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```
addpath('toolboxes/');
nsegments_in = 20; % select number of segments to process for testing
```

Import data

```
%[x, fs] = audioread('resources/heli_and_boat_short/boat2_short.wav');
 %assume 44.1kHz
[x, fs] = audioread('resources/Cessna.wav'); %assume 44.1kHz
x = mean(x,2);% col vector

% Resample to around 8KHz
x = resample(x,2,11);
fs = fs*2/11;
%x = resample(x,1,2);
%fs = fs/2;
xlen = length(x);

% Construct final window
ham_t = .25; %250 ms duration window
ham_N = floor(ham_t*fs);
w = hamming(ham_N);
wshift = 4; %4hz
exp_modulator = exp(1j*2*pi*wshift.*(1:ham_N)); %mod by 4 hz
exp_modulator = exp_modulator.';
w = w.*exp_modulator;
```

Bandpass using Gammatone Filterbank

```
% Make the center frequency vector
LOW_CF = 200;
HIGH_CF = 4000;
NUMCHANS = 18;
CFS = iosr.auditory.makeErbCFs(LOW_CF,HIGH_CF,NUMCHANS);
```

Segment the data as needed (nonoverlapping)

```
segmentlen = fs;
nsegments_total = floor(xlen/segmentlen);

nsegments = min(nsegments_in,nsegments_total); % for testing

start_pos = 1;
```

```
% Operate on each time segment
for segmentind = 1:nsegments
    end_pos = start_pos + segmentlen - 1;

    x_segment = x(start_pos:end_pos);

    BM = iosr.auditory.gammatoneFast(x_segment,CFS,fs); %operate on
 every col

    for channum = 1:NUMCHANS

        % calculate envelope and downsample
        envt = envelope(BM(:,channum)); %operate on every col
        envt = downsample(envt, 100);


        % normalize
        envt = envt./mean(abs(envt));

        % bp filter
        bp_sig = log10(abs(filter(w, 1, envt)));

        % threshold
        bp_sig(bp_sig>0) = 0;
        bp_sig(bp_sig<(-30)) = -30;

        out_chann(:,channum) = bp_sig;
    end

    out(:,:,segmentind) = out_chann;

    start_pos = start_pos + segmentlen;

end

for segmentind = 1:nsegments
    figure;
    data = out(:,:,segmentind);
    imagesc(data);
    title(['mod specgram for frame number ' num2str(segmentind)]);
    xlabel('filterbank frequencies (Hz)');
    ylabel('acoustic frequencies (Hz)');
    axis xy; colormap(jet);
    colorbar;

    xticklabels = LOW_CF:NUMCHANS:HIGH_CF;
    xticks = linspace(1, size(data,2), numel(xticklabels));
    set(gca, 'XTick', xticks, 'XTickLabel', xticklabels);
end
```

