



ShAhinMPA / Periodic-Video-Patterns



<> Code

(●) Issues

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Projects 1

Security

Insights

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21.8 MB

In [2]:

```
from scipy.stats import pearsonr
from skimage.metrics import structural_similarity as ssim
from scipy.fft import fft, fftfreq, rfft, rfftfreq
from sklearn.preprocessing import MinMaxScaler
from scipy.signal import correlate2d
import matplotlib.pyplot as plt
import numpy as np
import cv2
import os
import ast
import time
import pandas as pd
import random
```

Matplotlib is building the font cache; this may take a moment.

In [3]:

```
def video_frames_fps(filename):
    cap = cv2.VideoCapture(filename)
    return int(cap.get(cv2.CAP_PROP_FRAME_COUNT)), cap.get(cv2.CAP_PROP_FPS) #fps = video.get(cv2.CAP_PROP_FPS)
```

In [4]:

```
def normalize_list_sklearn(lst):
    scaler = MinMaxScaler()
    return scaler.fit_transform([[x] for x in lst]).flatten()
```

In [5]:

```
def extract_frames(video_path, output_folder):
    # Ensure the output folder exists
    os.makedirs(output_folder, exist_ok=True)

    # Open the video file
    video = cv2.VideoCapture(video_path)
    if not video.isOpened():
        raise ValueError(f"Error opening video file: {video_path}")

    frame_count = 0
    while True:
        ret, frame = video.read()
        if not ret:
            break

        # Save the frame as an image file
```

```

    # Save the frame as an image file
    frame_filename = os.path.join(output_folder, f"frame_{frame_count:04d}.jpg")
    cv2.imwrite(frame_filename, frame)

    frame_count += 1

    # Release the video capture object
    video.release()

    print(f"Extracted {frame_count} frames to '{output_folder}'")
    return frame_count

```

In [6]:

```

def compare_images(func, image_path1, image_path2):
    # Read the images
    image1 = cv2.imread(image_path1, cv2.IMREAD_GRAYSCALE)
    image2 = cv2.imread(image_path2, cv2.IMREAD_GRAYSCALE)

    # Check if images were loaded correctly
    if image1 is None or image2 is None:
        raise ValueError("One or both image paths are invalid or the images cannot be read.")

    # Resize images to the same dimensions, if necessary
    if image1.shape != image2.shape:
        image2 = cv2.resize(image2, (image1.shape[1], image1.shape[0]))

    if func == 'histogram':
        hist1 = cv2.calcHist([image1], [0], None, [256], [0, 256])
        hist2 = cv2.calcHist([image2], [0], None, [256], [0, 256])
        similarity = cv2.compareHist(hist1, hist2, cv2.HISTCMP_CORREL)

    elif func == 'cor3':
        # Calculate correlation
        image1 = image1.flatten()
        image2 = image2.flatten()
        similarity = np.corrcoef(image1, image2)[0,1]

    return similarity

```

In [7]:

```

def similarity_Signal(func, reference_frame_number):
    simSig = []
    ref_frame_number_str = f"{reference_frame_number:04d}"
    image_path1 = 'Frames/Video_'+video_name+'/frame_' + ref_frame_number_str + '.jpg'
    for i in range(totalFrames):
        image_path2 = 'Frames/Video_'+video_name+'/frame_' + f"{{i:04d}}"+'.jpg'

```

```
    imagePath1 = os.path.join(videoPath, frameName[0], frameName[1], frameName[2], frameName[3] + ".JPG")
    simSig.append(compare_images(func, imagePath1, imagePath2))

return simSig
```

```
In [8]: def plot_similarity(sim_metric, y_values, y_range):
    x = np.linspace(0, totalFrames, totalFrames)
    y = y_values

    # Create the plot
    plt.plot(x, y, label=sim_metric)
    plt.ylim(y_range[0], y_range[1])

    # Add Labels and title
    plt.xlabel("frame")
    plt.ylabel("similarity")
    plt.title("Frames Similarities to frame 0001")

    # Add a Legend
    plt.legend()

    # Show the grid
    plt.grid()

    # Display the plot
    plt.show()
```

```
In [9]: def subplot_similarity(subpl, sim_metric, y_values, y_range):
    x = np.linspace(0, totalFrames, totalFrames)
    y = y_values

    # Create the plot
    plt.subplot(2, 1, subpl)
    plt.plot(x, y, label=sim_metric)
    plt.ylim(y_range[0], y_range[1])

    # Add Labels and title
    plt.xlabel("frame")
    plt.ylabel("similarity")
    plt.title("Frames Similarities to frame 0001")

    # Add a Legend
    plt.legend()
```

```
plt.yscale()
```

```
# Show the grid  
plt.grid()  
  
# Display the plot  
plt.show()
```

In [10]:

```
def second_max_index(arr):  
    # Find the index of the maximum value  
    max_index = np.argmax(arr)  
  
    # Create a copy of the array and set the maximum value to negative infinity  
    arr_copy = np.copy(arr)  
    arr_copy[max_index] = -np.inf  
  
    # Find the index of the second maximum value  
    second_max_index = np.argmax(arr_copy)  
  
    return second_max_index
```

In [11]:

```
def find_period(signal):  
    # Sample data  
    x = np.linspace(0, totalFrames, totalFrames)  
    y = signal  
  
    # Calculate FFT  
    yf = fft(y)  
    xf = fftfreq(len(y), x[1] - x[0])  
  
    # Find the dominant frequency  
    dominant_frequency = xf[second_max_index(np.abs(yf))]  
  
    # Calculate the period  
    period = 1 / dominant_frequency  
  
    # Plot the results  
    plt.figure(figsize=(12, 6))  
  
    plt.subplot(2, 2, 1)  
    plt.plot(x, y)  
    plt.title('Original Signal')
```

```

#Xf = np.where(xf >= 0)

plt.subplot(2, 2, 1)
plt.plot(xf, np.abs(yf))
plt.title('FFT')
plt.xlabel('Frequency')
plt.ylabel('Amplitude')

plt.tight_layout()
plt.show()

print("\t\t\tDominant Frequency: %.3f , Period: %.3f" %(dominant_frequency, period))

```

In [12]:

```

def autoCorrelation(signal):
    fs = totalFrames # Sampling rate

    t = np.arange(0, 1, 1/fs) # Time vector
    t = t[:len(signal)]


    autocorr = np.correlate(signal, signal, mode='full')
    autocorr = autocorr[len(signal)-1:] # Only take positive lags

    peaks = np.diff(np.sign(np.diff(autocorr))) < 0 # Find local maxima
    peak_indexes = np.where(peaks)[0] + 1

    if len(peak_indexes) <= 0:
        print("\t\t\tNo clear period found.")
        period = 0
    else:

        period = peak_indexes[0] / fs # Period in seconds
        print(f"\t\t\tPeriod: {(totalFrames/frame_rate)*period:.3f} seconds" ,end = "")
        print(f"\t\t\tPeriod: {totalFrames*period:.3f} frames" ) # frame_rate frames / second

    plt.figure(figsize=(12, 6))
    plt.subplot(2, 2, 2)
    plt.plot(t*(totalFrames/frame_rate), signal)
    plt.title("Signal")

    plt.subplot(2, 2, 1)
    plt.plot((totalFrames/frame_rate)*np.arange(len(autocorr))/fs, autocorr)
    plt.title("Autocorrelation")
    plt.xlabel("Lag (seconds)")
    plt.scatter((totalFrames/frame_rate)*period, autocorr[int(period*fs)], color='red', marker='o', label=f'Period')

```

```
plt.legend()
plt.tight_layout()
plt.show()

In [13]: def cepstrumAnalysis(signal):
    # Define the signal
    fs = totalFrames # Sampling frequency

    t = np.arange(0, 1, 1/fs) # Time vector
    t = t[:len(signal)]

    # Calculate the cepstrum
    spectrum = np.fft.fft(signal)
    log_spectrum = np.log(np.abs(spectrum))
    cepstrum = np.fft.ifft(log_spectrum)

    # Identify the peak
    cepstrum = np.abs(cepstrum) # Take the absolute value to get the real cepstrum
    peak_index = np.argmax(cepstrum[3:-3]) + 3 # Exclude first 5 samples

    # Calculate the period
    period = peak_index / fs

    # Plot the signal and the cepstrum
    plt.figure(figsize=(12, 6))

    plt.subplot(2, 2, 2)
    plt.plot((totalFrames/frame_rate)*t, signal)
    plt.title('Signal')
    plt.xlabel('Time (s)')
    plt.ylabel('Amplitude')

    plt.subplot(2, 2, 1)
    plt.plot((totalFrames/frame_rate)*np.arange(len(cepstrum))/fs, cepstrum)
    plt.title('Cepstrum')
    plt.xlabel('Quofrency (s)')
    plt.ylabel('Amplitude')
    plt.axvline(x=(totalFrames/frame_rate)*period, color='r', linestyle='--', label=f'Period = {(totalFrames/frame_rate)*period:.2f} s')
    plt.legend()

    plt.tight_layout()
    plt.show()
```

```
print(f"\t\tPeriod: {(totalFrames/frame_rate)*period:.3f} seconds\tPeriod: {totalFrames*period:.3f} frames")
```

In [14]:

```
def read_signal_file(file_name):
    # opening the file in read mode
    my_file = open(file_name, "r")

    data = my_file.read()
    data_into_list = data.replace(']', ']\\n')
    data_into_list = data_into_list.replace('np.float64(','(')
    data_into_list = data_into_list.split('\\n')
    my_file.close()
    return data_into_list
```

In [15]:

```
def write_signal_file(file_name, reference_frame_number):
    with open(file_name, 'w') as output:

        signal = similarity_Signal('histogram', reference_frame_number)
        output.write(str(signal))

        signal = similarity_Signal('cor3', reference_frame_number)
        output.write(str(signal))
```

In [16]:

```
def reference_frame_analysis(video_name):
    for ref_frame_num in [0.2*totalFrames, 0.5*totalFrames, 0.8*totalFrames]:
        ref_frame_num = int(ref_frame_num)

        print('\n')
        print(5*' ' + 'Video: ' + video_name + ' ' + 'Reference frame at: (' + str(round(100*ref_frame_num/total

        write_signal_file('Signals/Video_' + video_name + '_ref_' + str(ref_frame_num) + '.txt', ref_frame_num)
        data_into_list = read_signal_file('Signals/Video_' + video_name + '_ref_' + str(ref_frame_num) + '.txt')

        ls_Histogram = ast.literal_eval(data_into_list[0])
        ls_PearsonCor2 = ast.literal_eval(data_into_list[1])

        print('\n Similarity Signal - Histogram \n')
        subplot_similarity(1,'Histogram', normalize_list_sklearn(ast.literal_eval(data_into_list[0])), (0,1))
        print('\n Similarity Signal - Pearson Correlation \n')
        subplot_similarity(1,'Pearson Cor. 2', normalize_list_sklearn(ast.literal_eval(data_into_list[1])), (0,1))
```

```
print('\n Histogram - FFT \n')
find_period(ls_Histogram)
print('\n PCC - FFT \n')
find_period(ls_PearsonCor2)

print('\n Histogram - Cepstrum \n')
cepstrumAnalysis(ls_Histogram)
print('\n PCC - Cepstrum \n')
cepstrumAnalysis(ls_PearsonCor2)
```

In [ ]:

```
...
for pair in [ ('1','.mp4'),
    ('2','.mp4'),
    ('3','.mp4'),
    ('4','.mp4'),
    ('5','.mp4'),
    ('6','.webm'),
    ('7','.webm'),
    ('8','.webm'),
    ('9','.webm'),
    ('10','.webm'),
    ('11','.webm'),
    ('12','.webm'),
    ('13','.mp4'),
    ('14','.webm'),
    ('15','.webm'),
    ('16','.webm'),
    ('17','.webm'),
    ('18','.webm'),
    ('19','.mp4'),
    ('20','.mp4'),
]:
    video_name = pair[0]
    video_ext = pair[1]
    totalFrames = extract_frames(video_name+video_ext, 'Frames/Video_'+video_name)
...
```

In [ ]:

```
#reference_frame_analysis(video_name)
```

In [26]:

```
for pair in [ ('1','.mp4'),
```

```

        ('2','.mp4'),
        ('3','.mp4'),
        ('4','.mp4'),
        ('5','.mp4'),
        ('6','.webm'),
        ('7','.webm'),
        ('8','.webm'),
        ('9','.webm'),
        ('10','.webm'),
        ('11','.webm'),
        ('12','.webm'),
        ('13','.mp4'),
        ('14','.webm'),
        ('15','.webm'),
        ('16','.webm'),
        ('17','.webm'),
        ('18','.webm'),
        ('19','.mp4'),
        ('20','.mp4'),
    ]:
video_name = pair[0]
video_ext = pair[1]
totalFrames, frame_rate = video_frames_fps(video_name+video_ext)

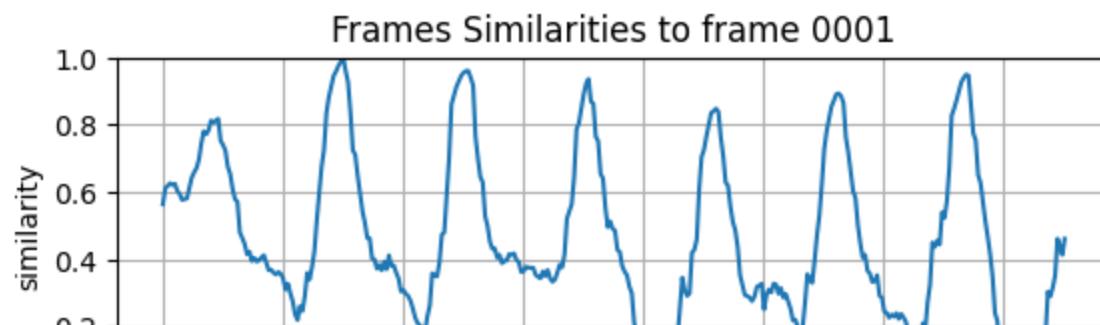
print(5**'*' + video_name + video_ext + f'  Frames:{totalFrames} FPS:{frame_rate}' + 5*' ')
reference_frame_analysis(video_name)

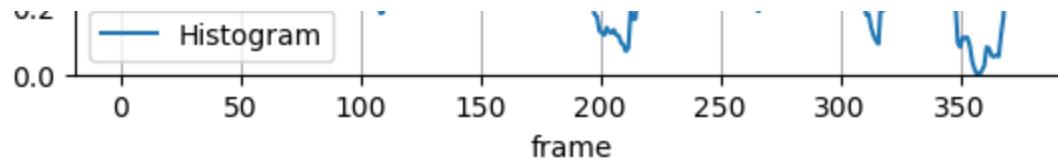
```

\* \* \* \* \* 1.mp4 Frames:376 FPS:25.0 \* \* \* \* \*

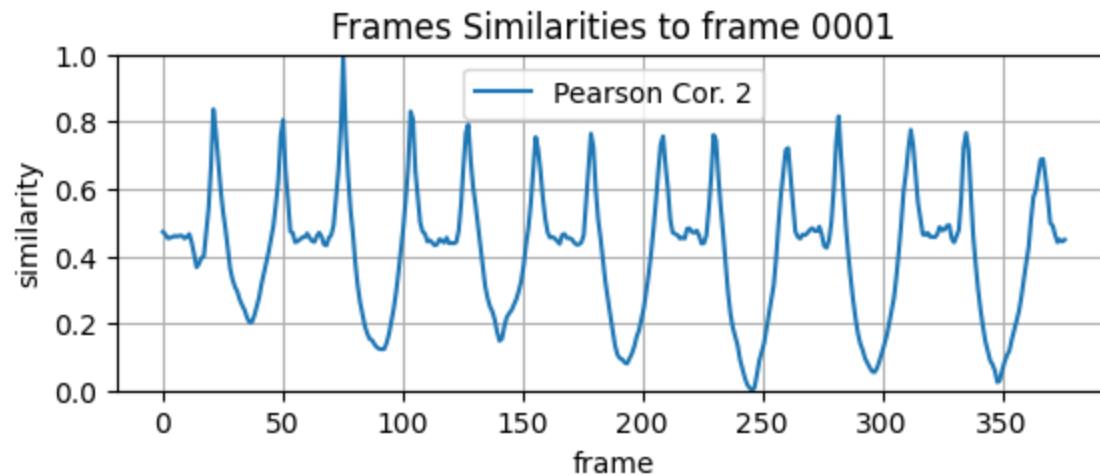
\* \* \* \* \* Video: 1 Reference frame at: (20%) 75 \* \* \* \* \*

