) to 10 (excellent) and sum them up. A total of 20 is equivalent to a numerical grade of 50% (very bad), and a total of 40 is equivalent to a numerical grade of 100% (excellent).