```
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 index
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```
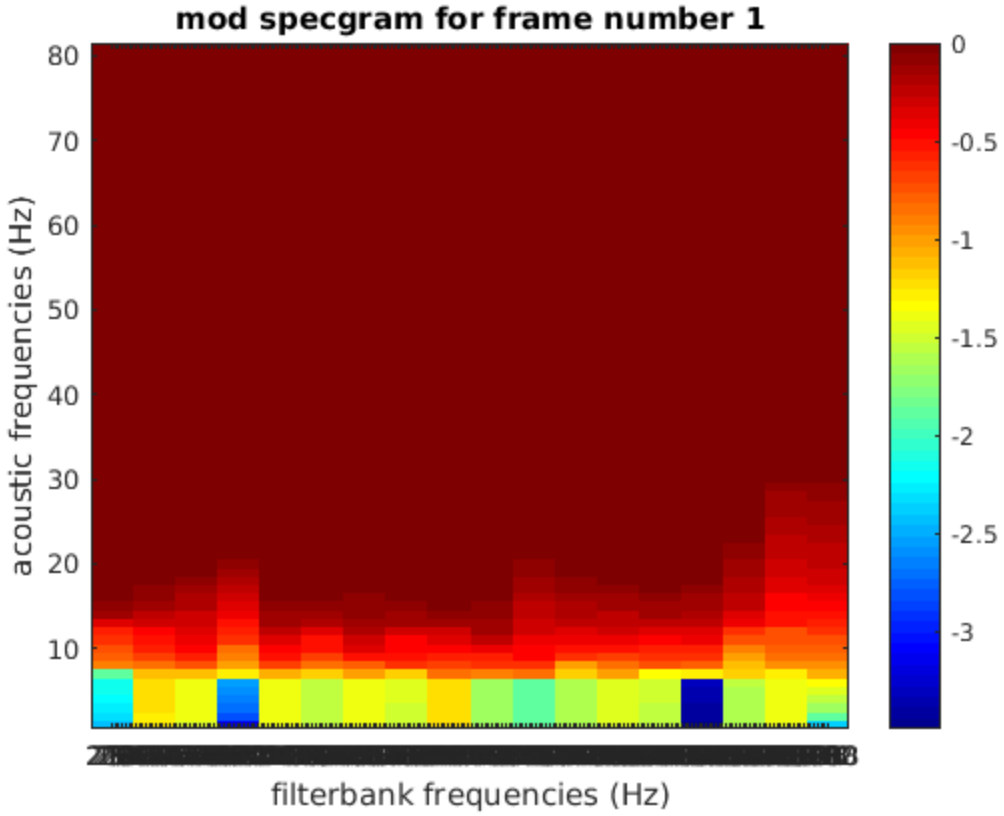
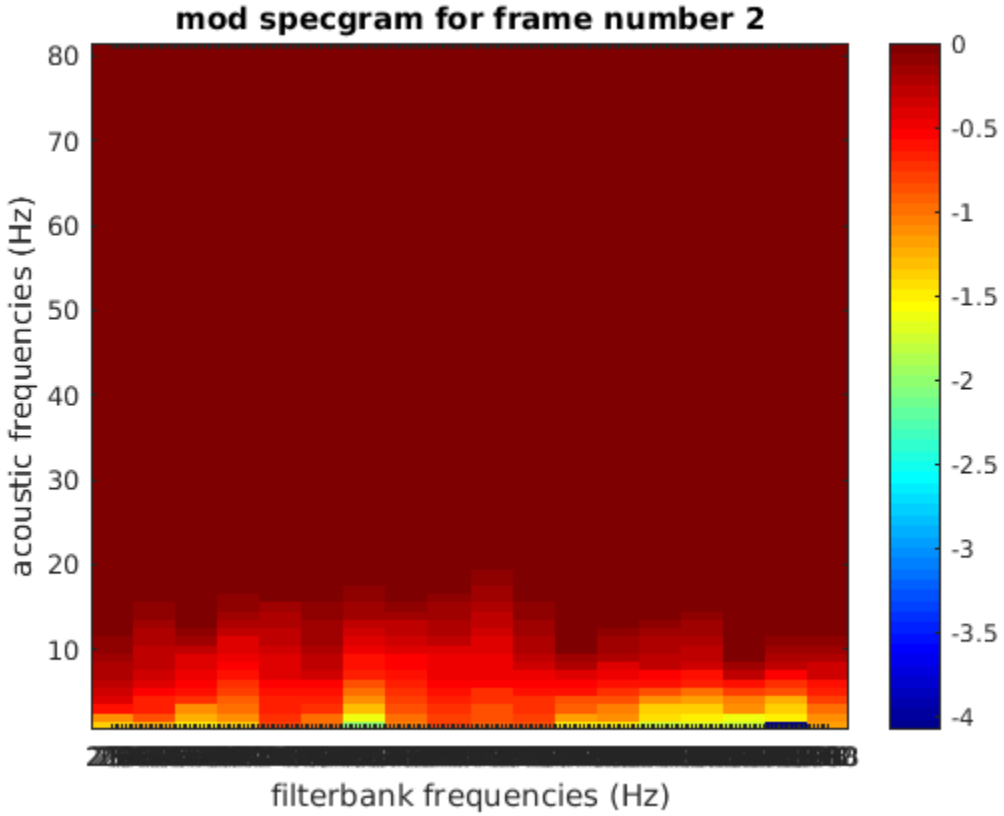
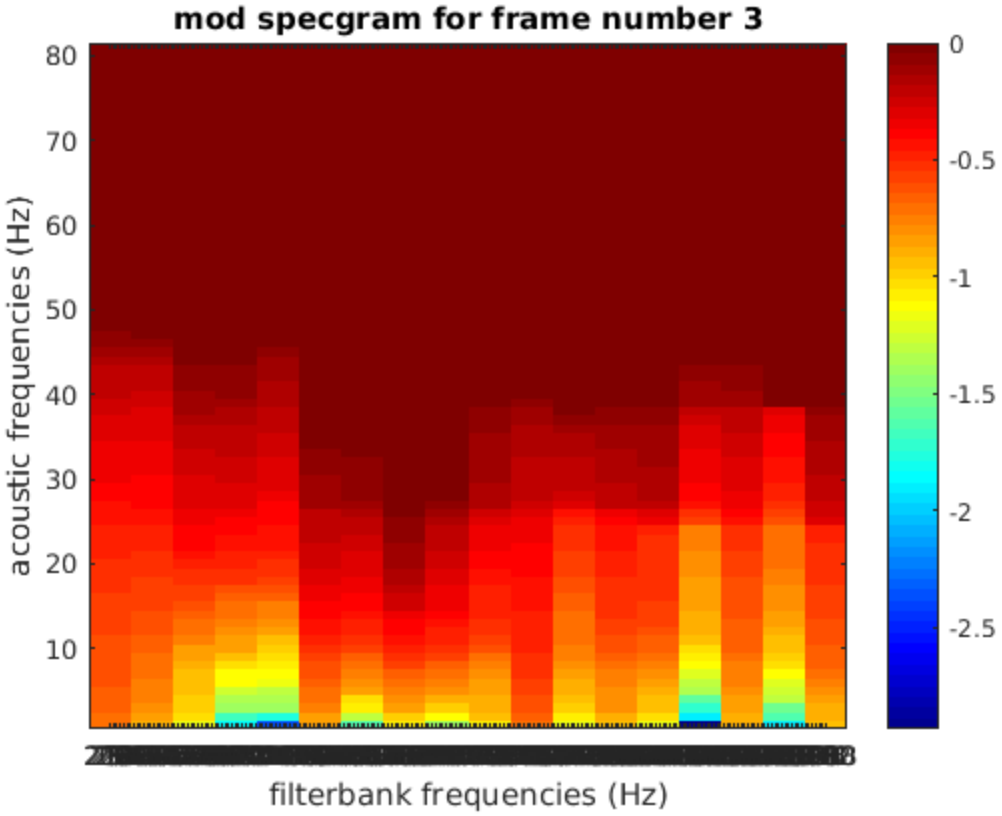
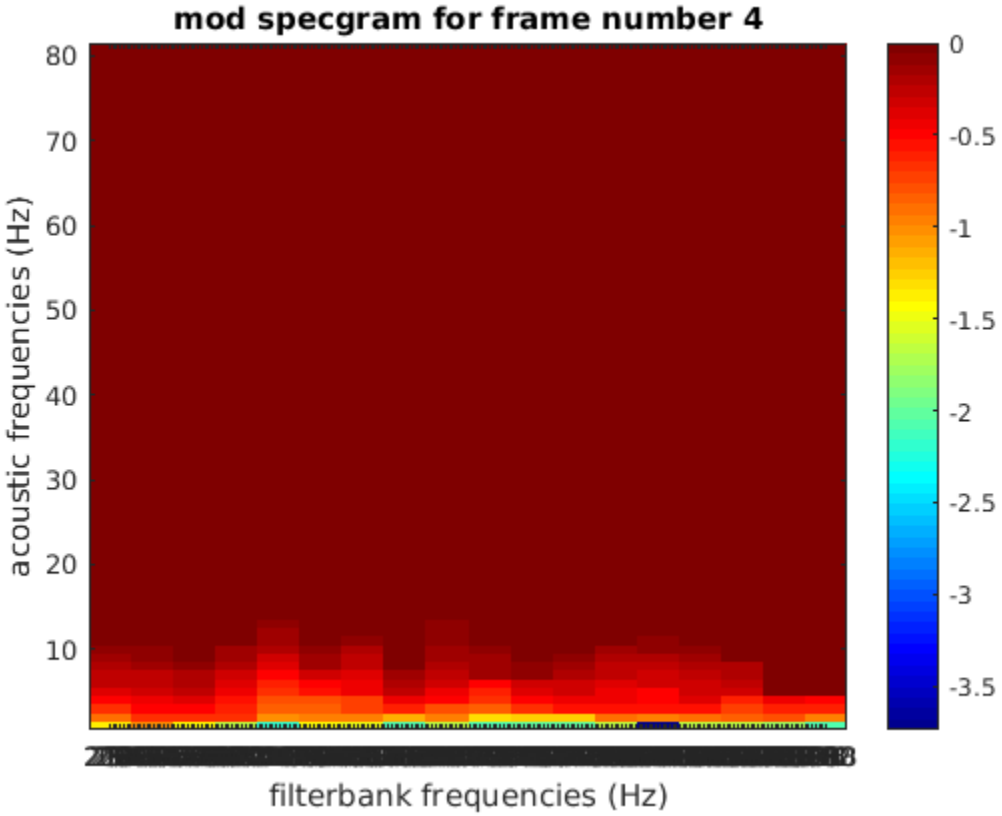
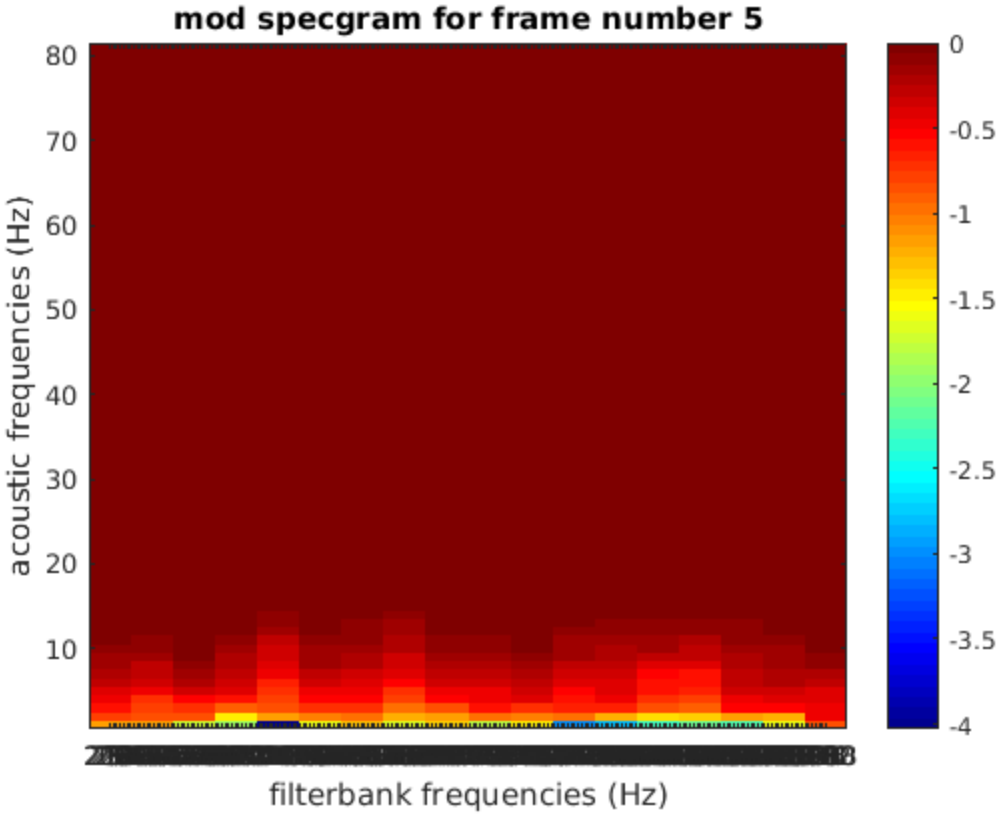
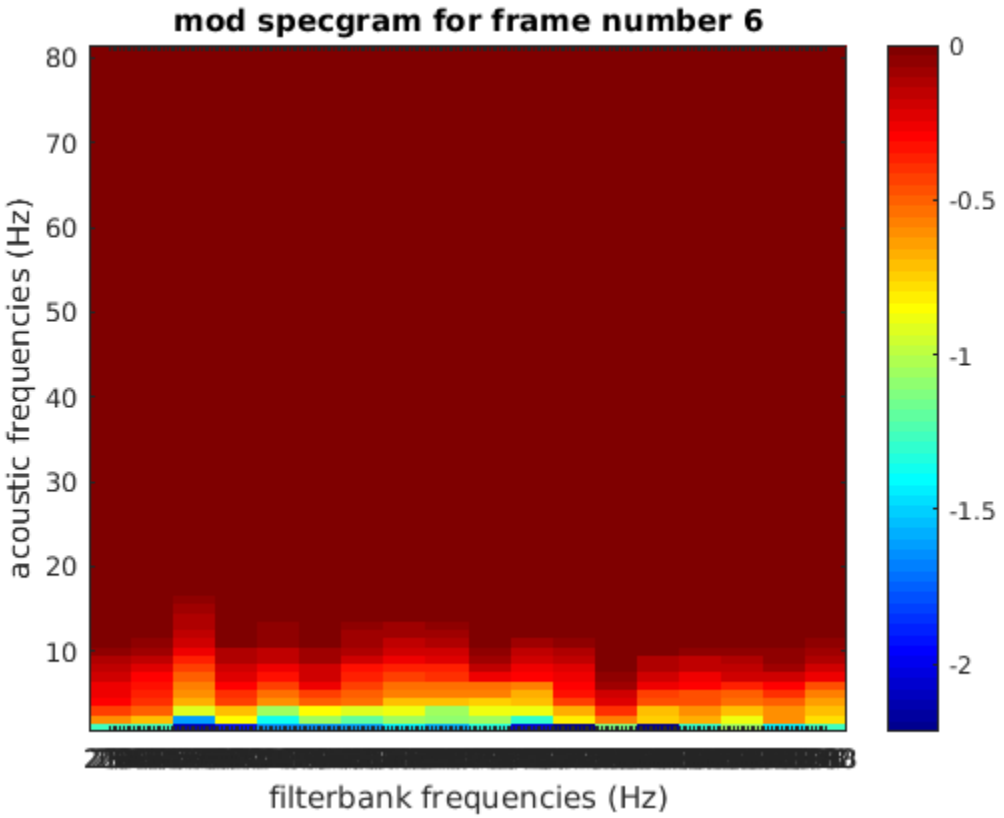