Similarity Signal - Histogram

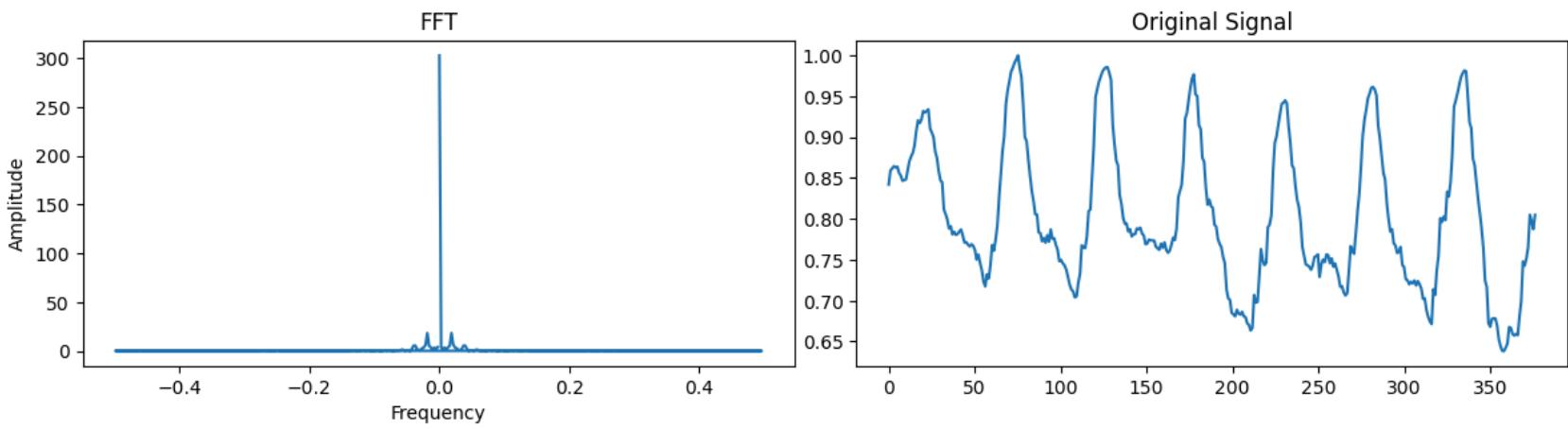




Similarity Signal - Pearson Correlation

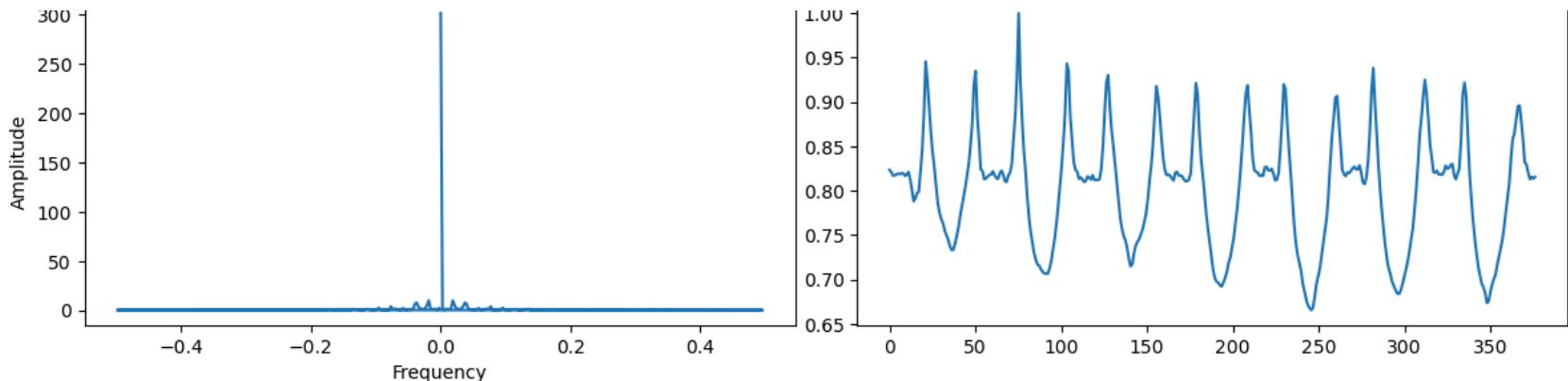


Histogram - FFT



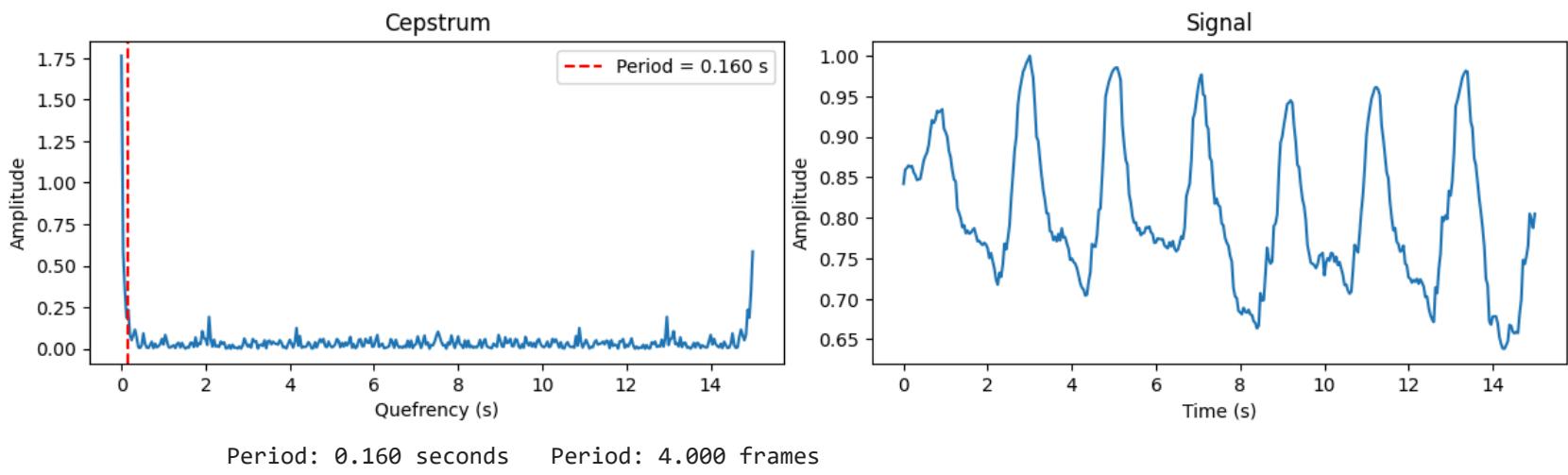
PCC - FFT





Dominant Frequency: 0.019 , Period: 53.858

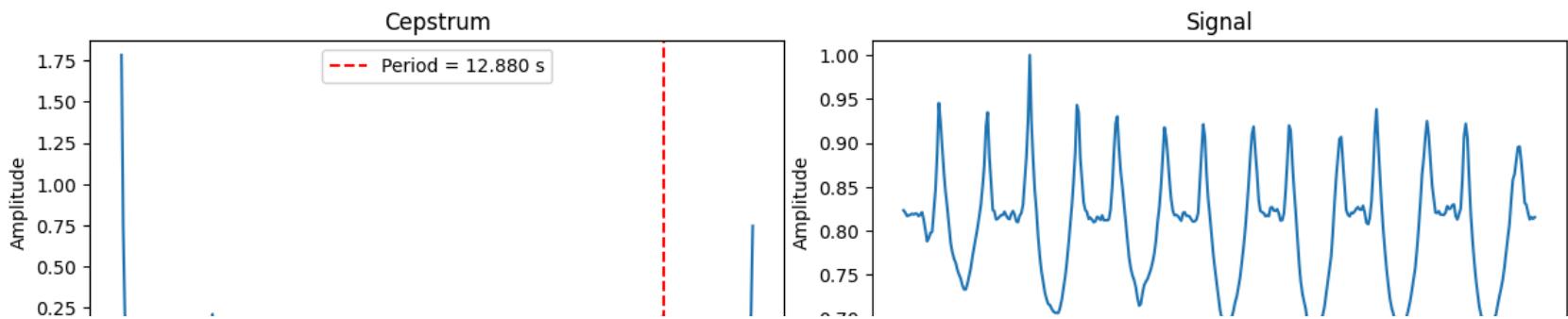
Histogram - Cepstrum



Period: 0.160 seconds

Period: 4.000 frames

PCC - Cepstrum

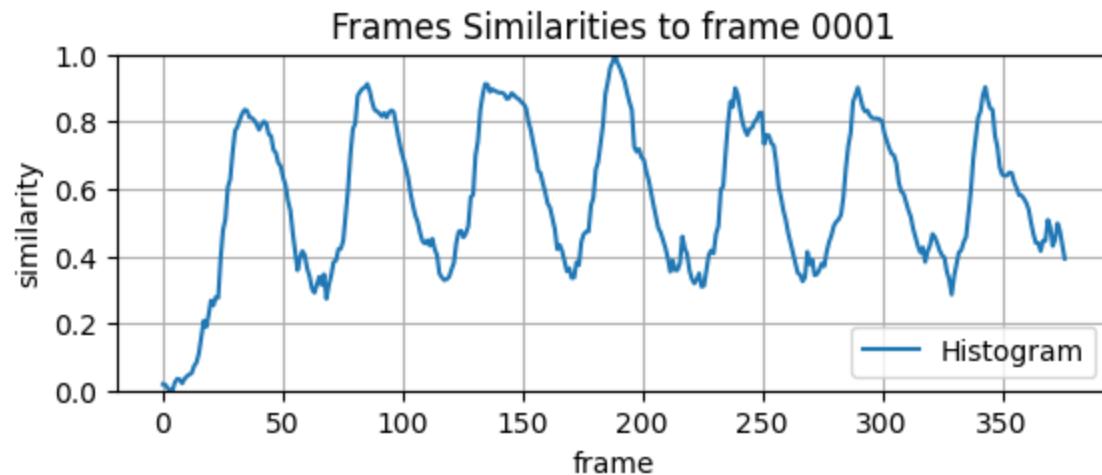




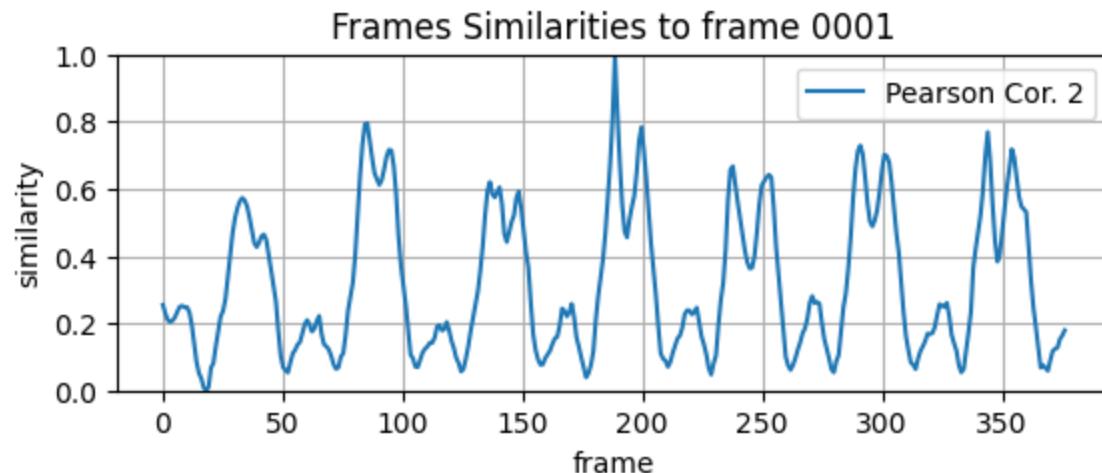
Period: 12.880 seconds Period: 322.000 frames

