The Cepstrum Function

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Introduction

The cepstrum function was originally developed for characterizing the seismic echoes resulting from earthquake and bomb explosions. It has also been used to determine the fundamental frequency of human speech and to analyze radar signal returns.

A cepstrum of time history is calculated as follows:

1. Take the Fourier transform of a time history
2. Take the magnitude of the Fourier transform
3. Take the natural logarithm of the magnitude
4. Take the inverse Fourier transform of the natural logarithm

An example is given in Appendix A.

References

1. T. Irvine, An Introduction to Spectral Functions Revision B, Vibrationdata, 2000.

2. T. Irvine, Vibrationdata Newsletter, April 2003.
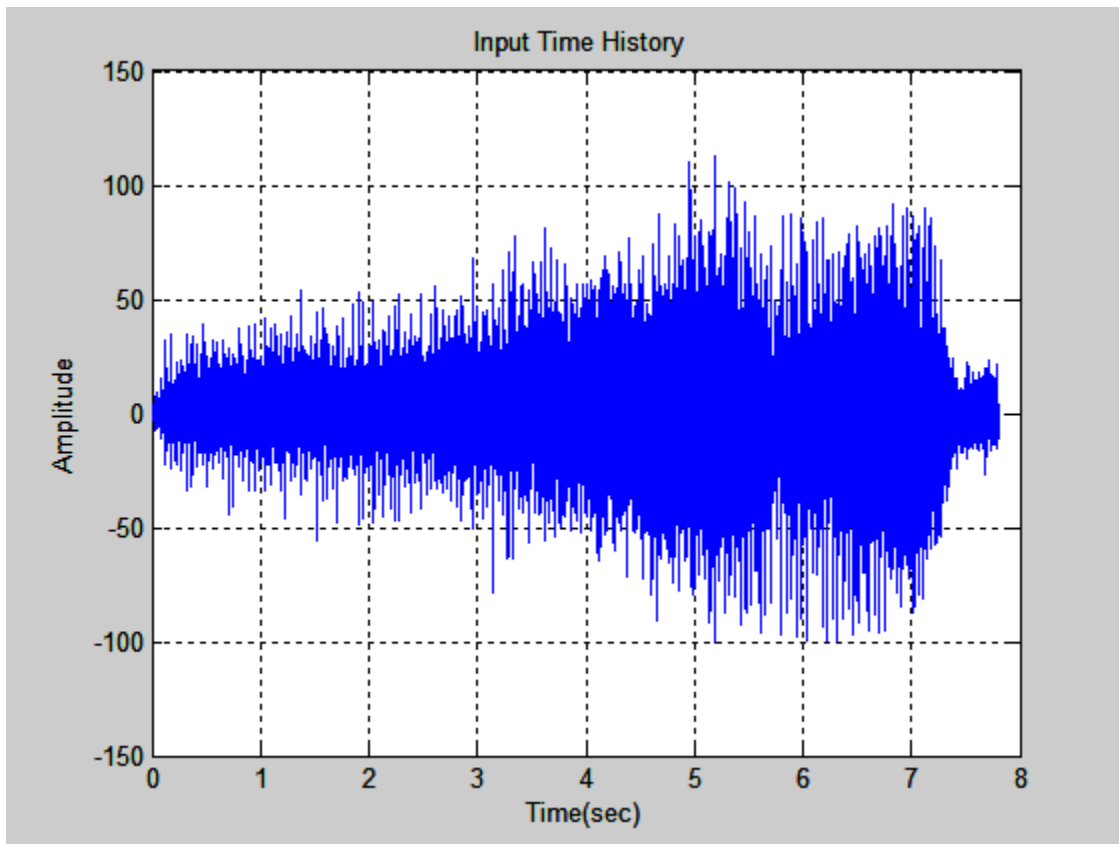   http://www.vibrationdata.com/Newsletters/April2003_NL.pdf

Figure A-1.