mod specgram for frame number 1
acoustic frequencies (Hz)
80
70
60
50
40
30
20
10
0
-0.5
-1
-1.5
-2
-2.5
-3
filterbank frequencies (Hz)

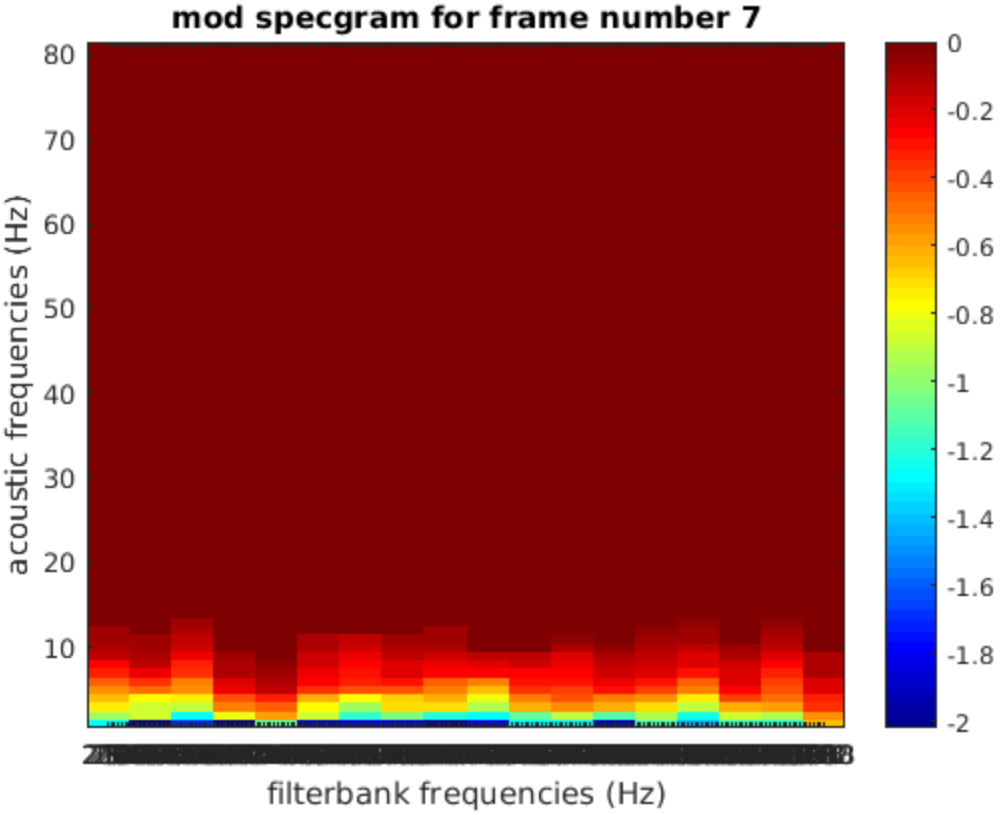

mod specgram for frame number 2
acoustic frequencies (Hz)
80
70
60
50
40
30
20
10
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
filterbank frequencies (Hz)