\* \* \* \* \* Video: 1 Reference frame at: (50%) 188 \* \* \* \* \*

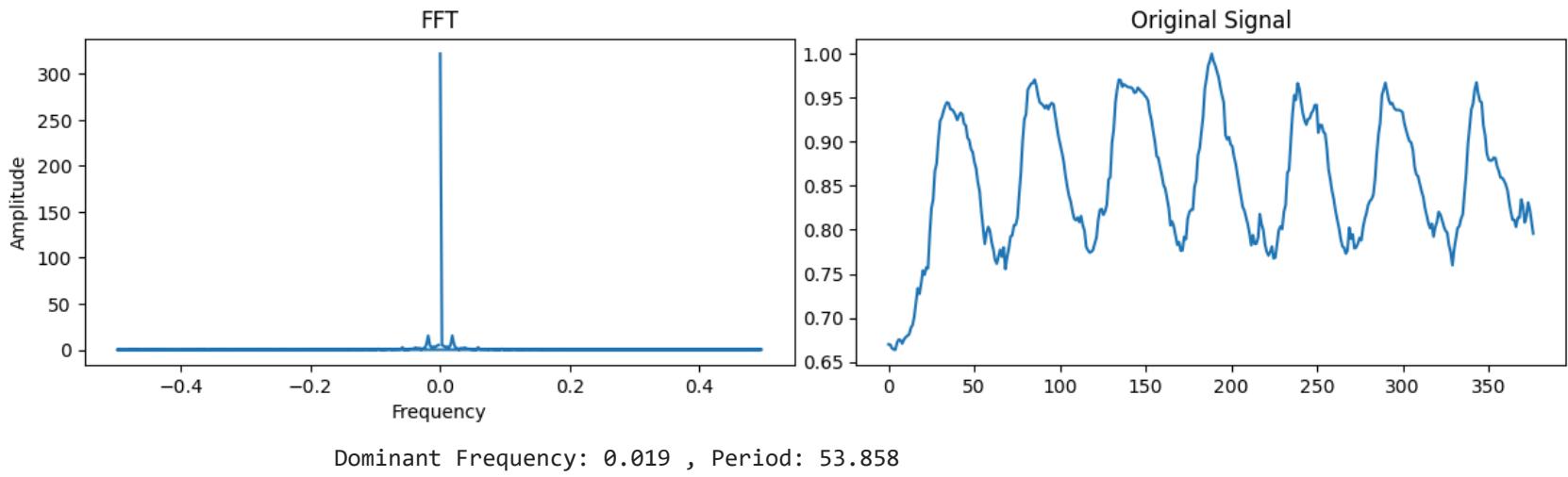
Similarity Signal - Histogram



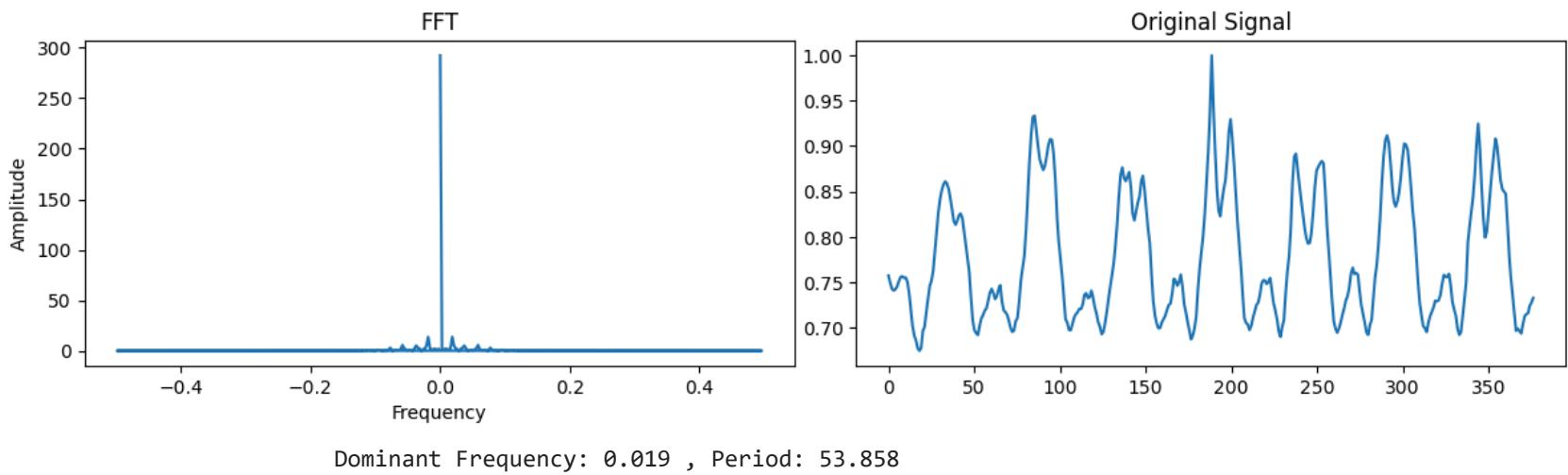
Similarity Signal - Pearson Correlation



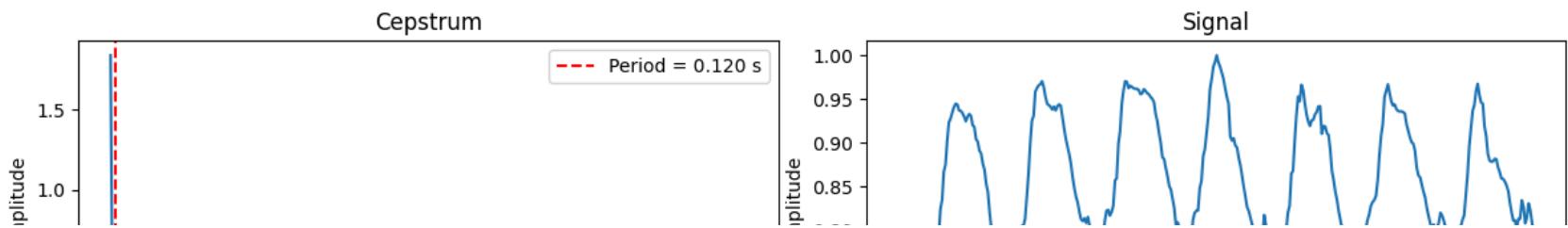
Histogram - FFT

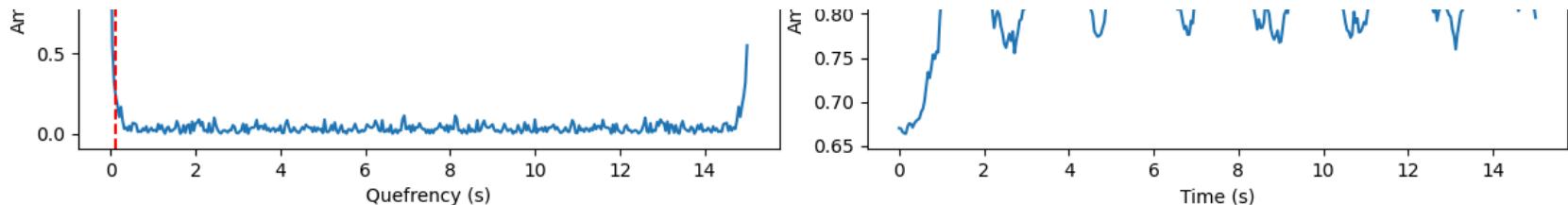


PCC - FFT



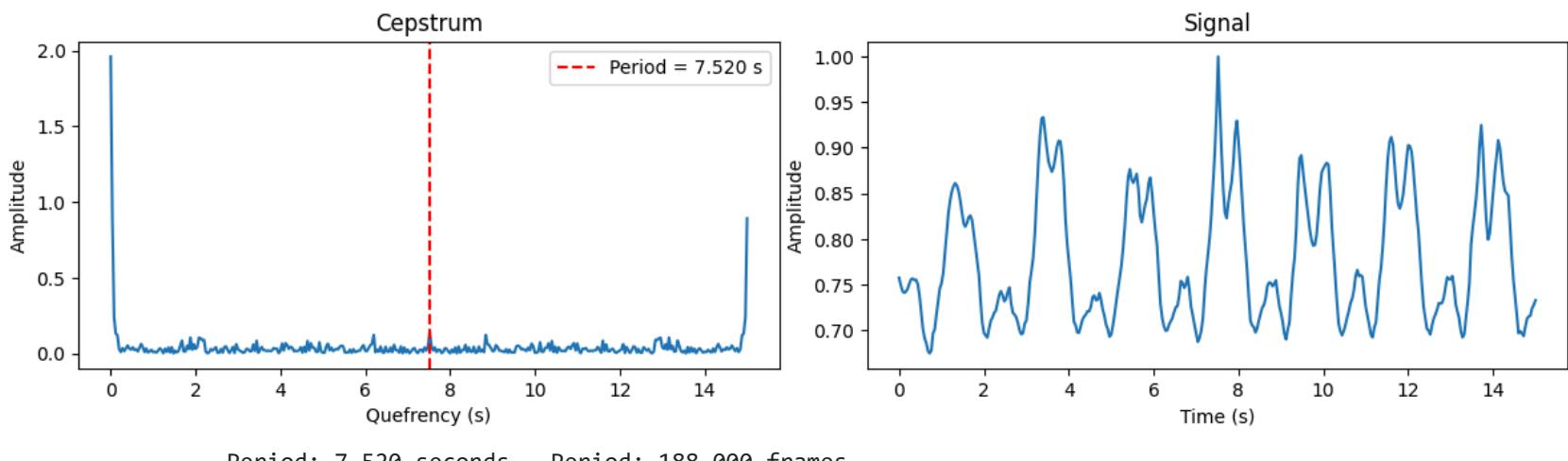
Histogram - Cepstrum





Period: 0.120 seconds      Period: 3.000 frames

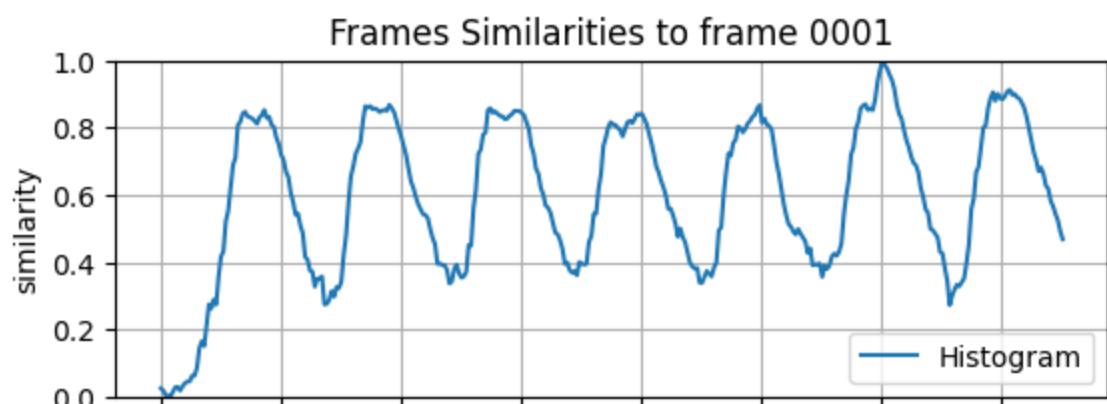
PCC - Cepstrum



Period: 7.520 seconds      Period: 188.000 frames

\* \* \* \* \* Video: 1 Reference frame at: (80%) 300 \* \* \* \* \*

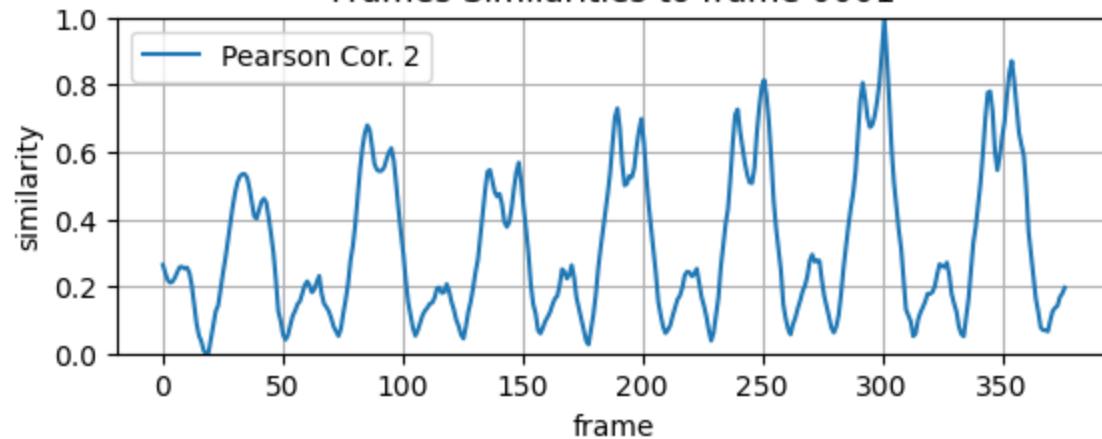
Similarity Signal - Histogram





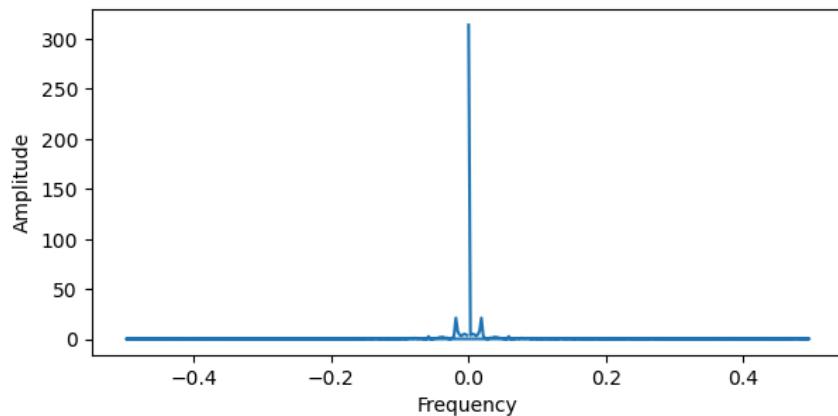
Similarity Signal - Pearson Correlation

Frames Similarities to frame 0001

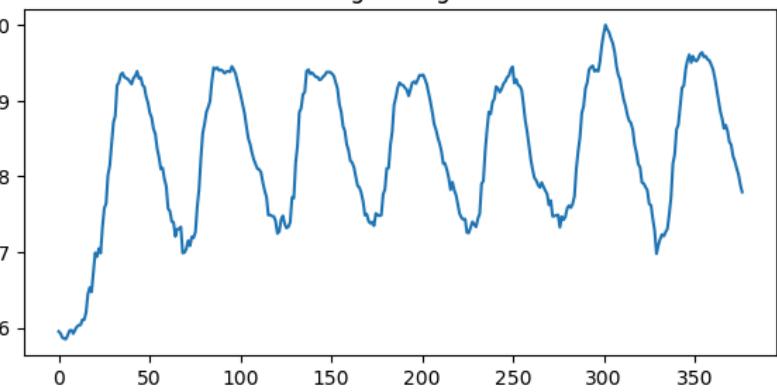


Histogram - FFT

FFT



Original Signal



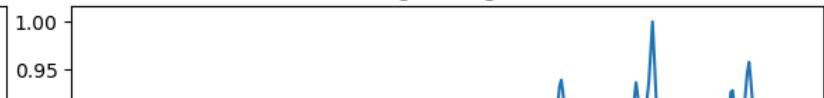
Dominant Frequency: 0.019 , Period: 53.858

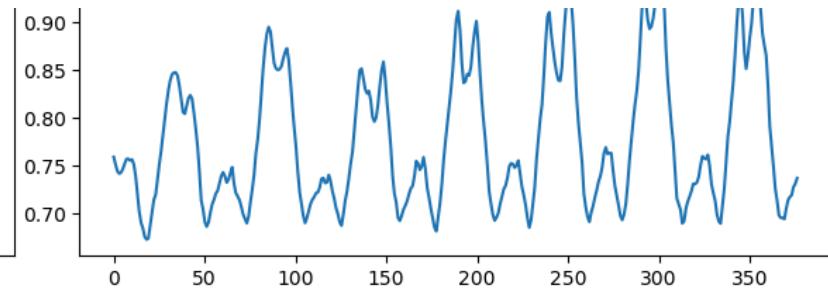
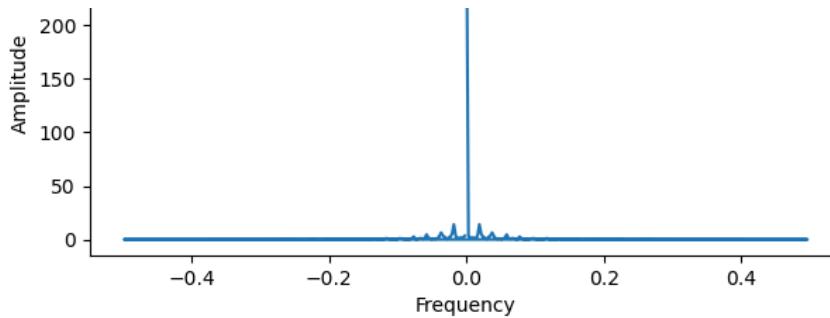
PCC - FFT

FFT



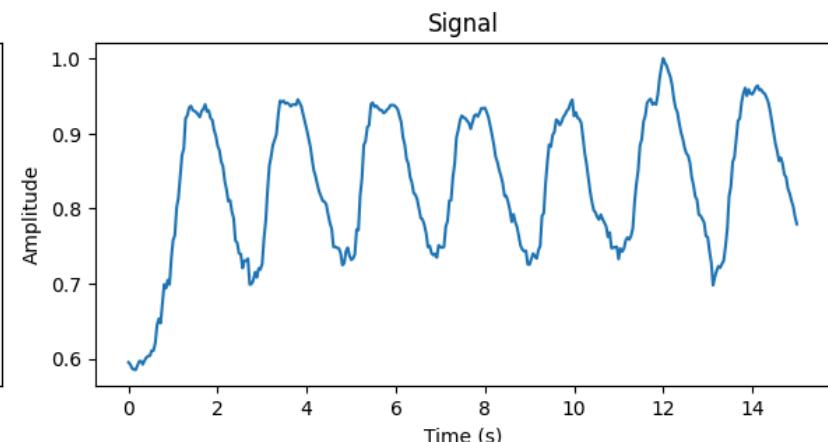
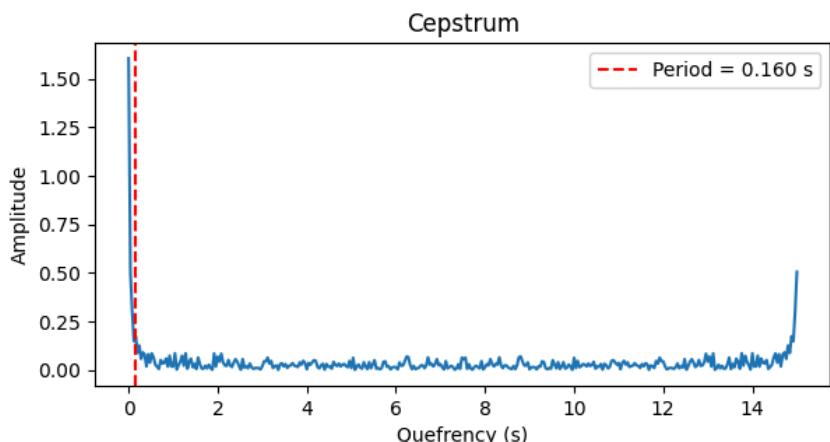
Original Signal





Dominant Frequency: 0.019 , Period: 53.858

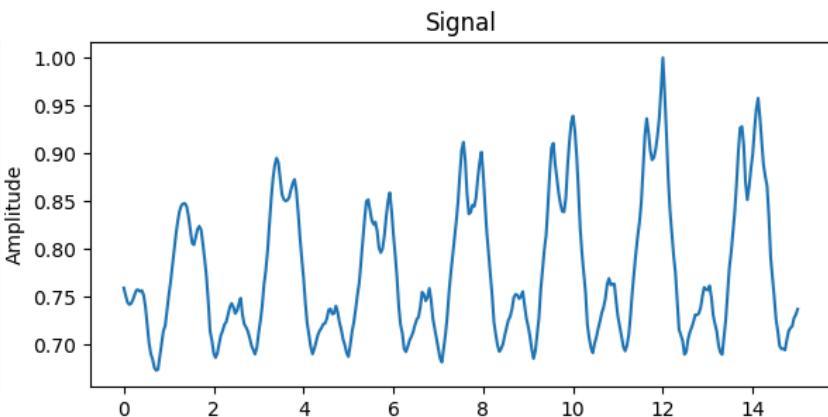
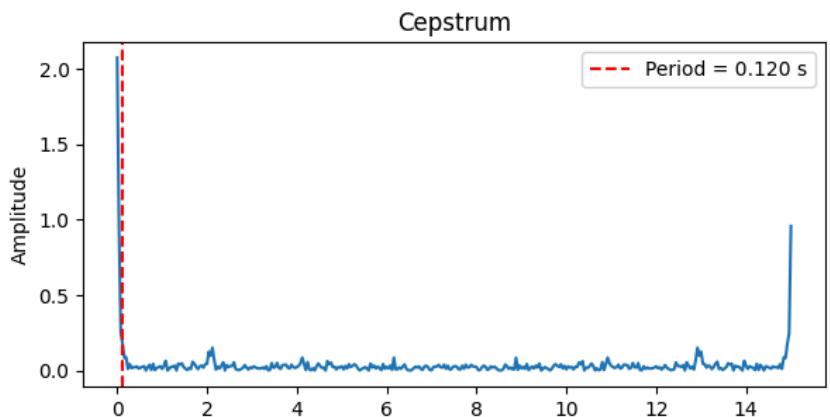
Histogram - Cepstrum



Period: 0.160 seconds

Period: 4.000 frames

PCC - Cepstrum



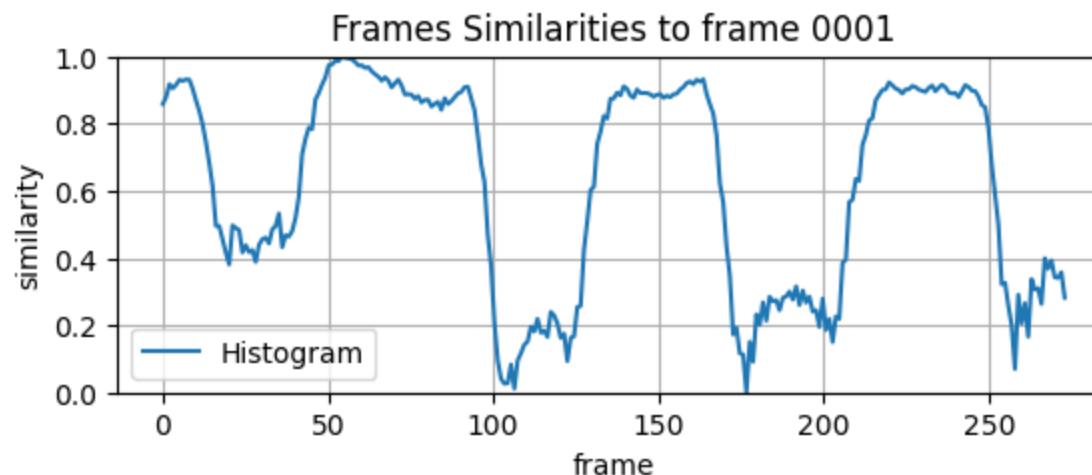
Quefrency (s)

Time (s)