A sound pressure time history from an Apache helicopter flyover is show in the figure.
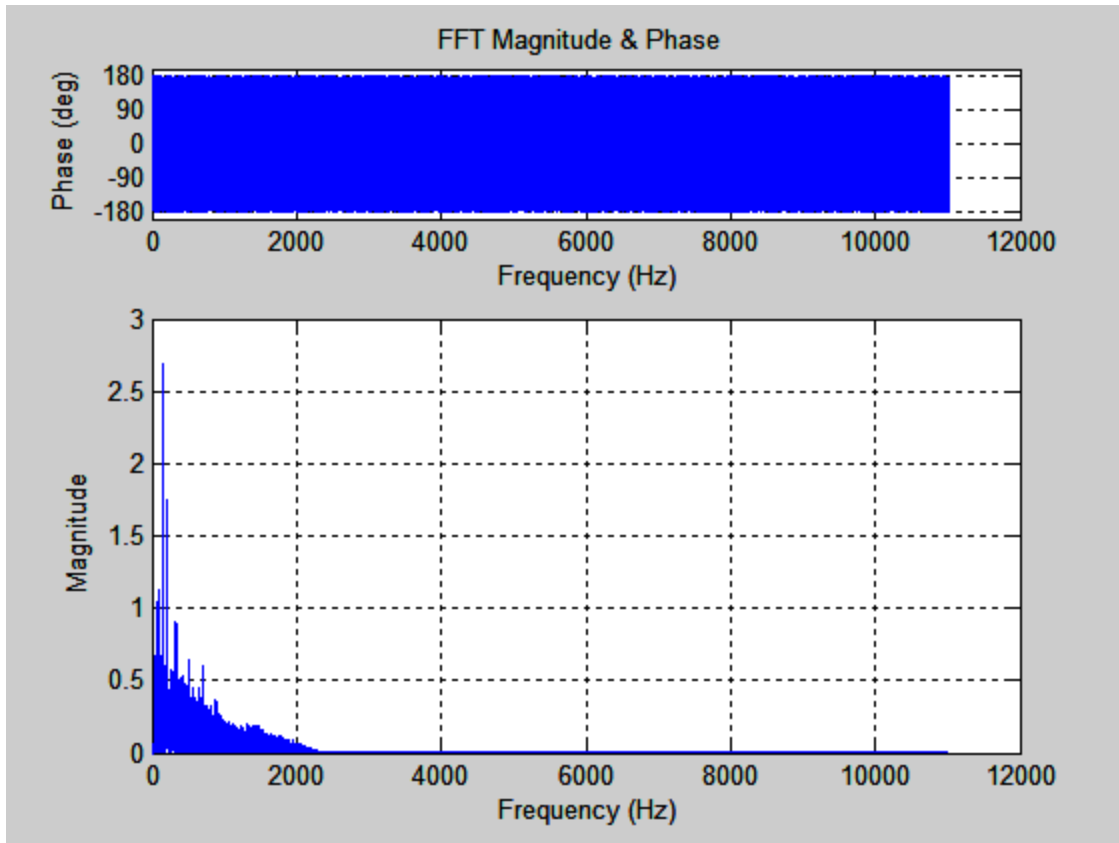
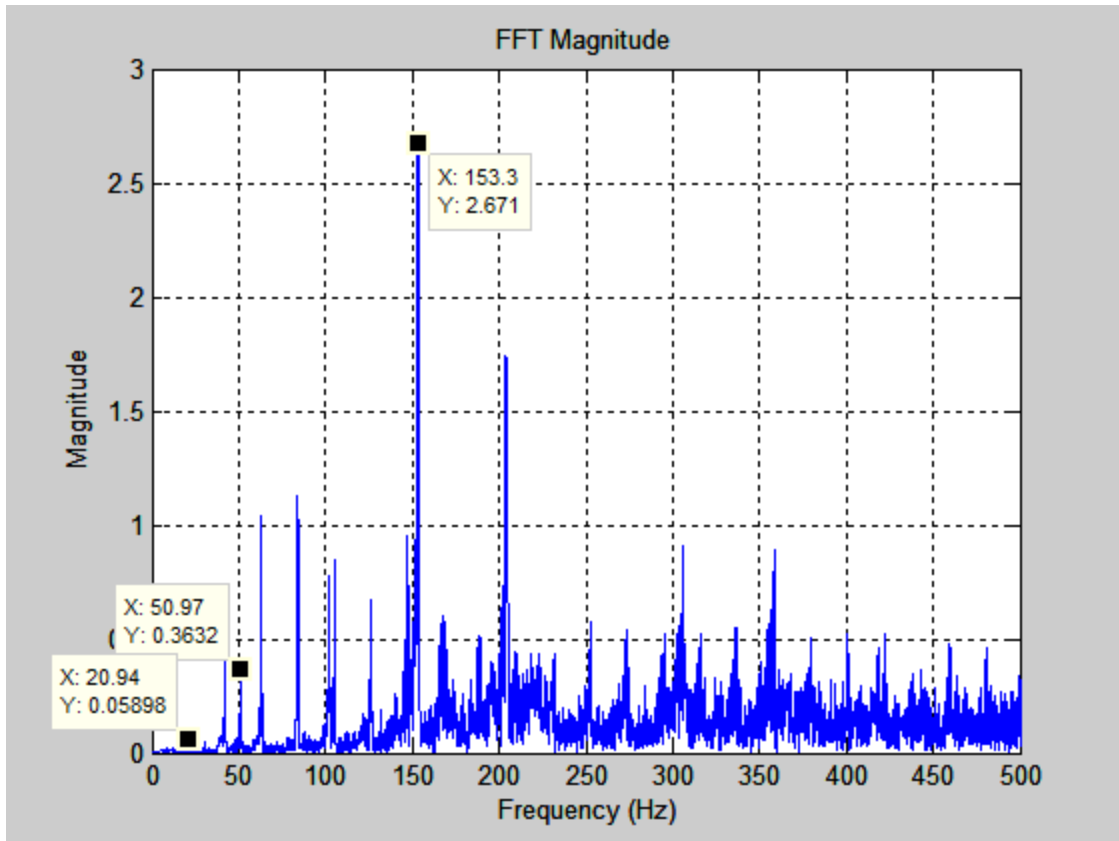The amplitude is uncalibrated.