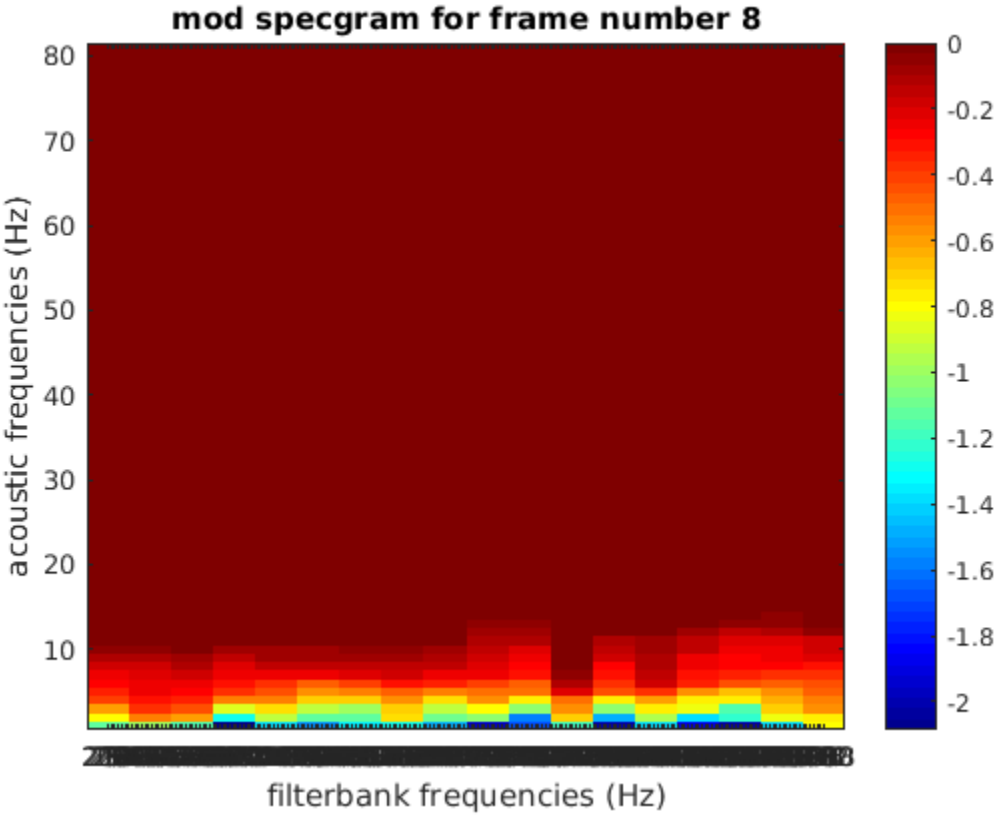

mod specgram for frame number 3
acoustic frequencies (Hz)
80
70
60
50
40
30
20
10
0
-0.5
-1
-1.5
-2
-2.5
filterbank frequencies (Hz)

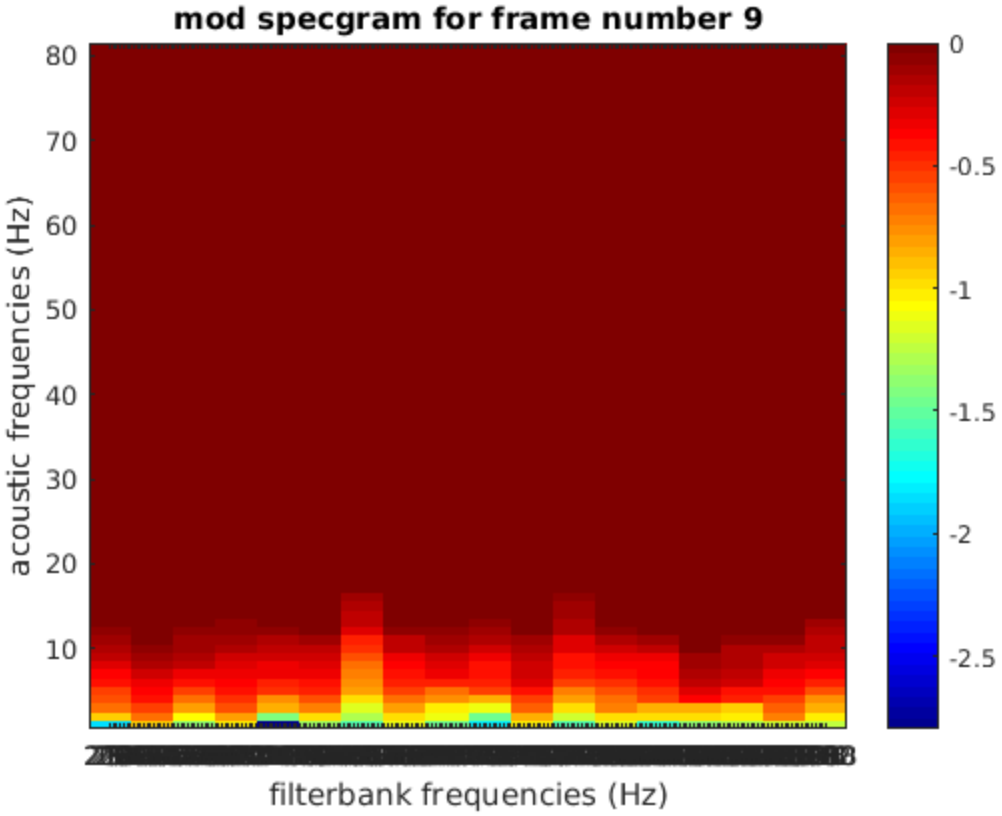

mod specgram for frame number 4
acoustic frequencies (Hz)
80
70
60
50
40
30
20
10
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
filterbank frequencies (Hz)

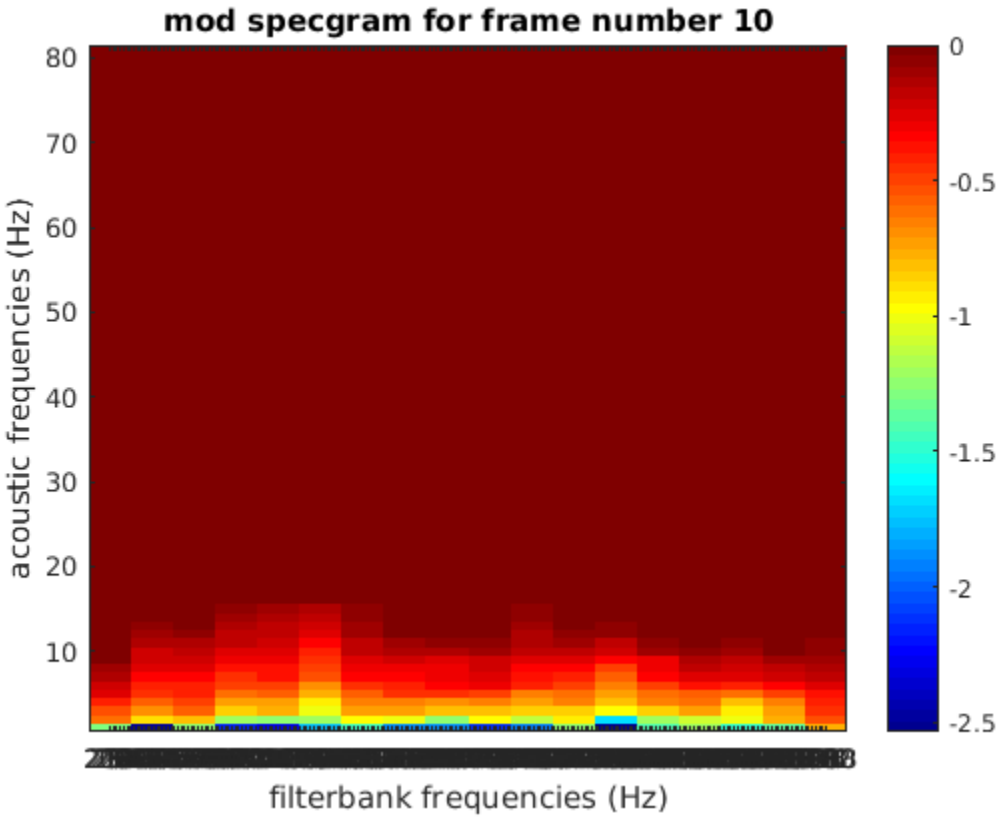

mod specgram for frame number 5
acoustic frequencies (Hz)
80
70
60
50
40
30
20
10
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
filterbank frequencies (Hz)