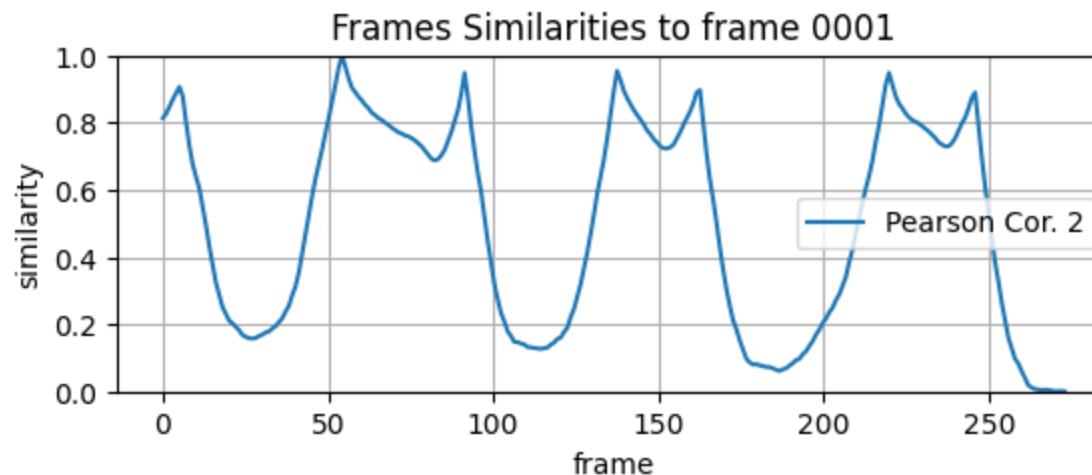
Period: 0.120 seconds    Period: 3.000 frames  
\* \* \* \* \* 2.mp4    Frames:273 FPS:25.0 \* \* \* \* \*

\* \* \* \* \* Video: 2 Reference frame at: (20%) 54 \* \* \* \* \*

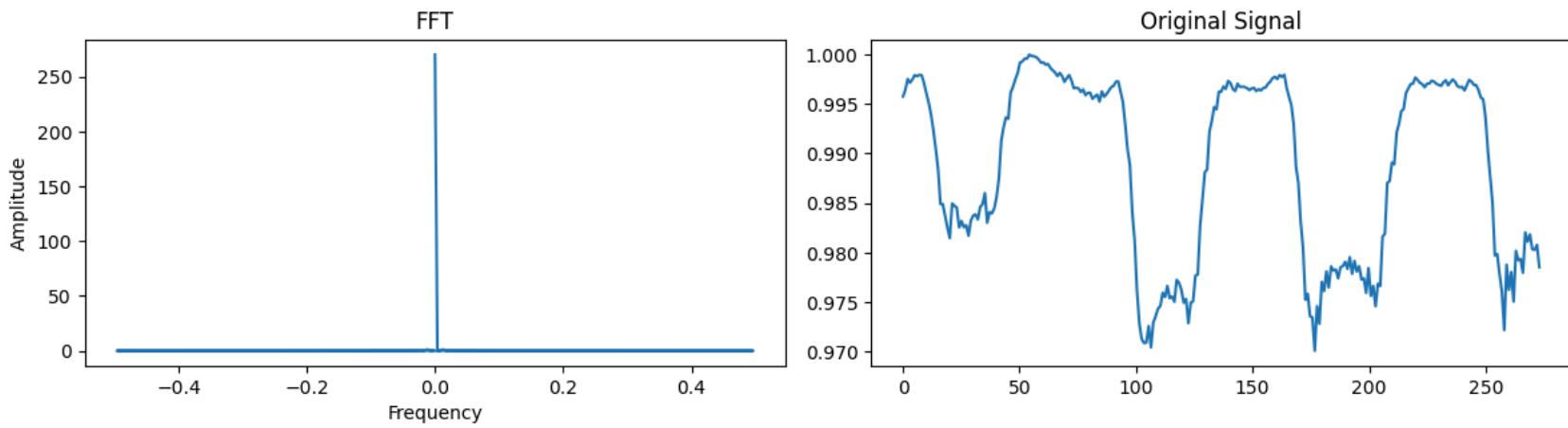
Similarity Signal - Histogram



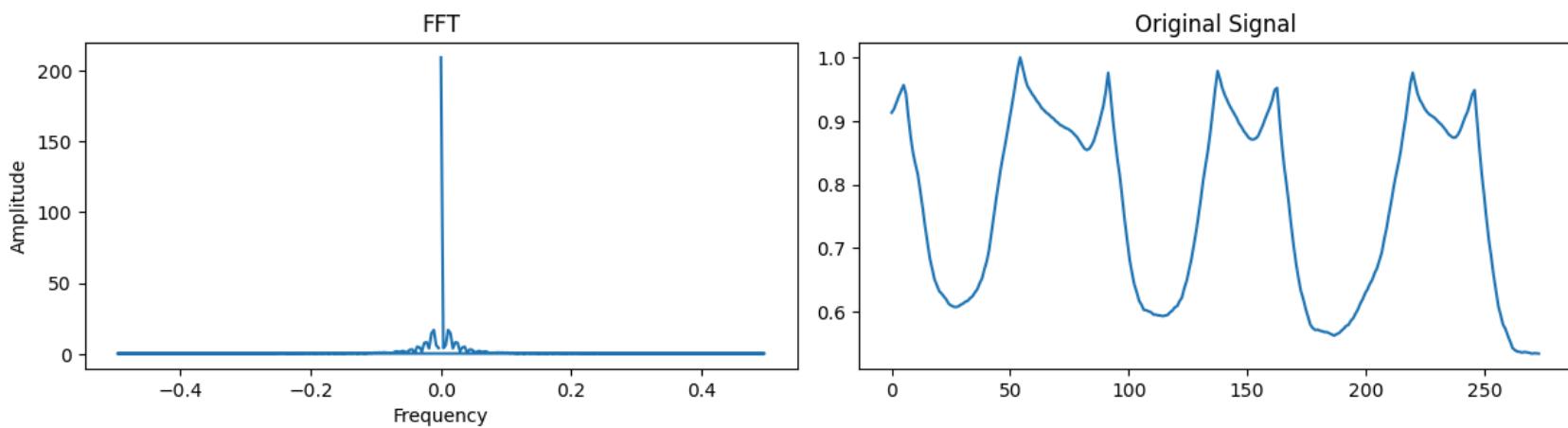
Similarity Signal - Pearson Correlation



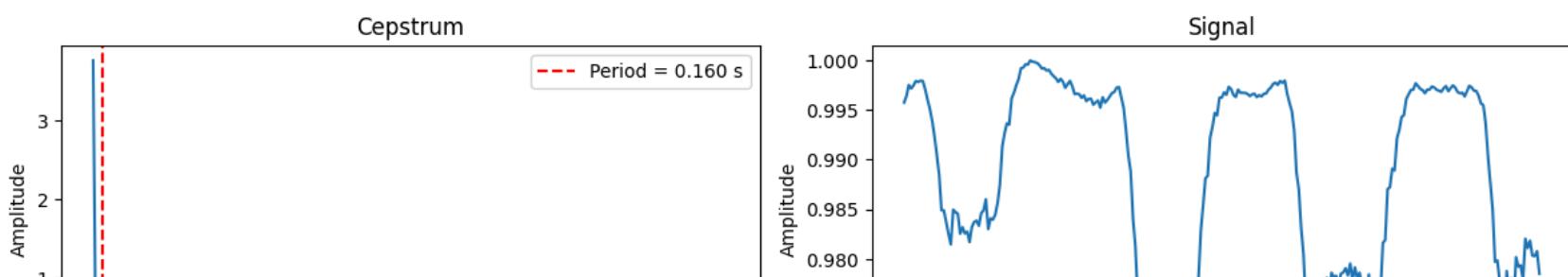
Histogram - FFT

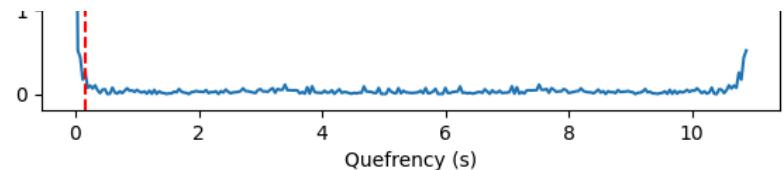


PCC - FFT



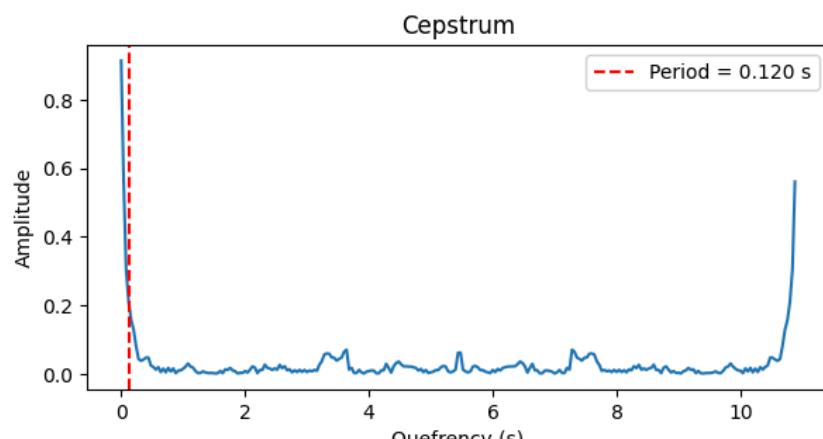
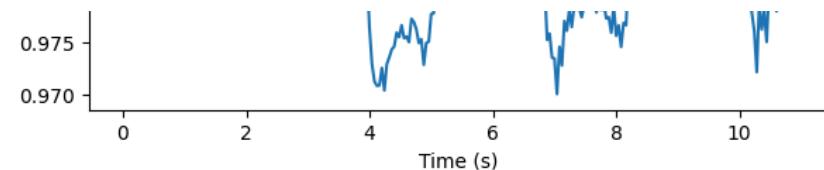
Histogram - Cepstrum



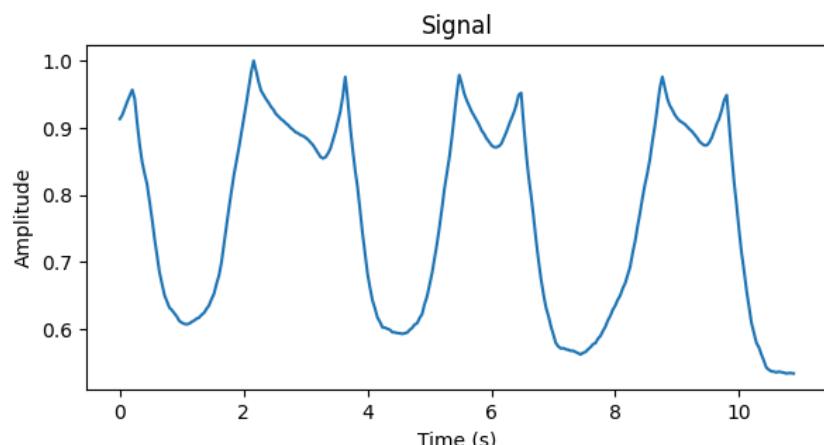


Period: 0.160 seconds      Period: 4.000 frames

PCC - Cepstrum

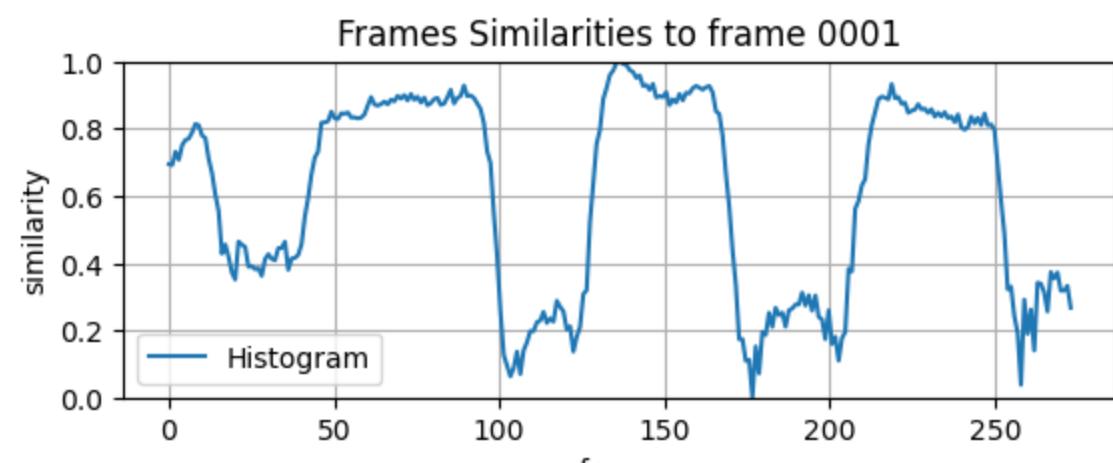


Period: 0.120 seconds      Period: 3.000 frames

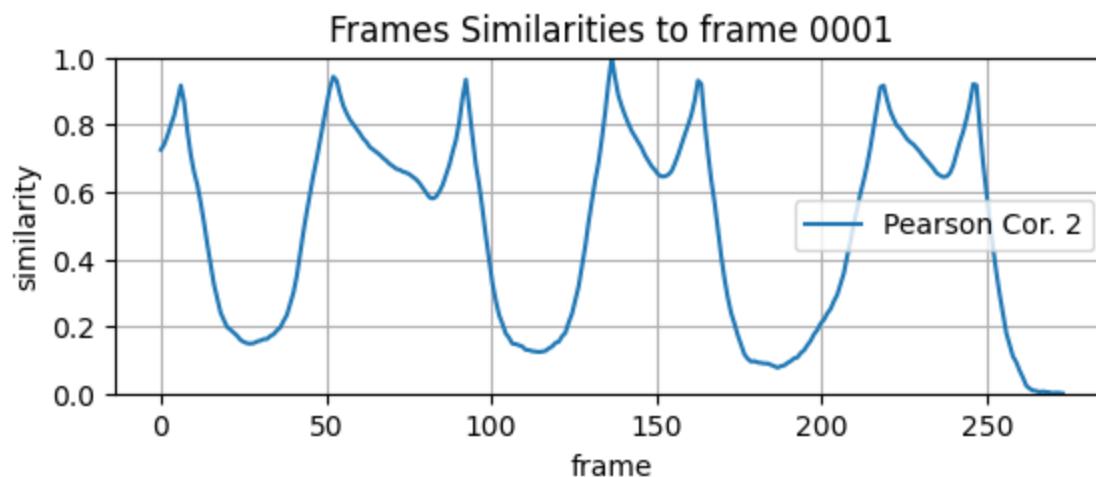


\* \* \* \* \* Video: 2 Reference frame at: (50%) 136 \* \* \* \* \*

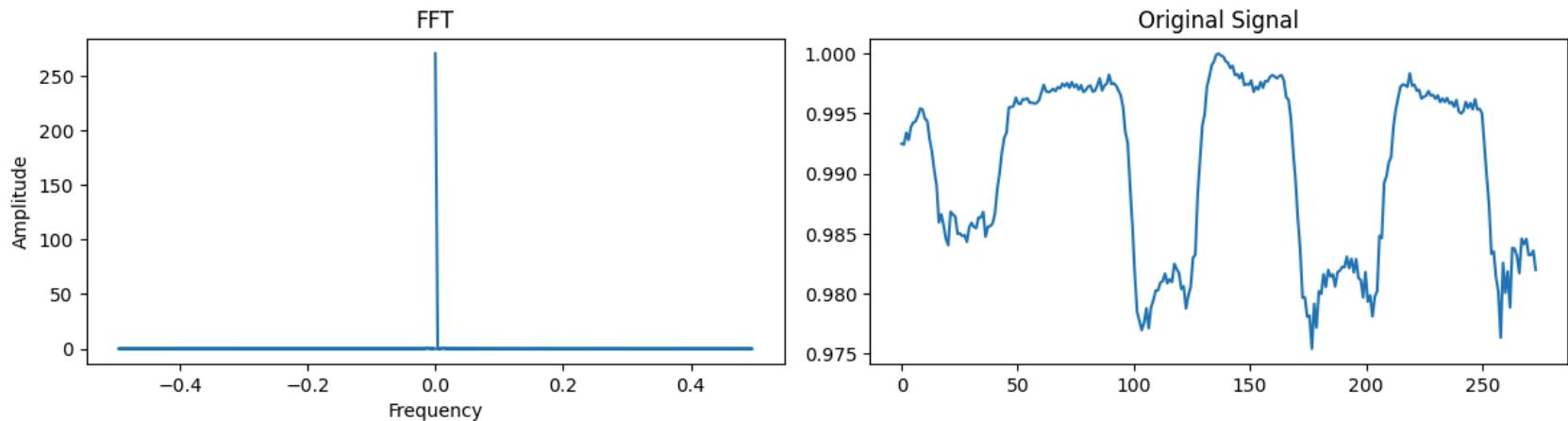
Similarity Signal - Histogram



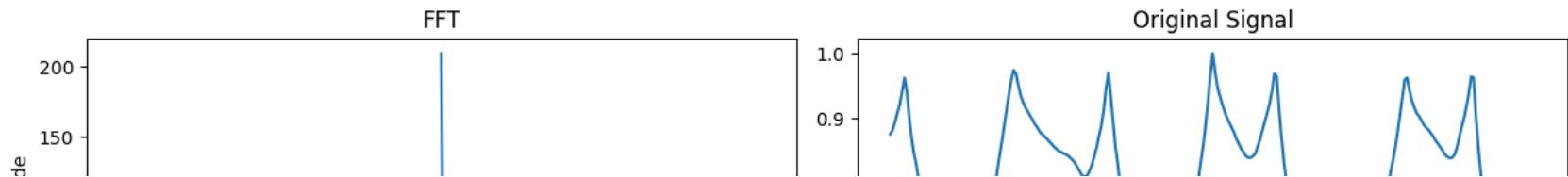
### Similarity Signal - Pearson Correlation