Figure A-2.

Figure A-3.

There are two sets of spectral peaks.

The first set occurs at 21 Hz and integer multiples thereof. This set represents the main rotor blade passing frequency.

The second set occurs at 51 Hz and integer multiples thereof. This set results from the tail rotor blade passing frequency.

The highest individual peak at 153 Hz is due to the tail rotor.

Both sets have a Doppler shift due to the relative velocity between the helicopter and the measurement location.
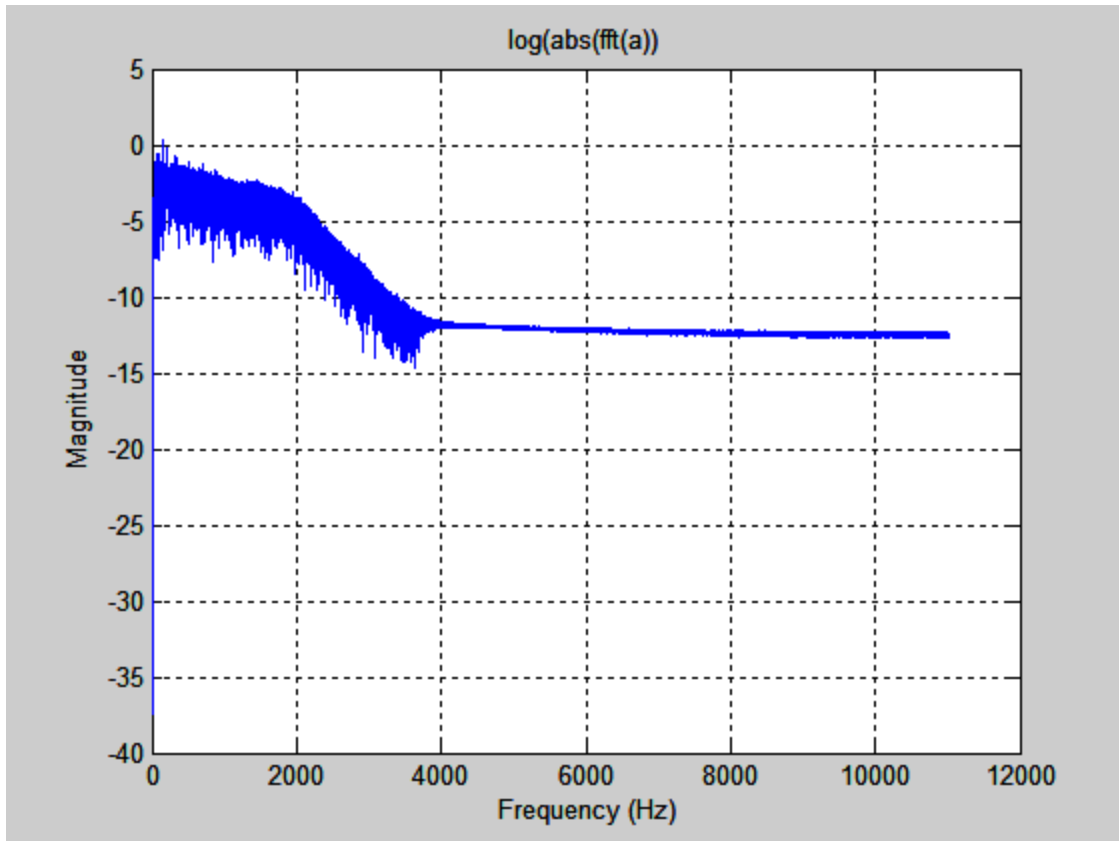
Further information is given in Reference 2.
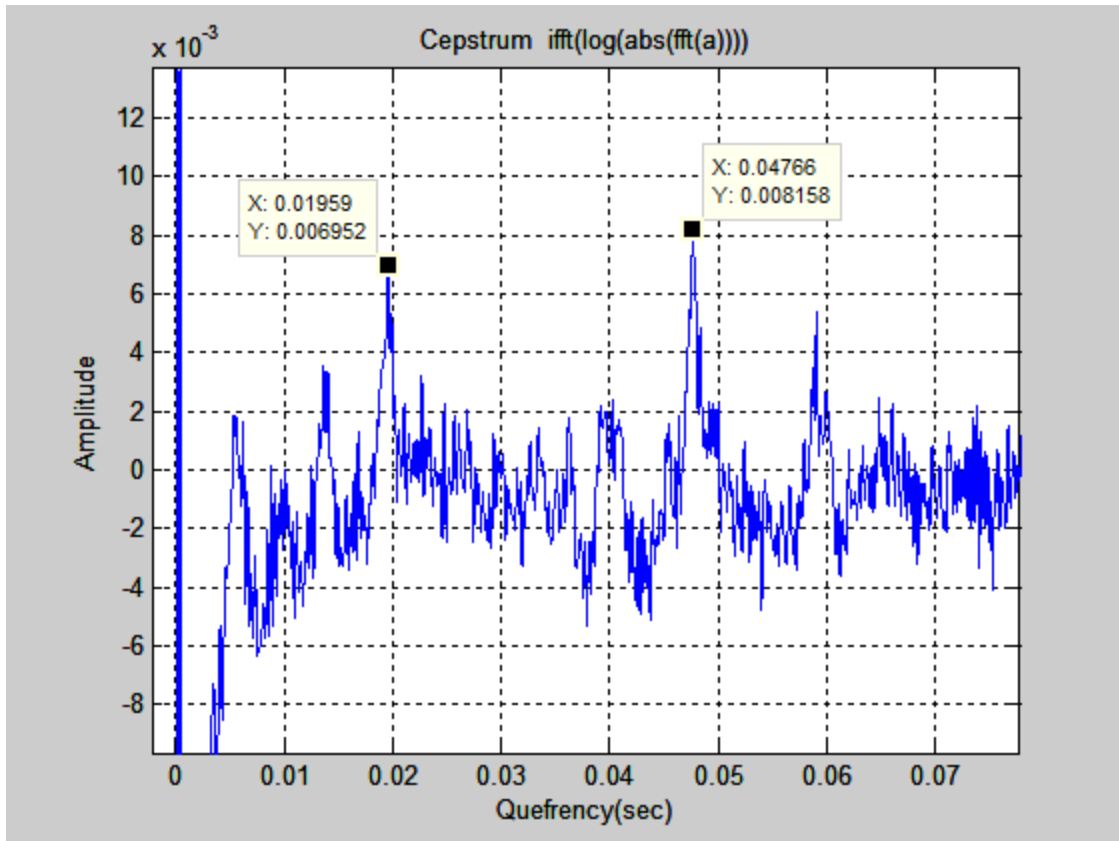
Figure A-4.

Figure A-5.

Tail Rotor Blade Passing Frequency: 1/0.01959 sec = 51.0 Hz

Main Rotor Blade Passing Frequency: 1/0.04766 sec = 21.0 Hz

Integer multiples of these two periods are also present in the cepstrum plot.