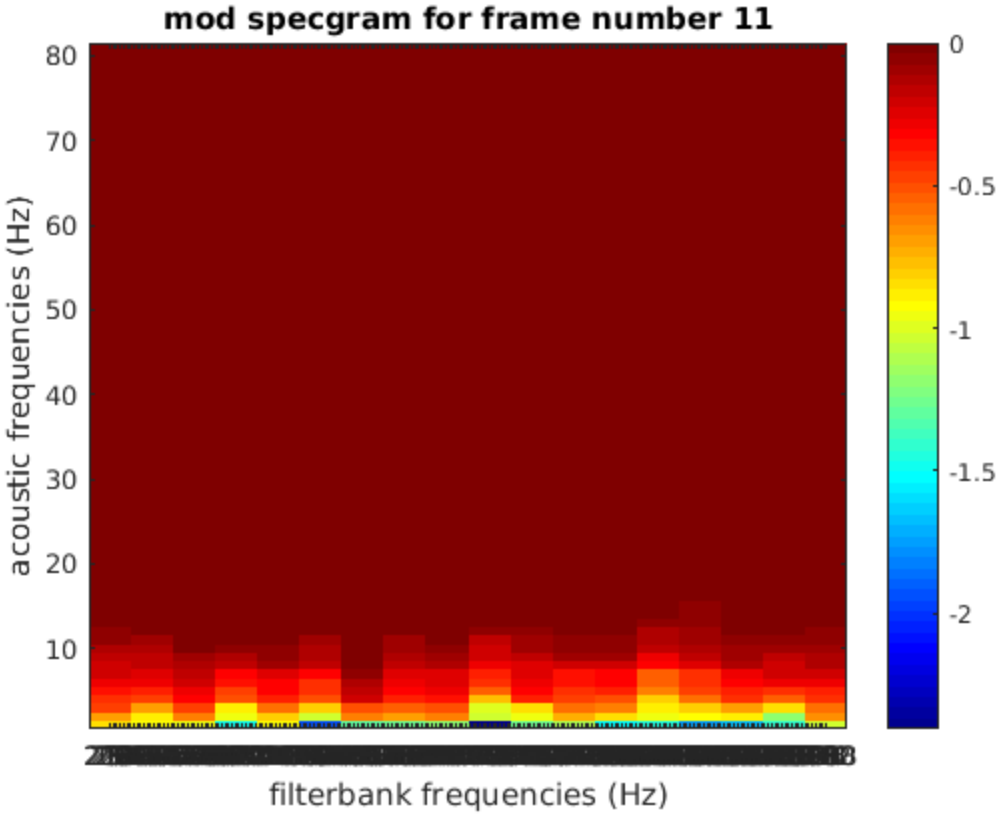

mod specgram for frame number 6
acoustic frequencies (Hz)
80
70
60
50
40
30
20
10
0
-0.5
-1
-1.5
-2
filterbank frequencies (Hz)

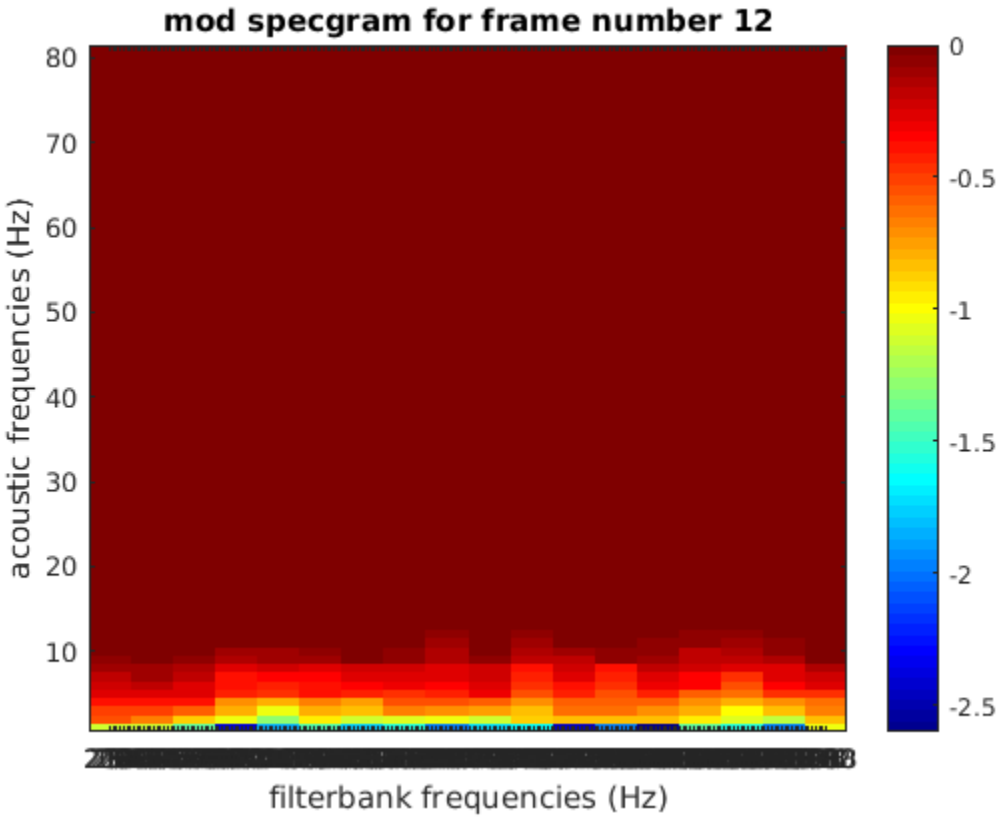

mod specgram for frame number 7
acoustic frequencies (Hz)
80
70
60
50
40
30
20
10
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
-1.4
-1.6
-1.8
-2
filterbank frequencies (Hz)