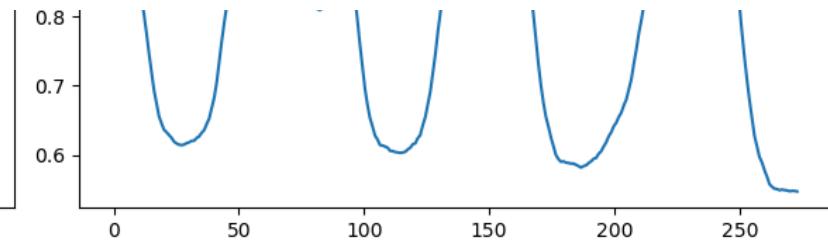
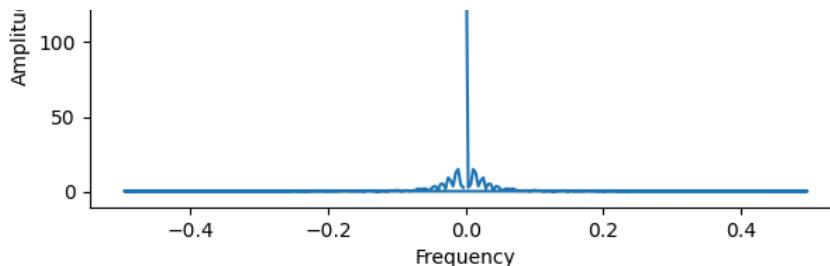


### Histogram - FFT



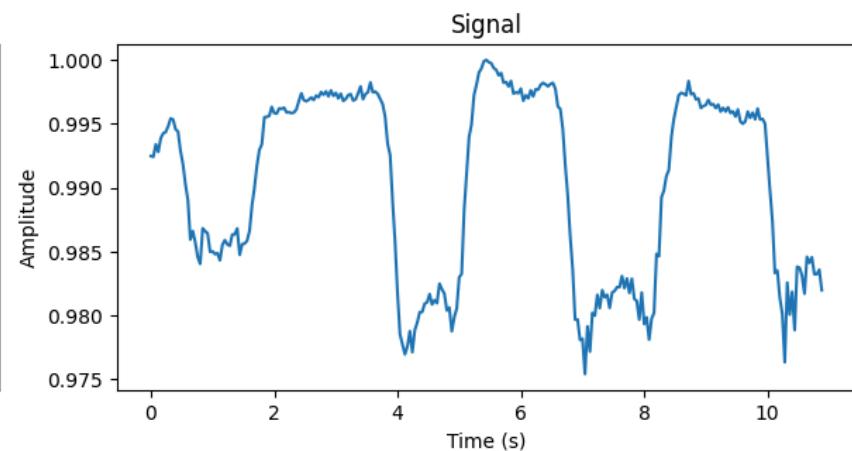
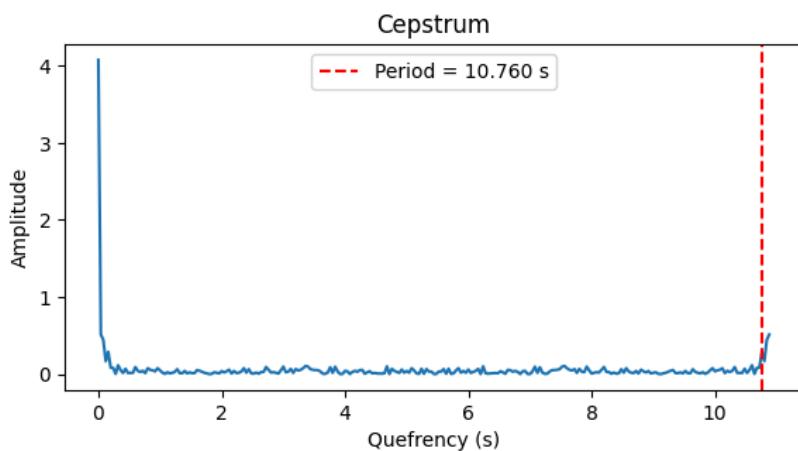
### PCC - FFT





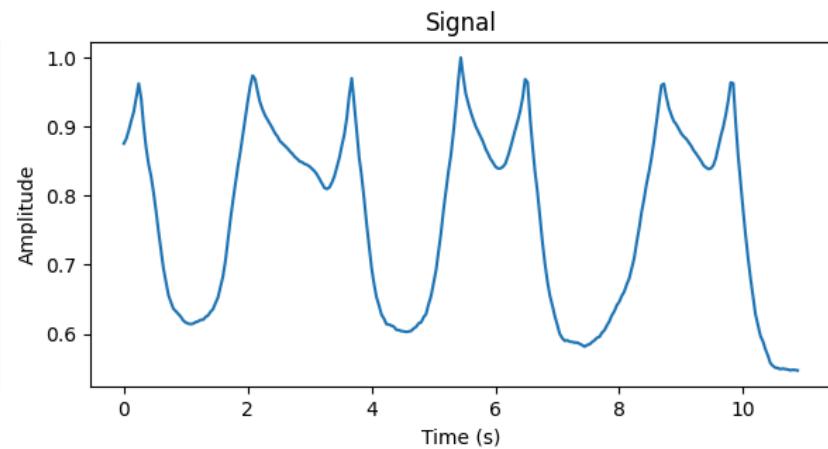
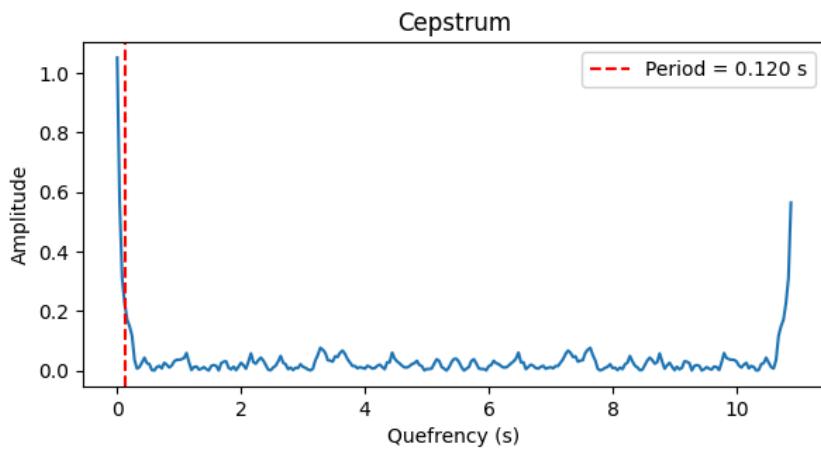
Dominant Frequency: 0.011 , Period: 91.335

#### Histogram - Cepstrum



Period: 10.760 seconds   Period: 269.000 frames

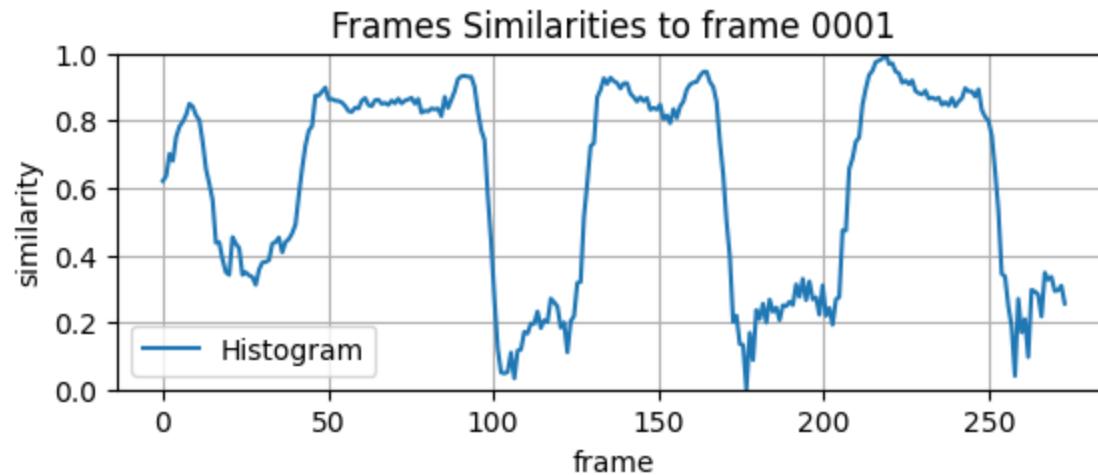
#### PCC - Cepstrum



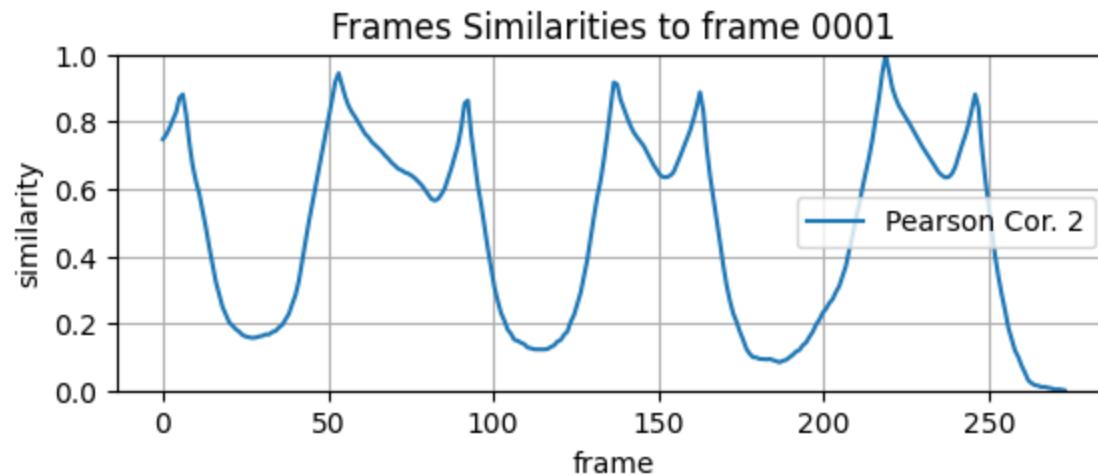
Period: 0.120 seconds    Period: 3.000 frames

\* \* \* \* \* Video: 2 Reference frame at: (80%) 218 \* \* \* \* \*

Similarity Signal - Histogram

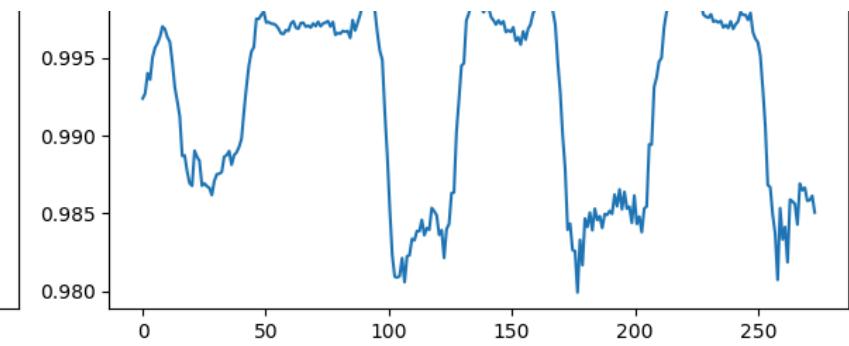
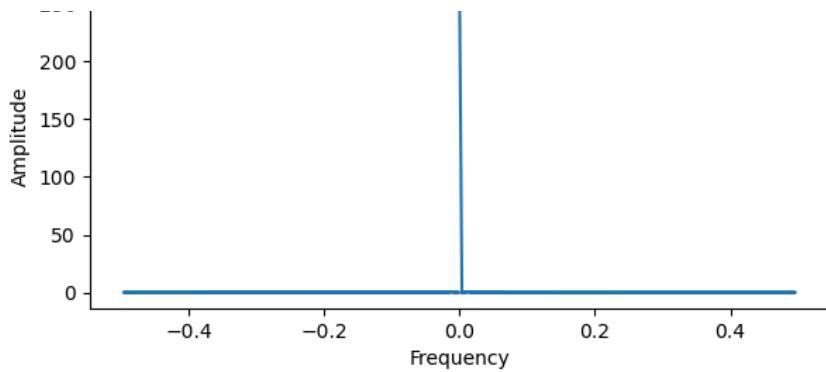


Similarity Signal - Pearson Correlation



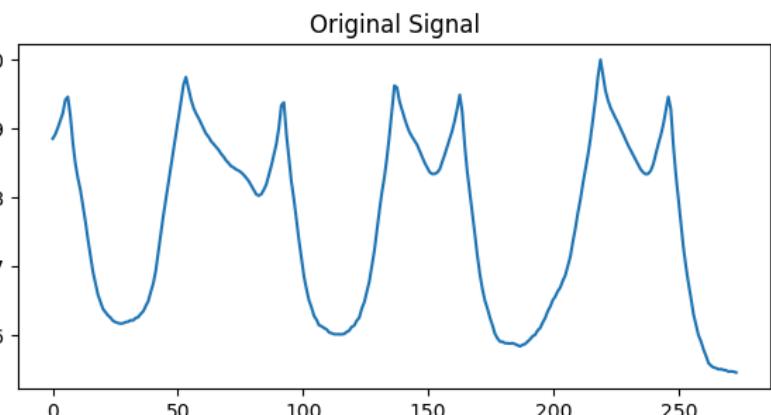
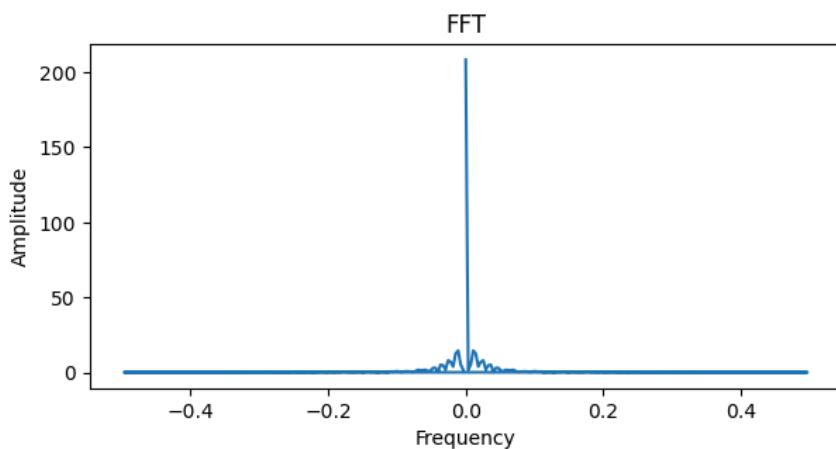
Histogram - FFT





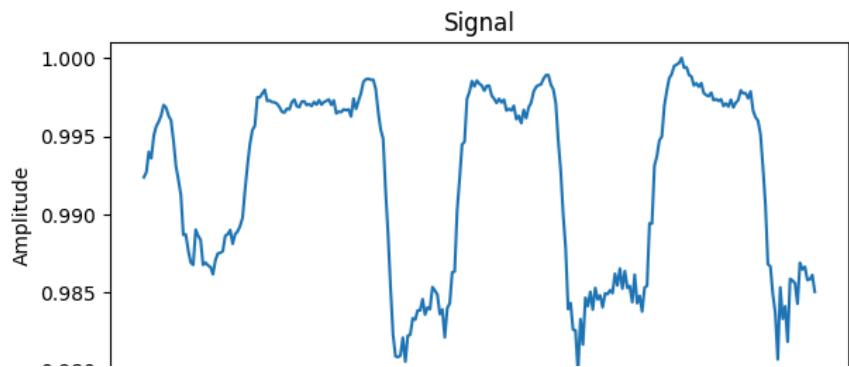
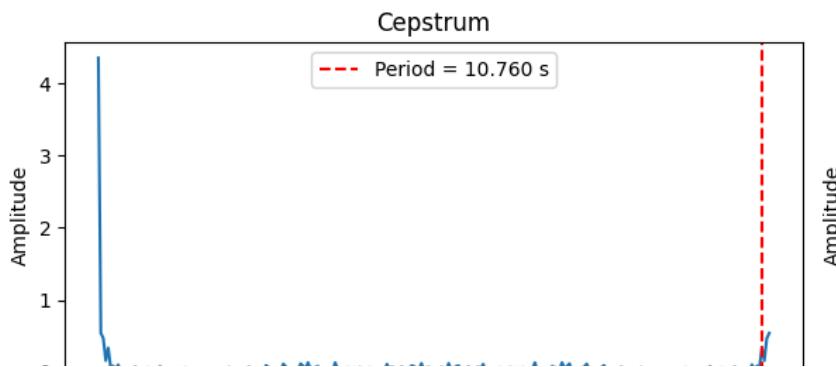
Dominant Frequency: 0.011 , Period: 91.335

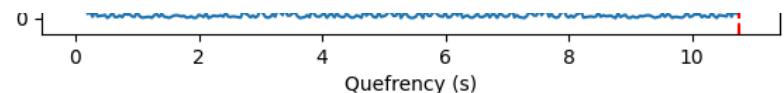
PCC - FFT



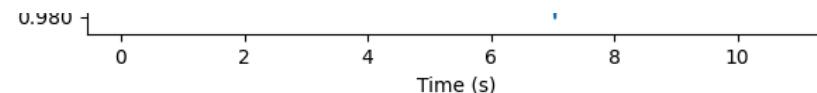
Dominant Frequency: 0.011 , Period: 91.335

