Spectrogram Examples

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MATLAB code

- You can use the MATLAB command: specgram
- **SPECGRAM** Spectrogram using a Short-Time Fourier Transform (STFT).
  - B = SPECGRAM(A) calculates the spectrogram for the signal in vector A.
  - SPECGRAM divides the signal into overlapping segments, windows each
    segment and forms the columns of B with their discrete Fourier
    transforms.

- B = SPECGRAM(A,NFFT,Fs) specifies the number of FFT points used to
calculate the discrete Fourier transforms. If NFFT = [] or is not
specified the default NFFT = minimum of 256 and the length of A. Fs is
the sampling frequency which does not effect the spectrogram but is
used for scaling plots. If Fs=[] or is not specified it defaults to 2
Hz.

- B = SPECGRAM(A,NFFT,Fs,WINDOW,NOVERLAP) uses WINDOW to window each
overlapping segment and forms the columns of B with their zero-padded,
length NFFT discrete Fourier transforms. If you specify a scalar for
WINDOW, SPECGRAM uses a Hanning window of length NFFT. WINDOW must
have a length smaller than or equal to NFFT and greater than NOVERLAP.
NOVERLAP is the number of samples each segment of A overlaps. The
default value of NOVERLAP = length(WINDOW)/2.
Example

- \%logon;
- \text{x=logon(64,0.4,128);}
- \text{tflog=specgram(x,32,128,32,31);}
- subplot(211);
- plot(real(x));
- subplot(212);
- imagesc(abs(tflog));
- pause;
- figure
- \%demo signal;
- \text{tfdemo=specgram(demosig,32,200,32,31);}
- imagesc(abs(tfdemo));
- pause
- figure;
- \% effect of the window length;
- \text{y=[zeros(1,128),exp(j*0.6*[1:128]);}
- subplot(411);
- plot(real(y));
- subplot(412);
- \text{tf1=specgram(y,16,256,16,15};
- imagesc(abs(tf1));
- subplot(413);
- \text{tf2=specgram(y,32,256,32,31);}
- imagesc(abs(tf2));
- subplot(414);
- \text{tf3=specgram(y,64,256,64,63);}
- imagesc(abs(tf3));
- \text{t=0:0.001:2; \quad \% 2 secs \@ 1kHz sample rate}
- \text{tf1=specgram(y,256,1E3,256,250);}
- \text{y=chirp(t,0,1,150); \quad \% Start \@ DC, cross 150Hz at t=1sec}
- \text{t=-2:0.001:2; \quad \% +/-2 secs \@ 1kHz sample rate}
- \text{y=chirp(t,100,1,200,'q'); \quad \% Start \@ 100Hz, cross 200Hz at t=1sec}
- \text{tf2=specgram(y,128,1E3,128,120); \% Display the spectrogram}
- figure;
- subplot(211)
- imagesc(abs(tf1));
- title('Linear Chirp: start at DC, cross 150Hz at t=1sec');
- subplot(212)
- imagesc(abs(tf2));
- title('Quadratic Chip: start at 100Hz and cross 200Hz at t=1sec');
Logon
Demo Signal
Effect of Window Length
Chirp Signals

Linear Chirp: start at DC, cross 150Hz at t=1sec

Quadratic Chirp: start at 100Hz and cross 200Hz at t=1sec
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- \%spcgrm;
- \texttt{x=logon(50,0.3,200)+logon(130,0.7,200)+logon(140,-0.5,200)};
- \texttt{S1=specgram(x,256,200,16,15)};
- \texttt{S2=specgram(x,256,200,32,31)};
- \texttt{S3=specgram(x,256,200,64,63)};
- \texttt{S4=specgram(x,256,200,128,127)};
- \texttt{subplot(221)};
- \texttt{imagesc(abs(S1));}
- \texttt{subplot(222)};
- \texttt{imagesc(abs(S2));}
- \texttt{subplot(223)};
- \texttt{imagesc(abs(S3));}
- \texttt{subplot(224)};
- \texttt{imagesc(abs(S4));}
- \%example 2;
- \texttt{x=exp(j*0.5*[1:200])+exp(j*2*[1:200])};
- \texttt{S=specgram(x,256,200,32,31)};
- \texttt{figure}
- \texttt{imagesc(abs(S));}
Multiple Logons
Two Sinusoids