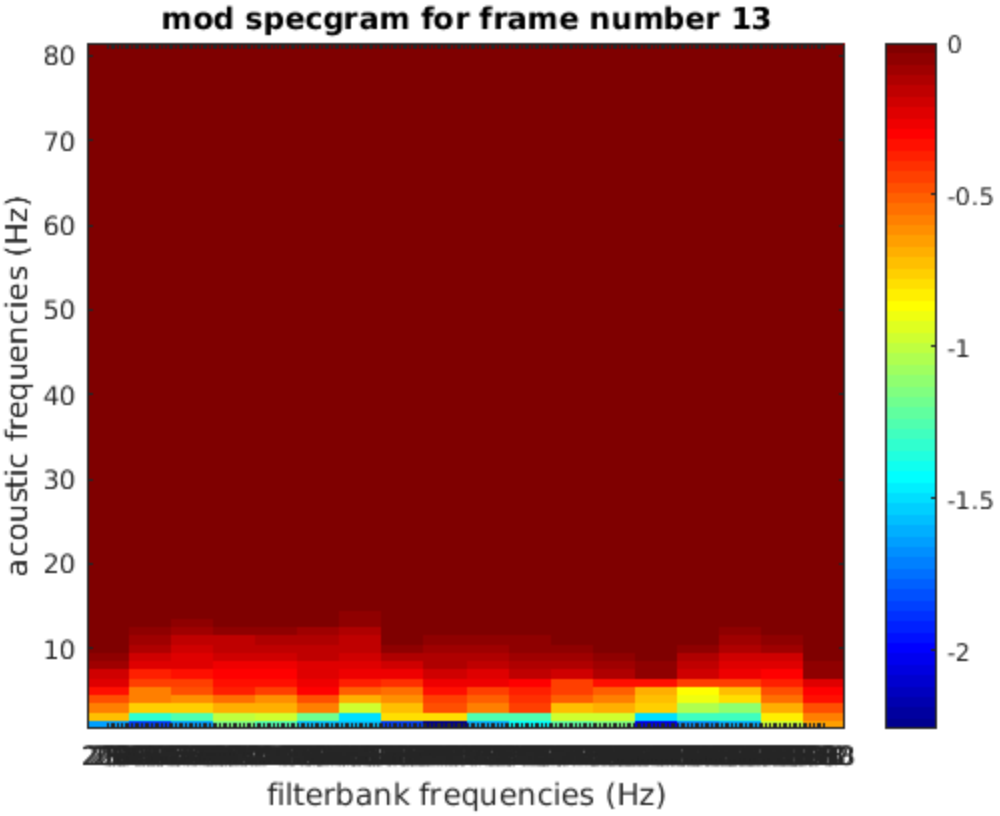

mod specgram for frame number 8
acoustic frequencies (Hz)
80
70
60
50
40
30
20
10
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
-1.4
-1.6
-1.8
-2
filterbank frequencies (Hz)

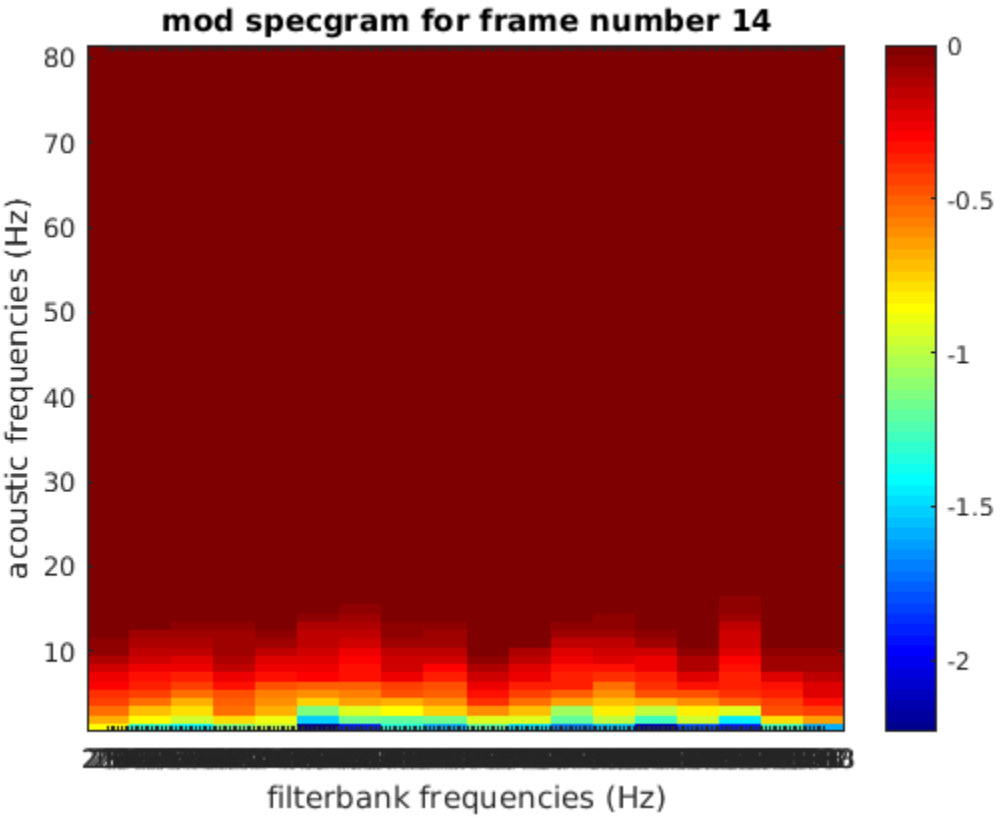

mod specgram for frame number 9
acoustic frequencies (Hz)
80
70
60
50
40
30
20
10
0
-0.5
-1
-1.5
-2
-2.5
filterbank frequencies (Hz)

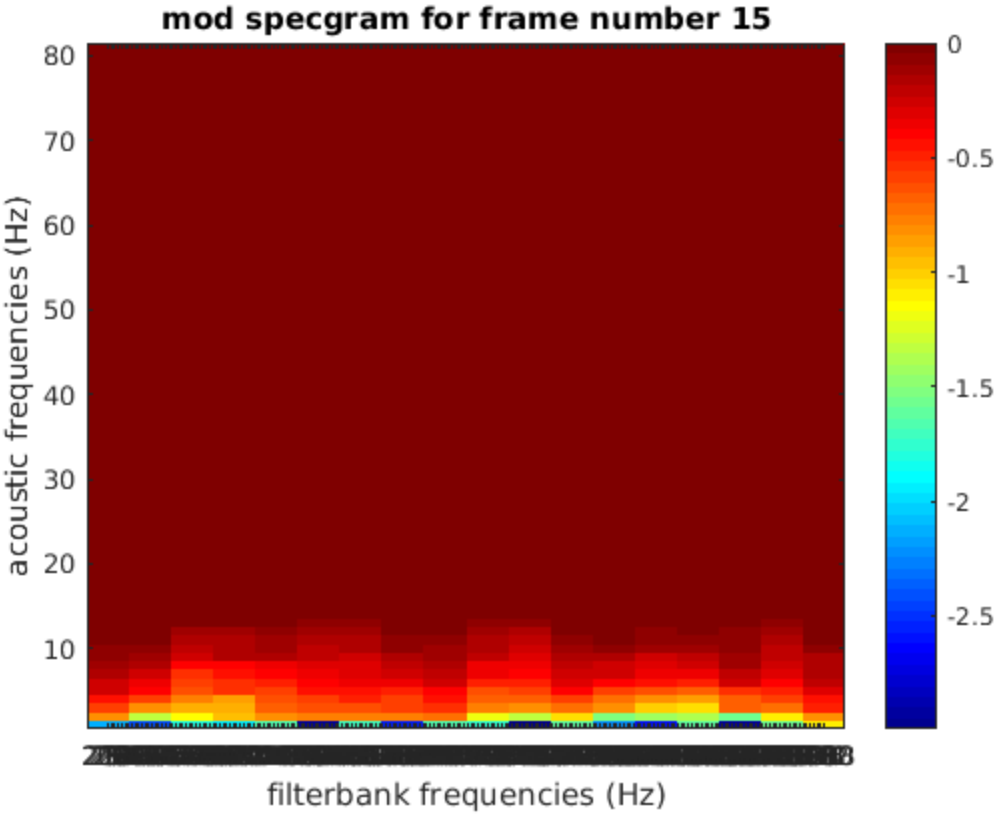

mod specgram for frame number 10
acoustic frequencies (Hz)
80
70
60
50
40
30
20
10
0
-0.5
-1
-1.5
-2
-2.5
filterbank frequencies (Hz)