Histogram - Cepstrum



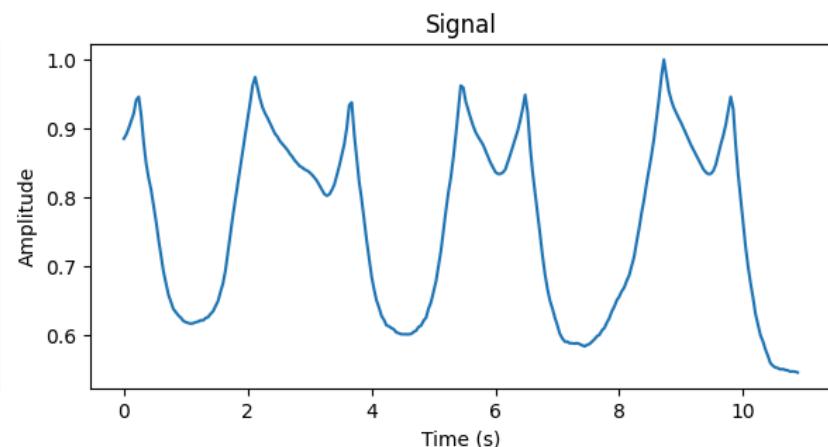
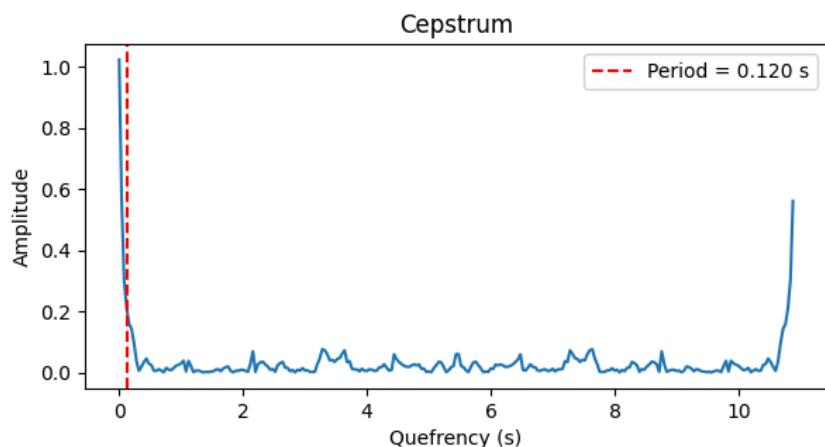


Period: 10.760 seconds



Period: 269.000 frames

PCC - Cepstrum

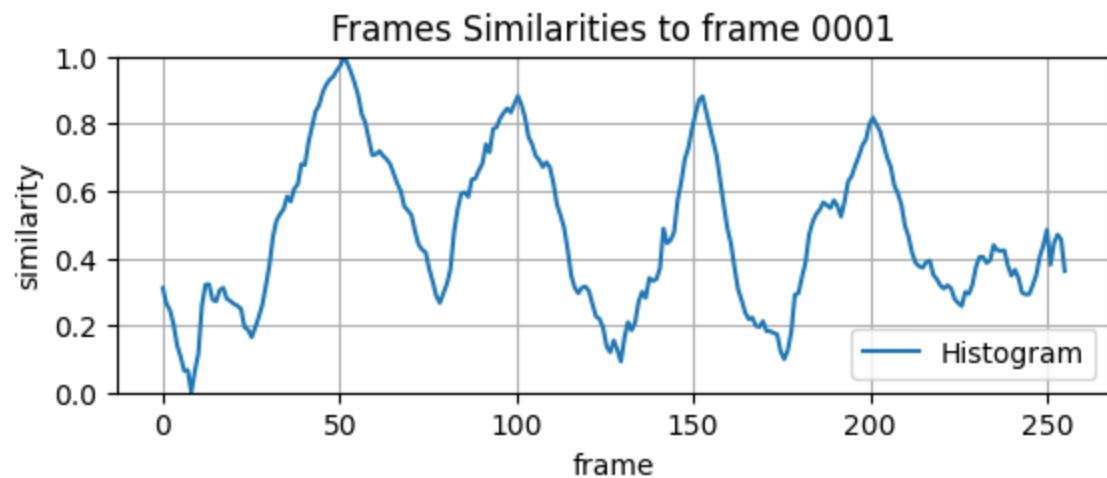


Period: 0.120 seconds

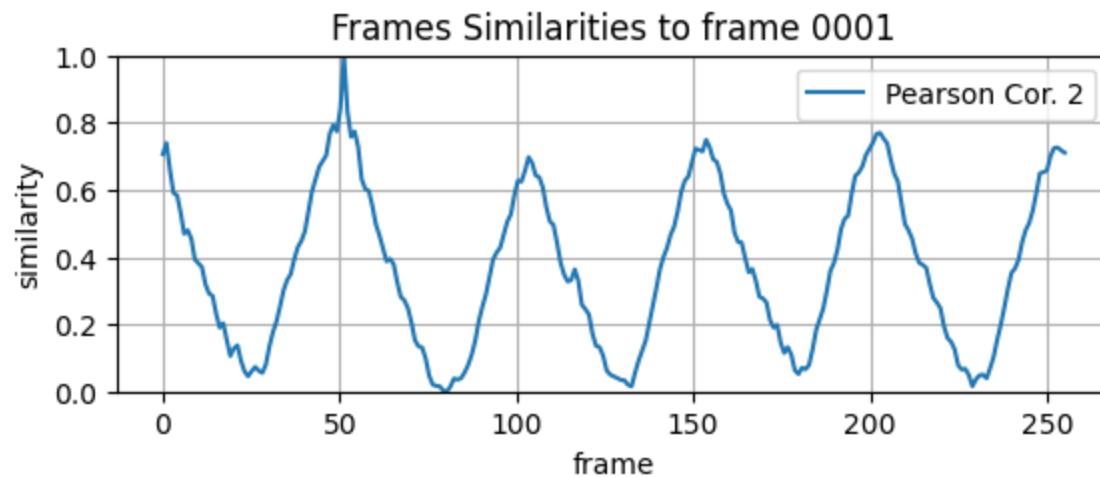
\* \* \* \* \* 3.mp4 Frames:255 FPS:25.0 \* \* \* \* \*

\* \* \* \* \* Video: 3 Reference frame at: (20%) 51 \* \* \* \* \*

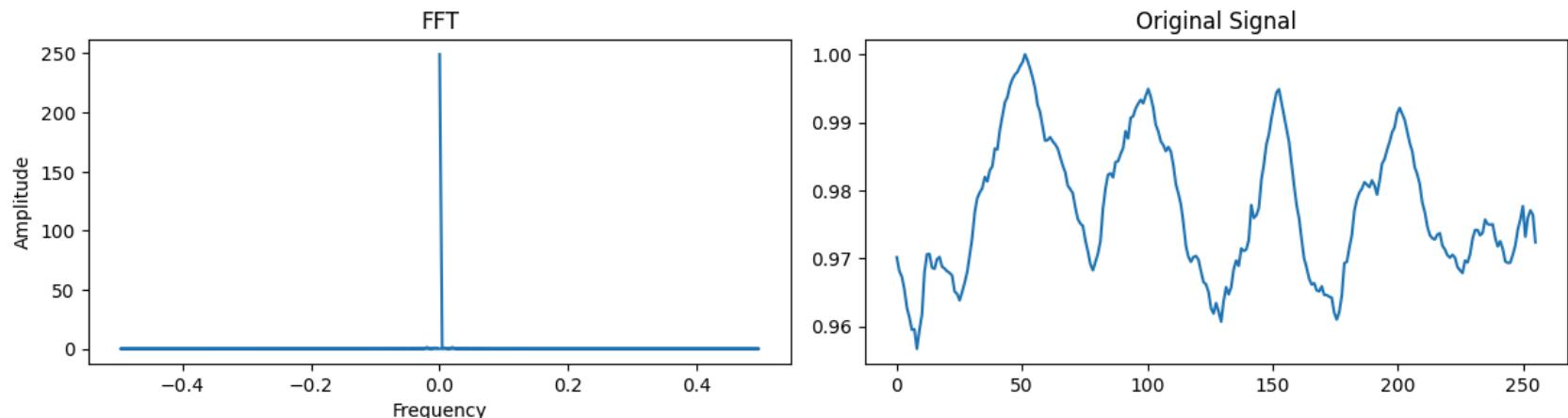
Similarity Signal - Histogram



### Similarity Signal - Pearson Correlation

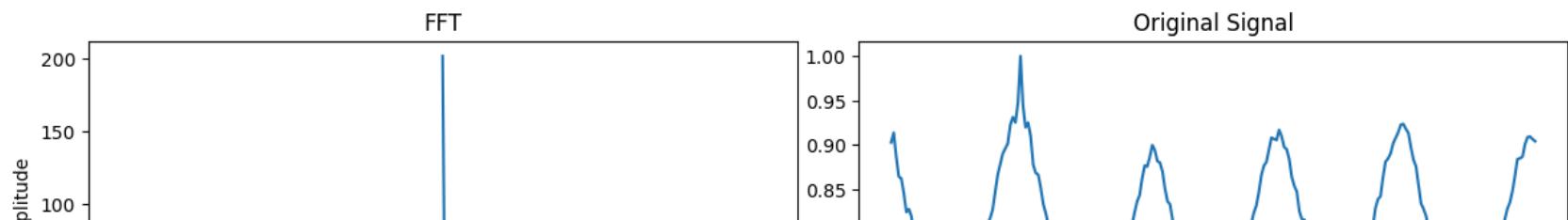


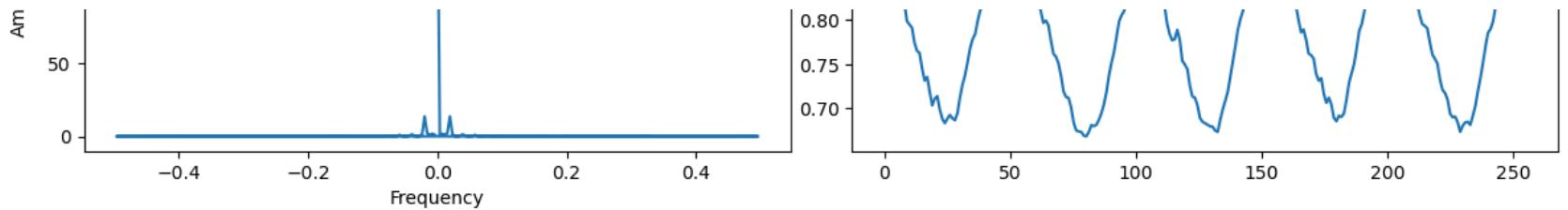
### Histogram - FFT



Dominant Frequency: 0.020 , Period: 51.201

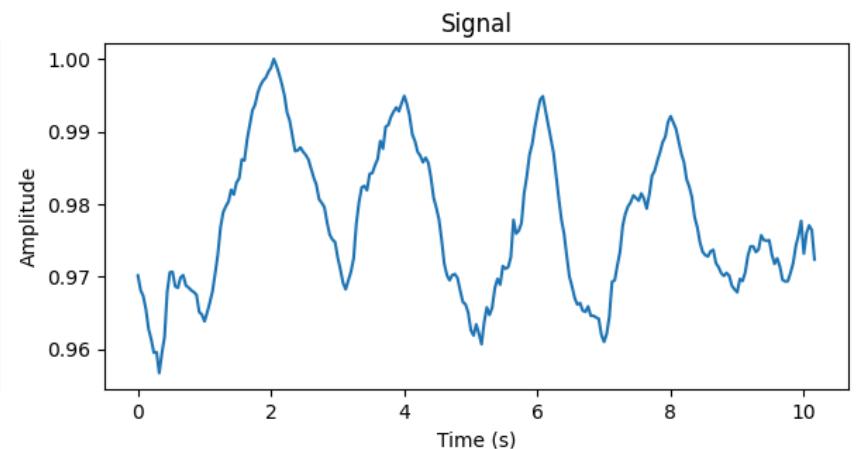
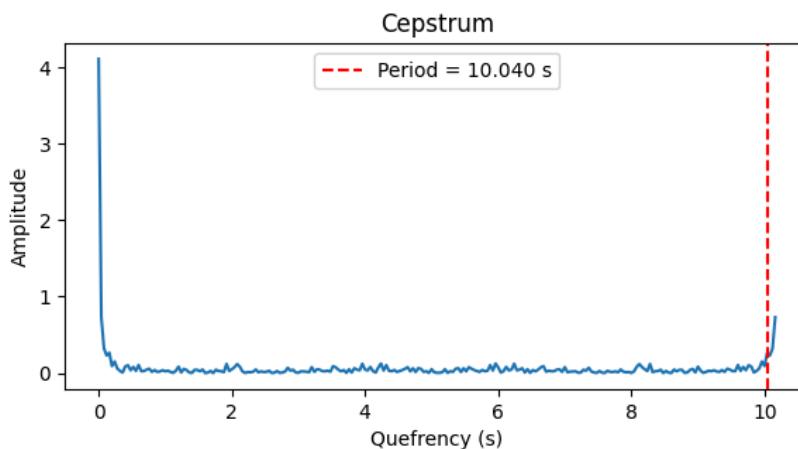
### PCC - FFT





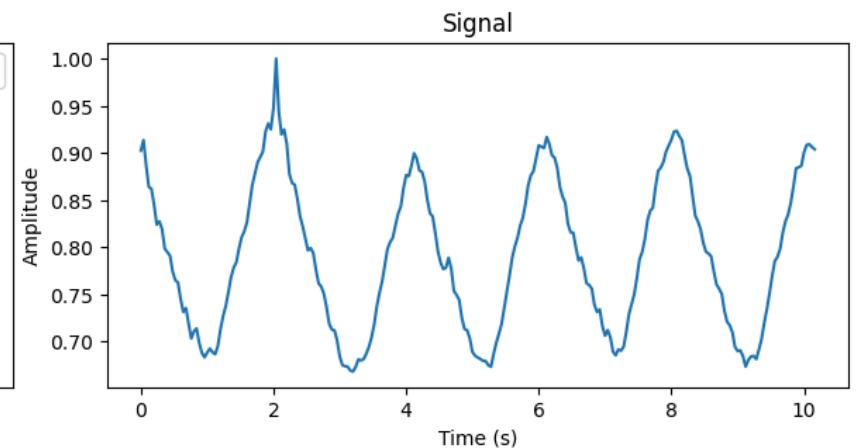
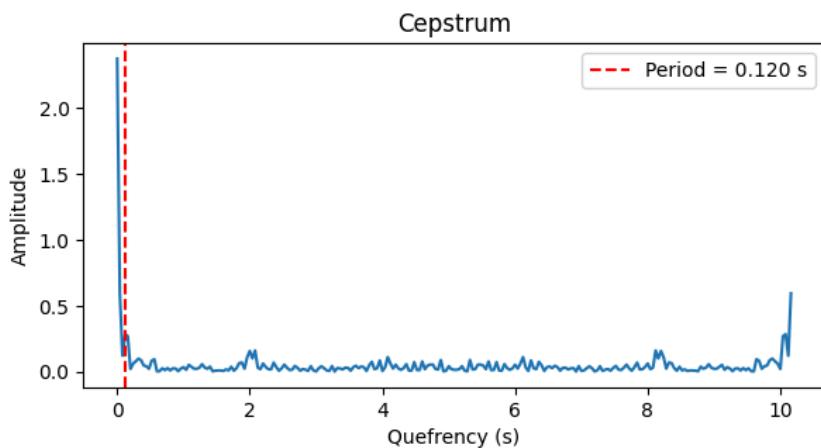
Dominant Frequency: 0.020 , Period: 51.201