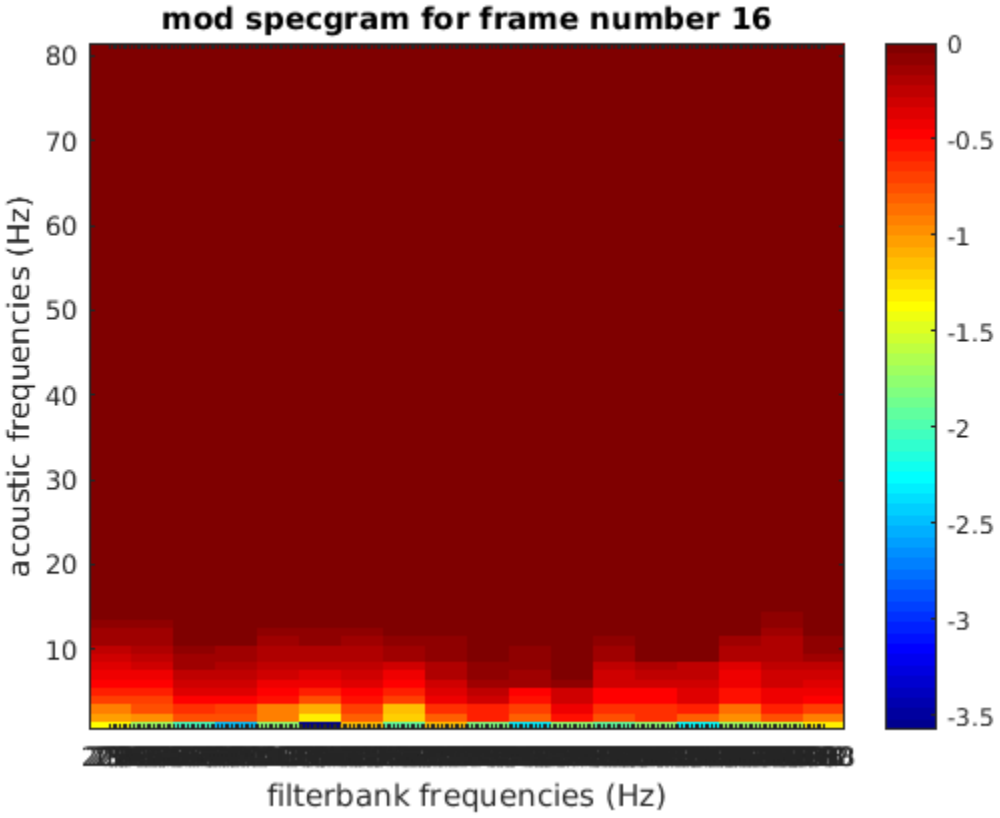

mod specgram for frame number 11
acoustic frequencies (Hz)
80
70
60
50
40
30
20
10
0
-0.5
-1
-1.5
-2
filterbank frequencies (Hz)

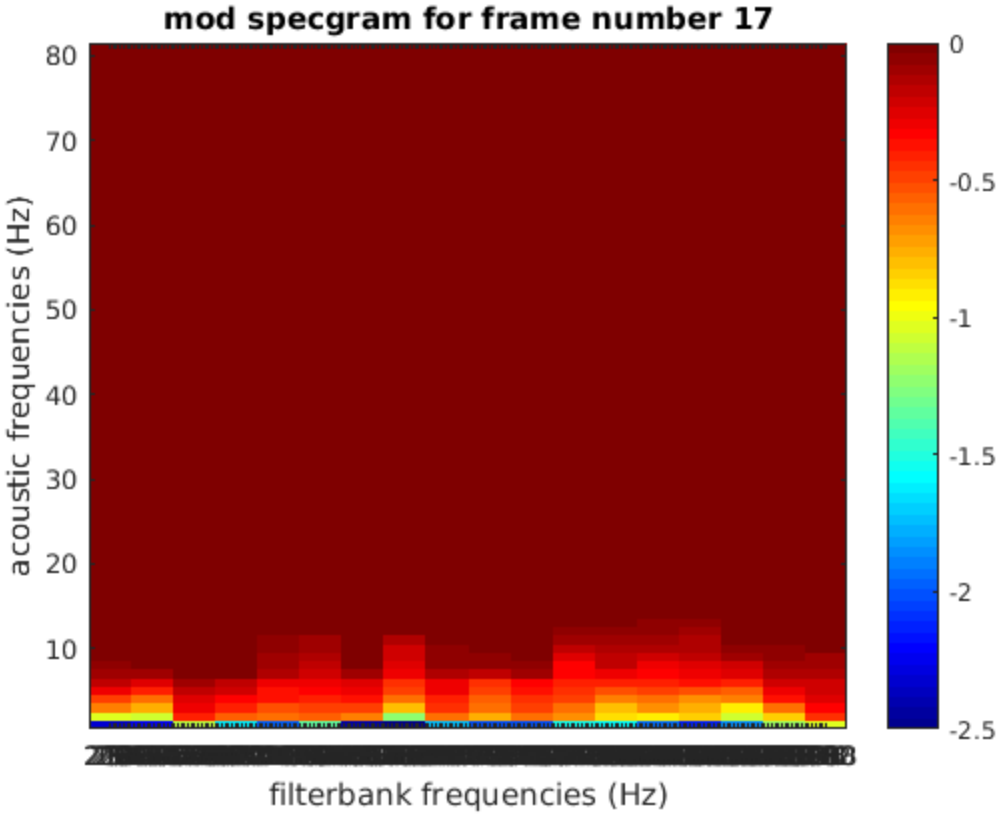

mod specgram for frame number 12
acoustic frequencies (Hz)
80
70
60
50
40
30
20
10
0
-0.5
-1
-1.5
-2
-2.5
filterbank frequencies (Hz)

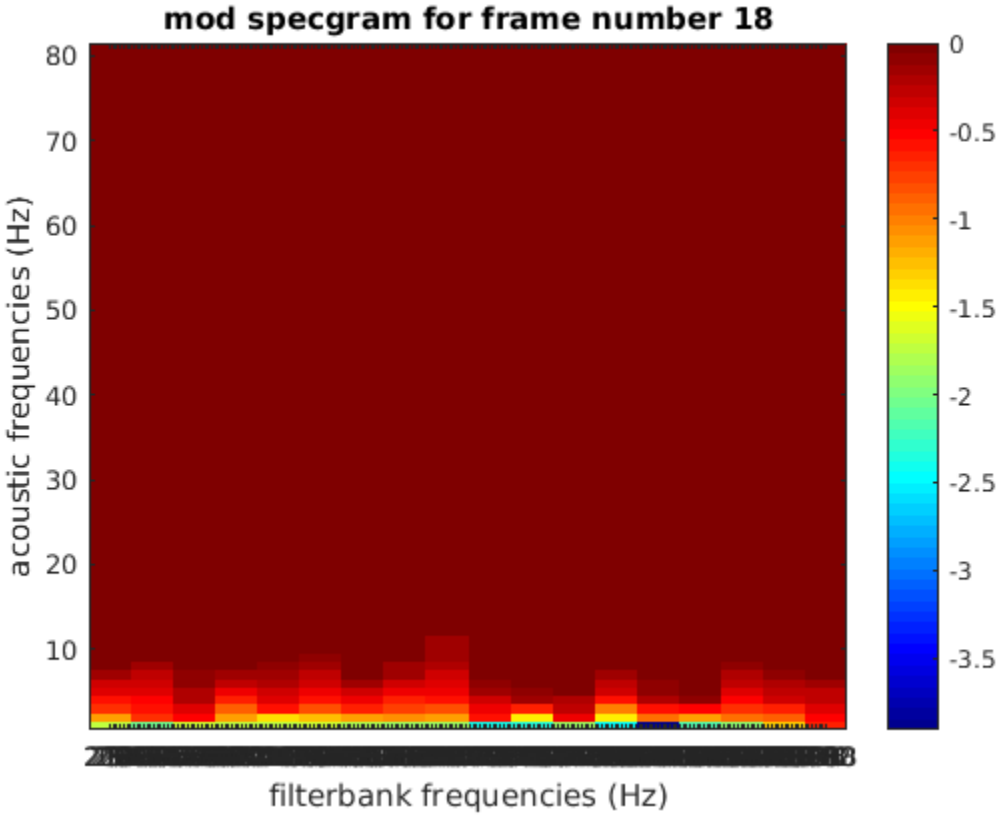

mod specgram for frame number 13
acoustic frequencies (Hz)
80
70
60
50
40
30
20
10
0
-0.5
-1
-1.5
-2
filterbank frequencies (Hz)