#### Histogram - Cepstrum



Period: 10.040 seconds   Period: 251.000 frames

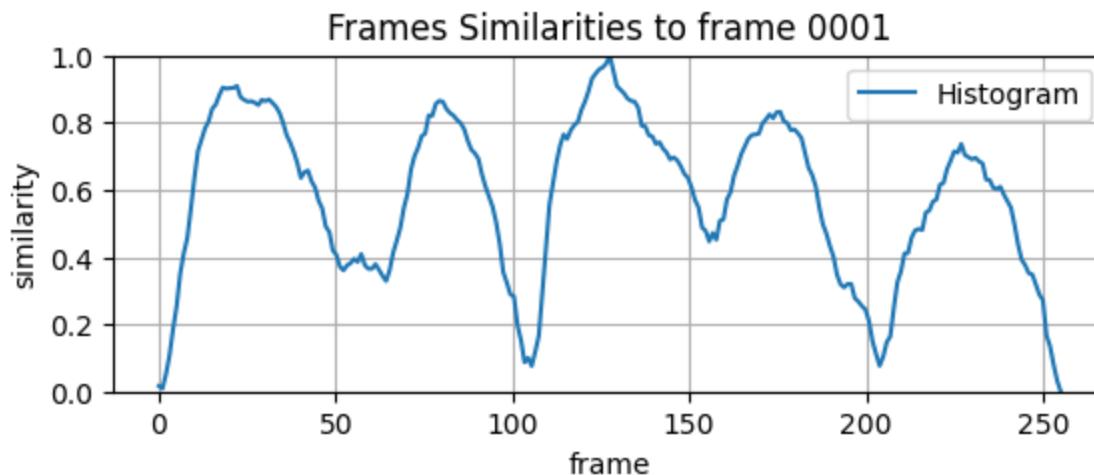
#### PCC - Cepstrum



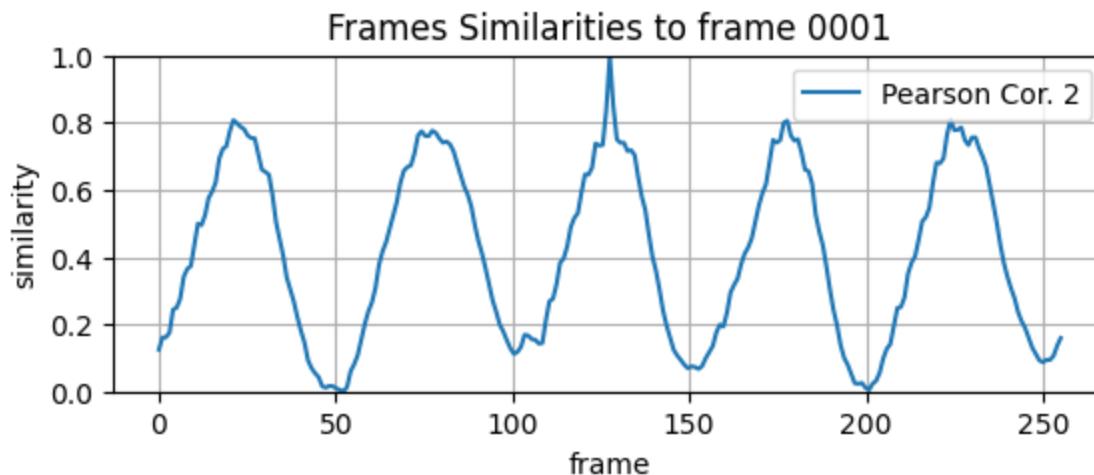
Period: 0.120 seconds   Period: 3.000 frames

\* \* \* \* \* Video: 3 Reference frame at: (50%) 127 \* \* \* \* \*

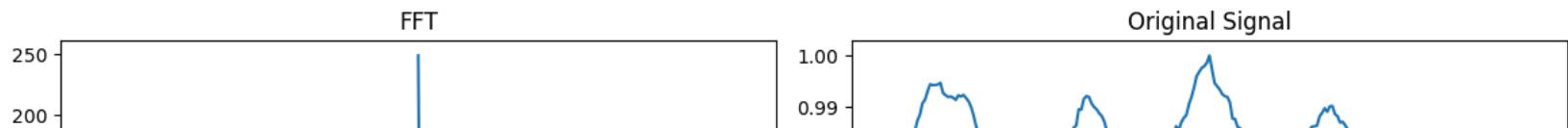
Similarity Signal - Histogram

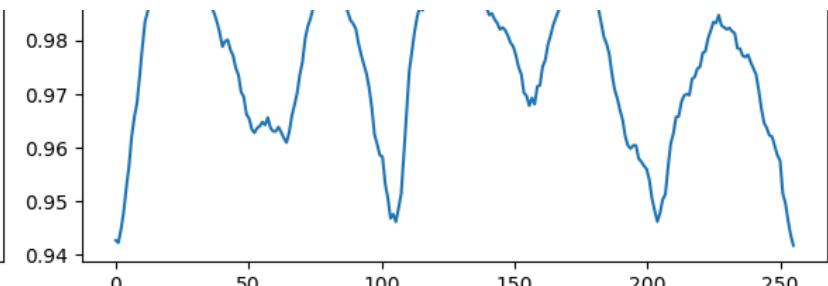
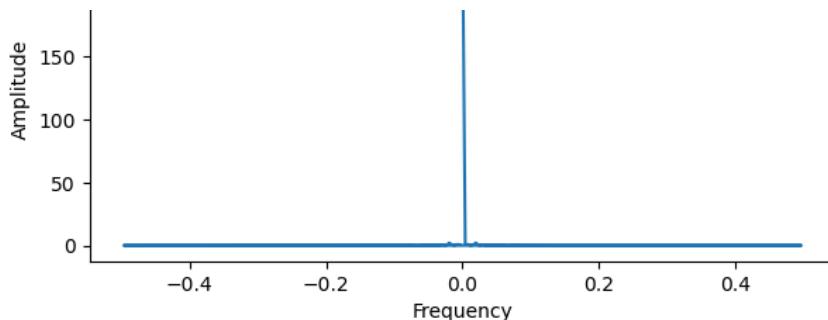


Similarity Signal - Pearson Correlation



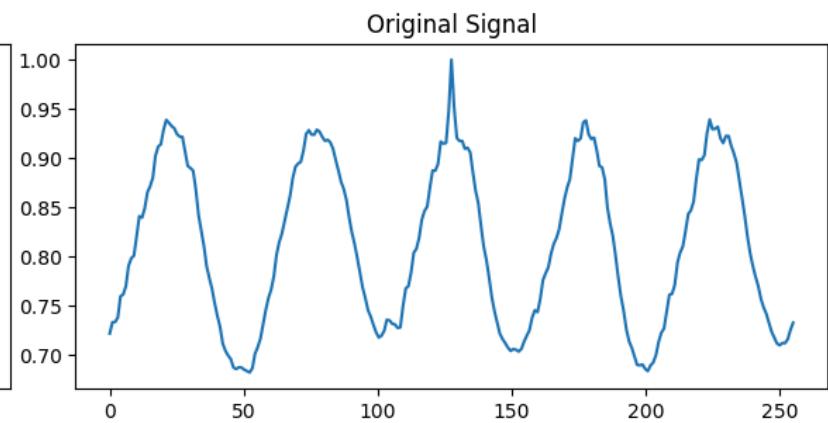
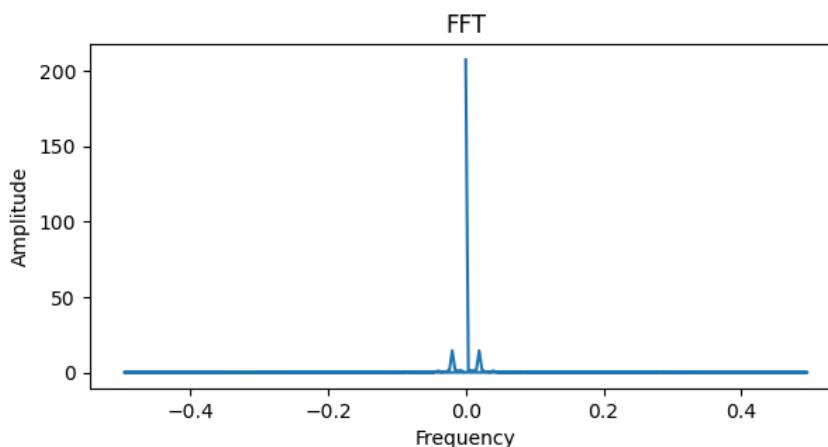
Histogram - FFT





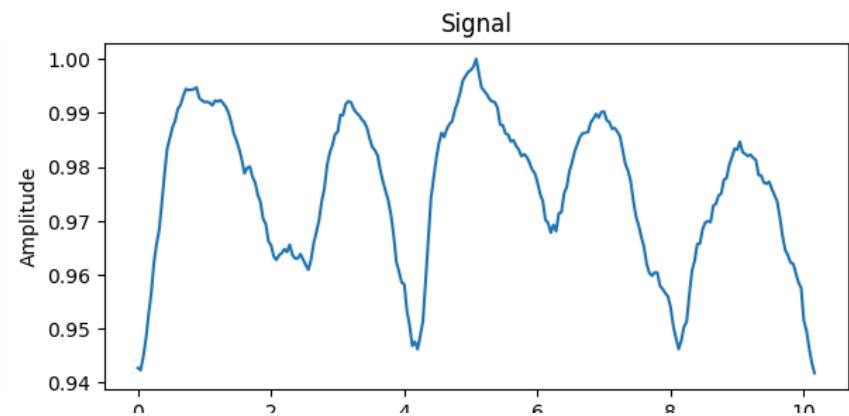
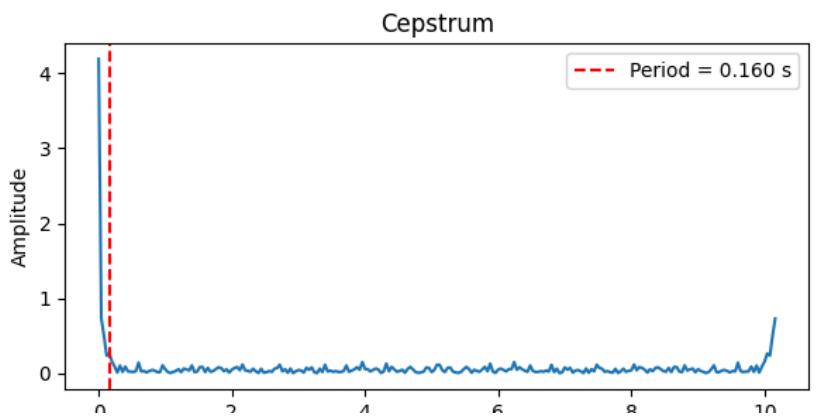
Dominant Frequency: 0.020 , Period: 51.201

PCC - FFT



Dominant Frequency: 0.020 , Period: 51.201

Histogram - Cepstrum

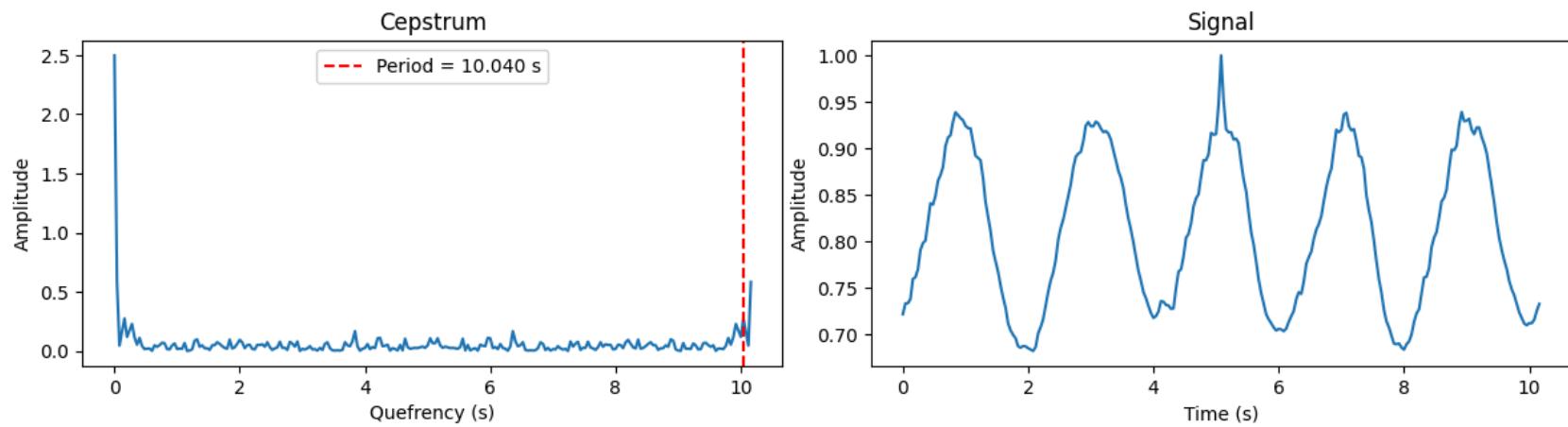


Quefrency (s)

Period: 0.160 seconds      Period: 4.000 frames

Time (s)

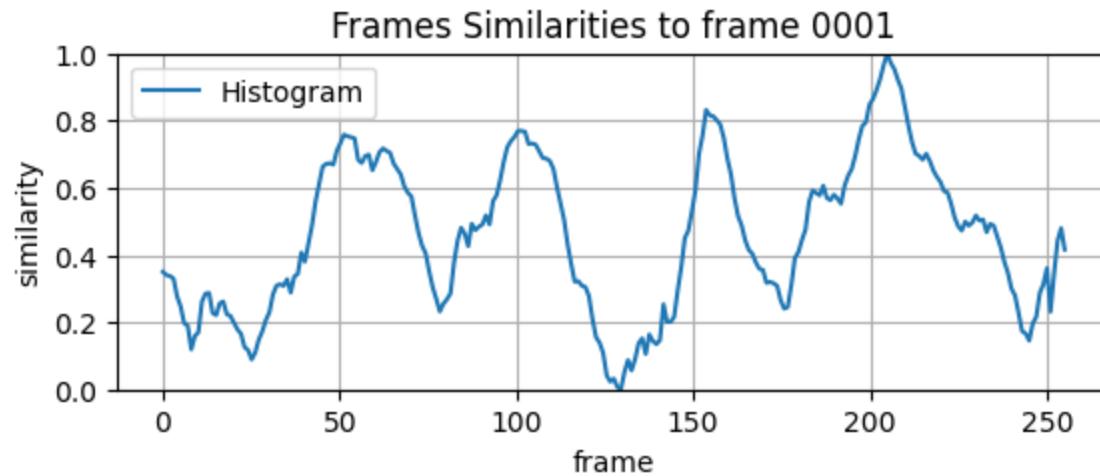
## PCC - Cepstrum



Period: 10.040 seconds Period: 251.000 frames

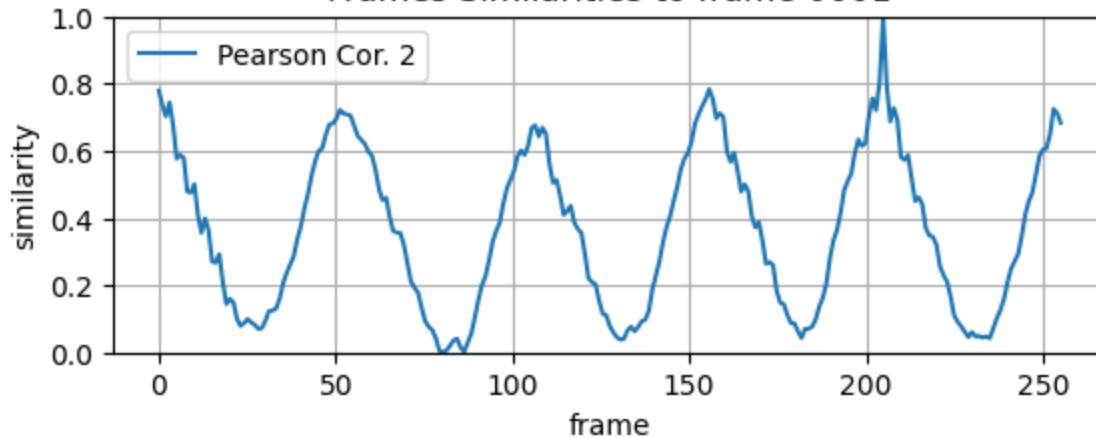
\* \* \* \* \* Video: 3 Reference frame at: (80%) 204 \* \* \* \* \*