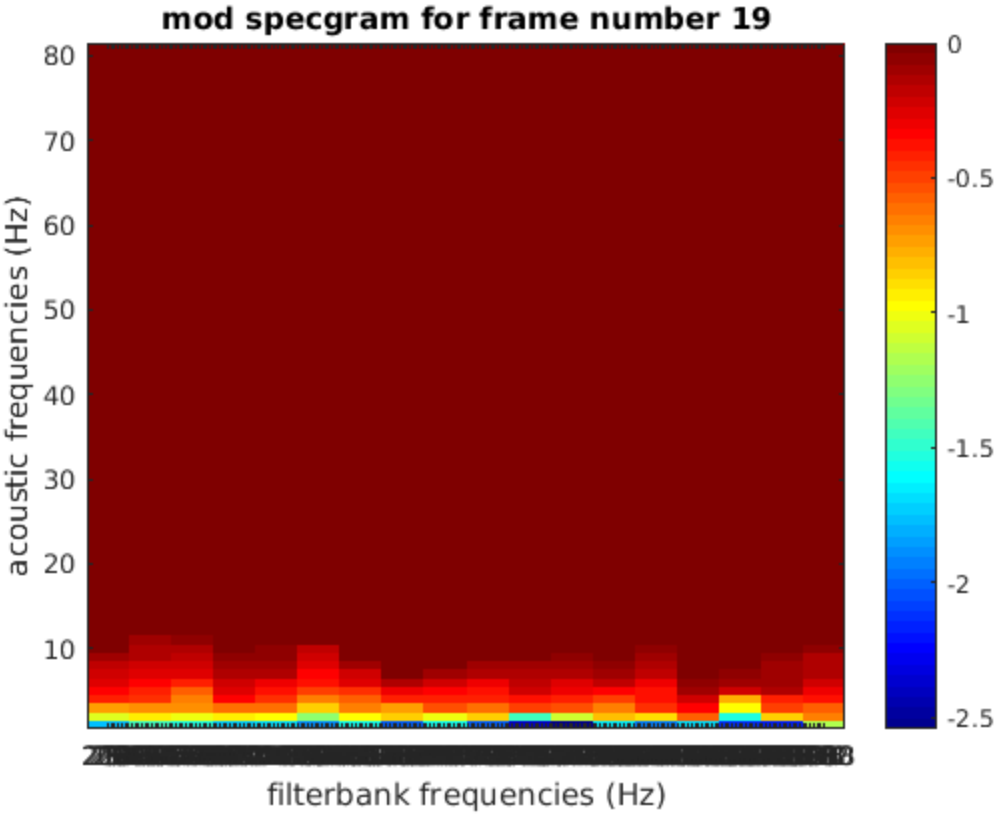

mod specgram for frame number 14
acoustic frequencies (Hz)
80
70
60
50
40
30
20
10
0
-0.5
-1
-1.5
-2
filterbank frequencies (Hz)

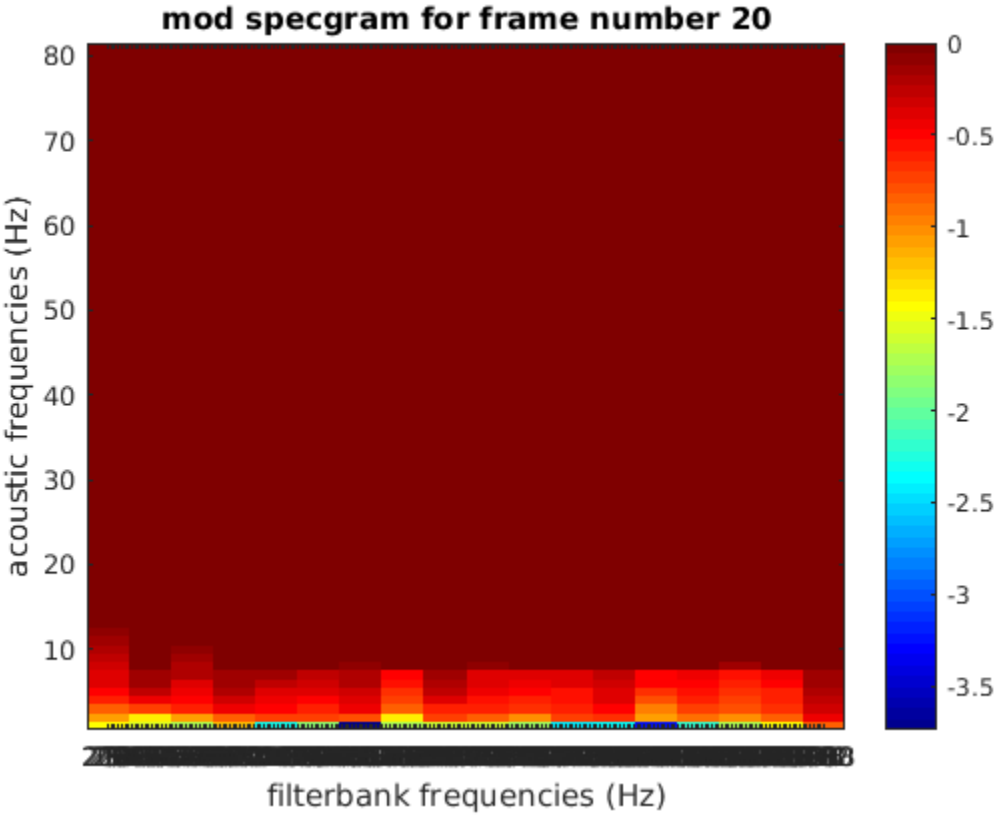

mod specgram for frame number 15
acoustic frequencies (Hz)
80
70
60
50
40
30
20
10
0
-0.5
-1
-1.5
-2
-2.5
filterbank frequencies (Hz)


mod specgram for frame number 16
acoustic frequencies (Hz)
80
70
60
50
40
30
20
10
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
filterbank frequencies (Hz)


mod specgram for frame number 17
acoustic frequencies (Hz)
80
70
60
50
40
30
20
10
0
-0.5
-1
-1.5
-2
-2.5
filterbank frequencies (Hz)


mod specgram for frame number 18
acoustic frequencies (Hz)
80
70
60
50
40
30
20
10
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
filterbank frequencies (Hz)


mod specgram for frame number 19
acoustic frequencies (Hz)
80
70
60
50
40
30
20
10
0
-0.5
-1
-1.5
-2
-2.5
filterbank frequencies (Hz)


mod specgram for frame number 20
acoustic frequencies (Hz)
80
70
60
50
40
30
20
10
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
filterbank frequencies (Hz)

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