## Similarity Signal - Histogram

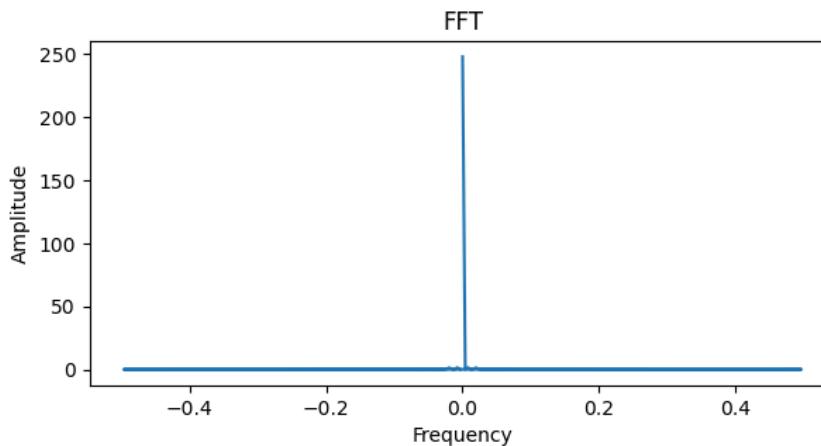


## Similarity Signal - Pearson Correlation

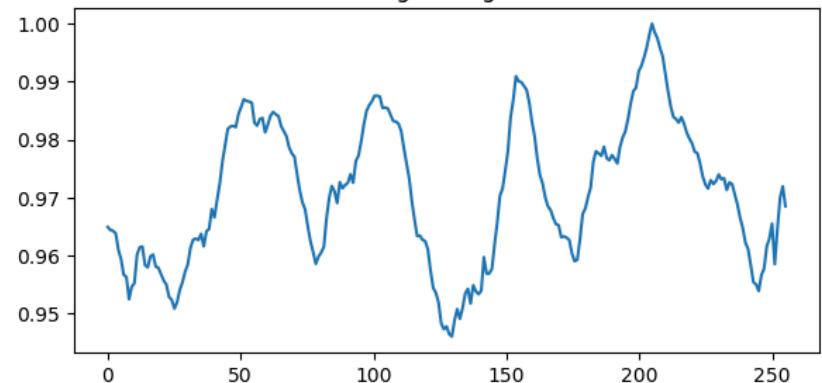
### Frames Similarities to frame 0001



Histogram - FFT

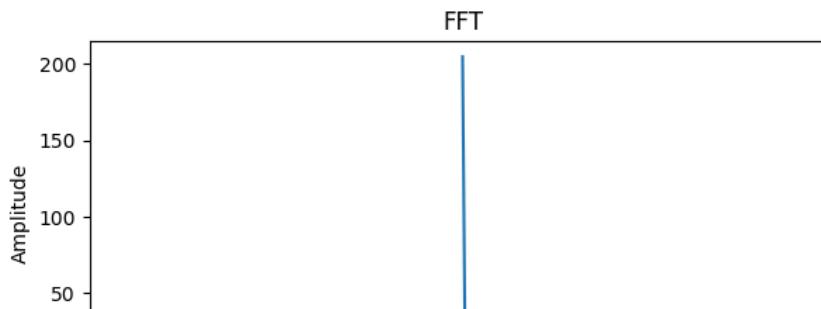


Original Signal

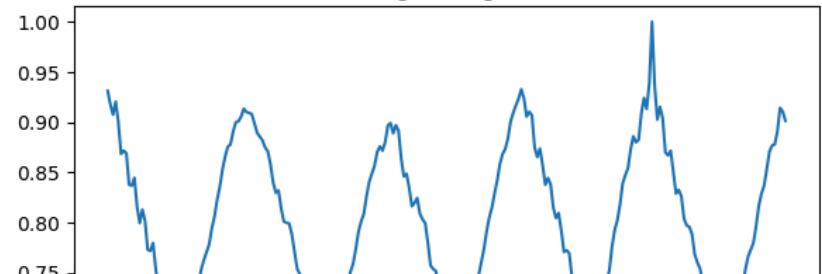


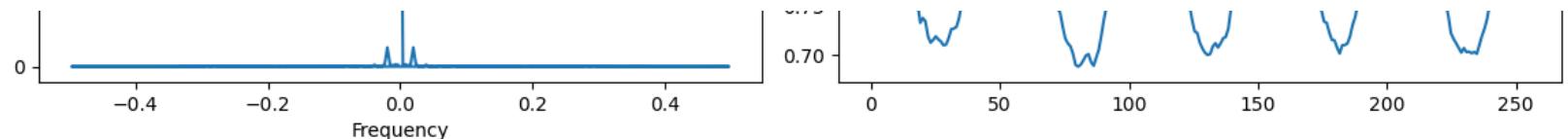
Dominant Frequency: 0.008 , Period: 128.002

PCC - FFT



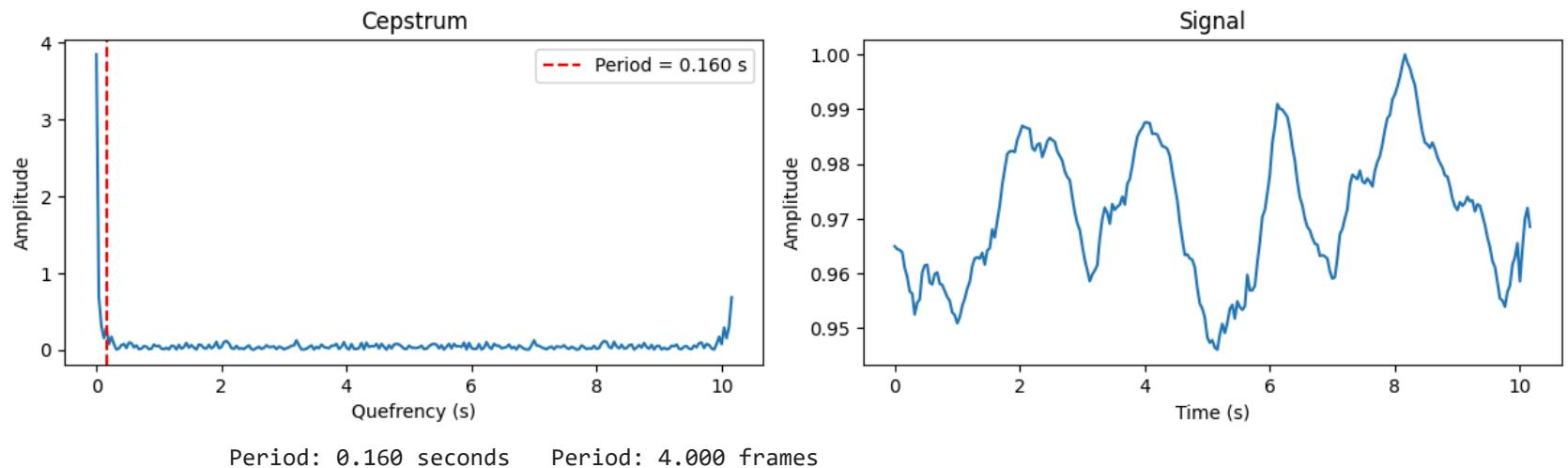
Original Signal



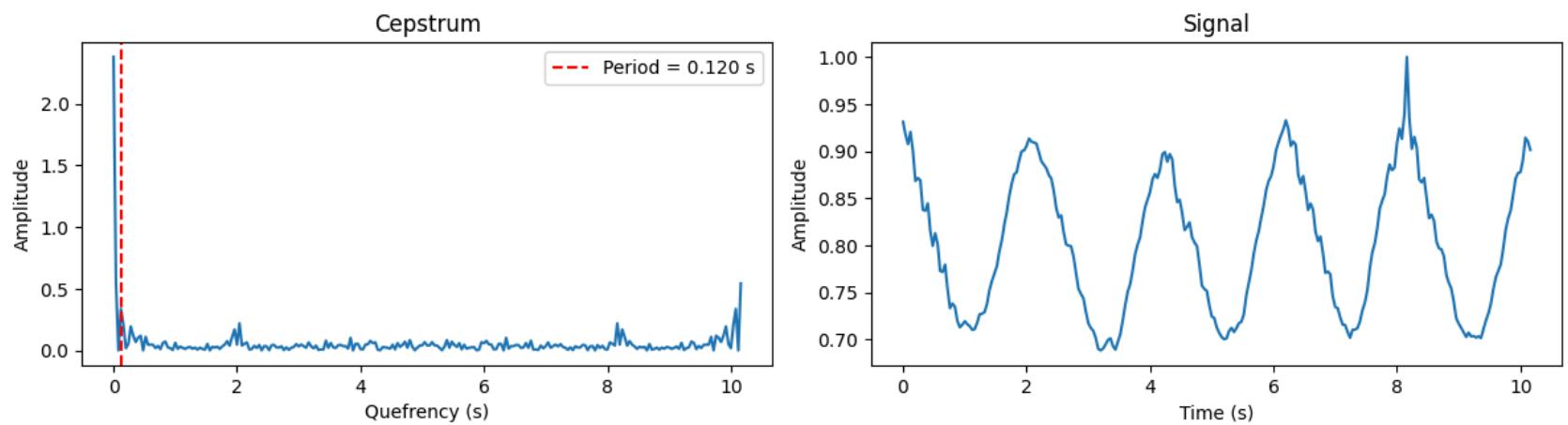


Dominant Frequency: 0.020 , Period: 51.201

#### Histogram - Cepstrum



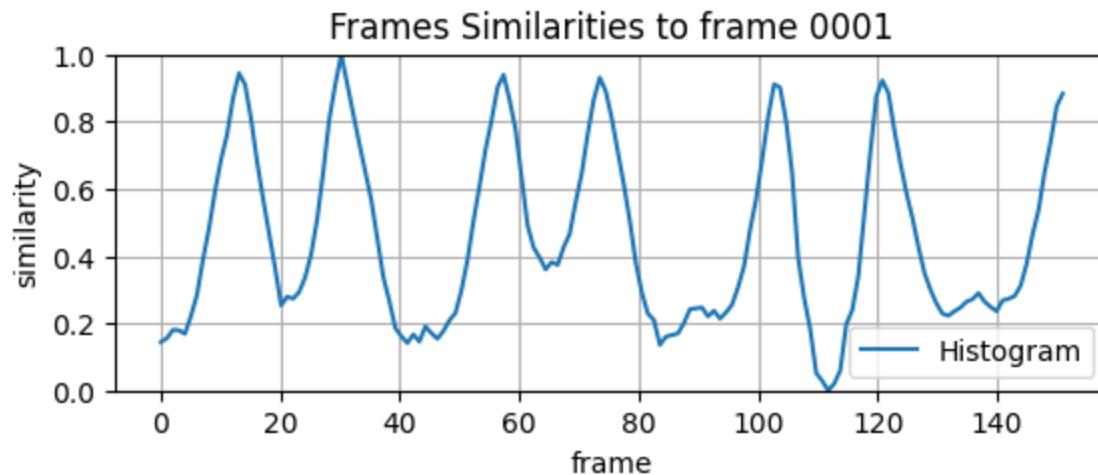
#### PCC - Cepstrum



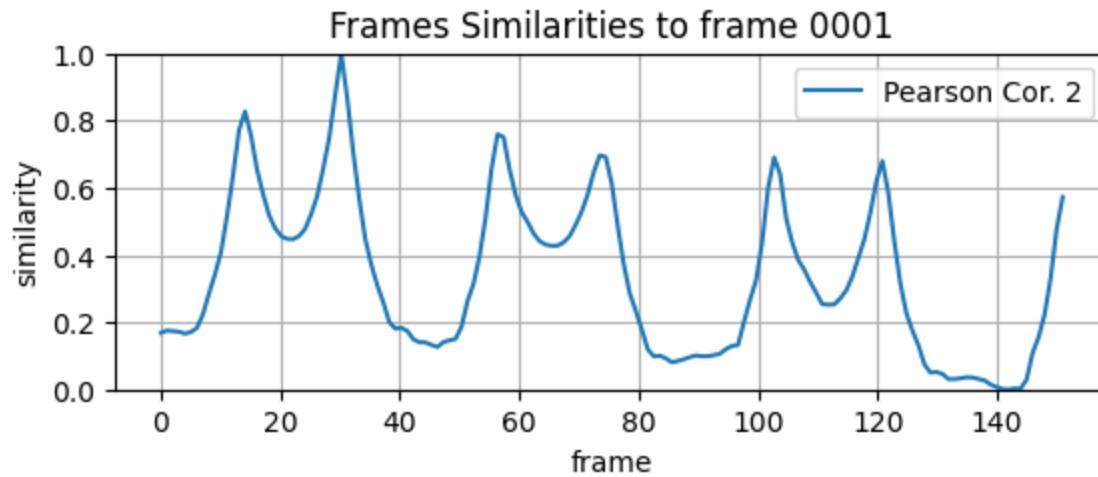
\* \* \* \* \* 4.mp4   Frames:151 FPS:25.0 \* \* \* \* \*

\* \* \* \* \* Video: 4 Reference frame at: (20%) 30 \* \* \* \* \*

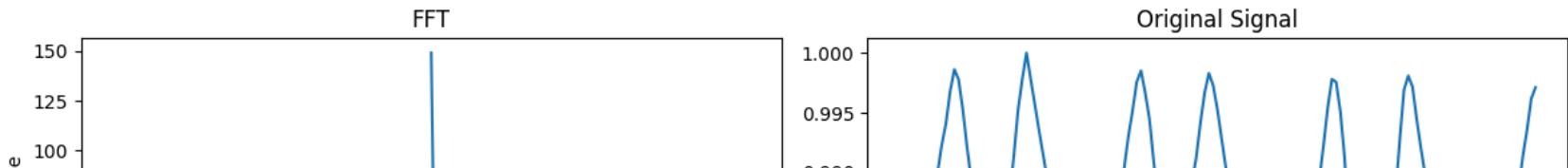
Similarity Signal - Histogram

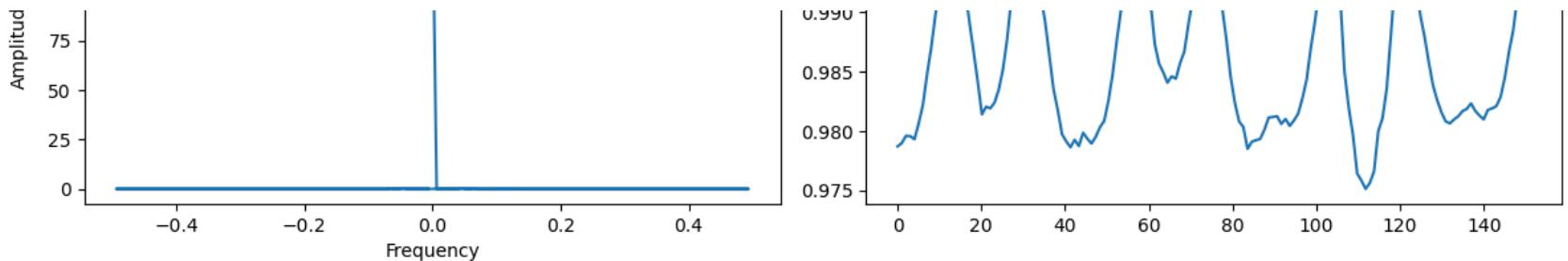


Similarity Signal - Pearson Correlation

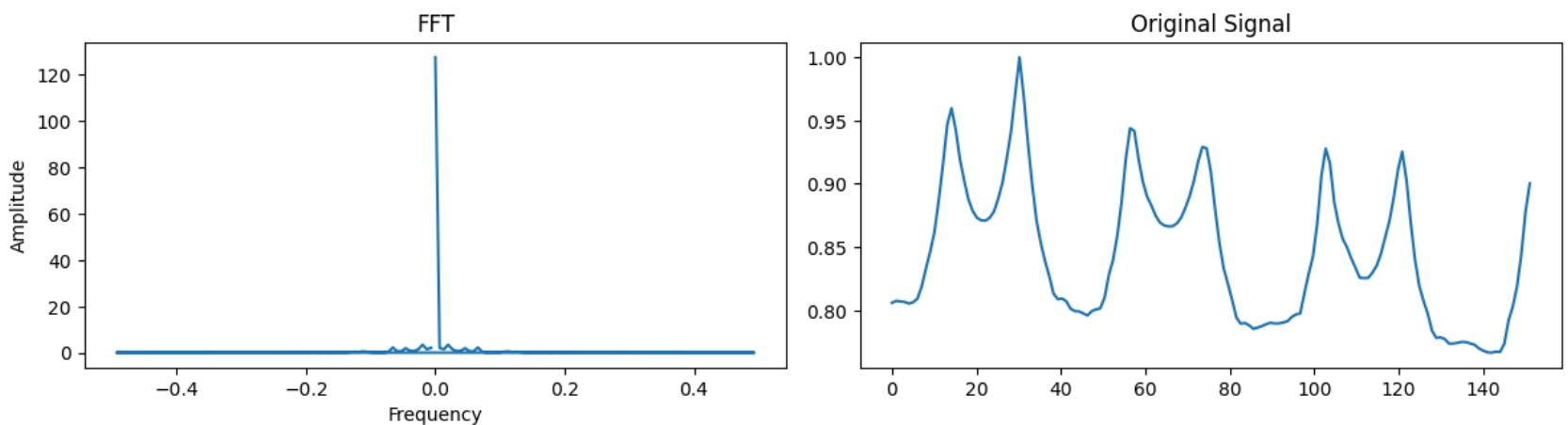


Histogram - FFT

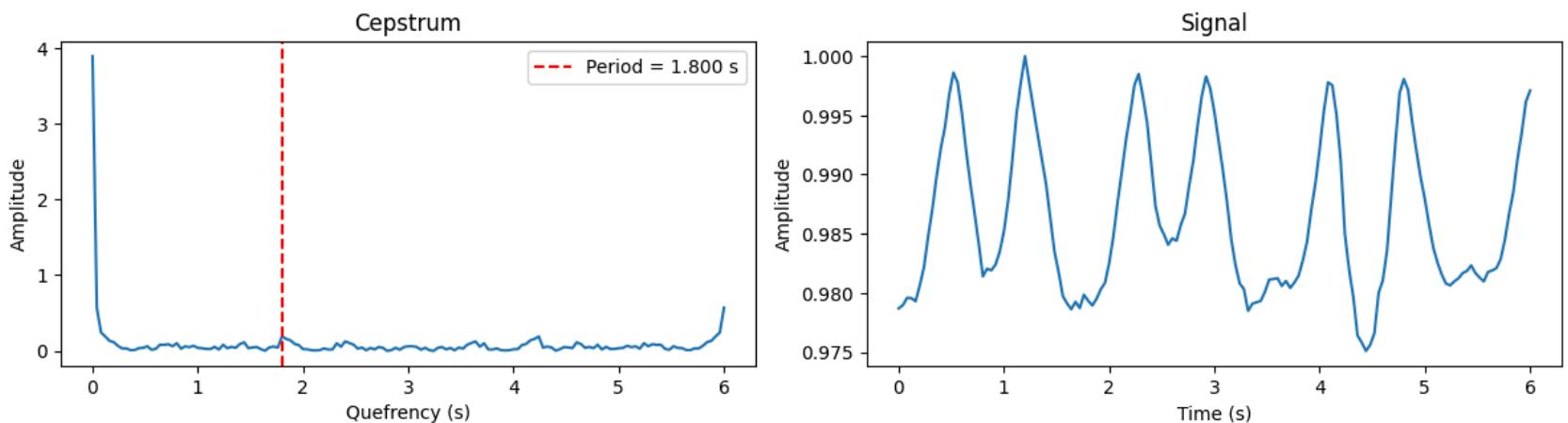




PCC - FFT

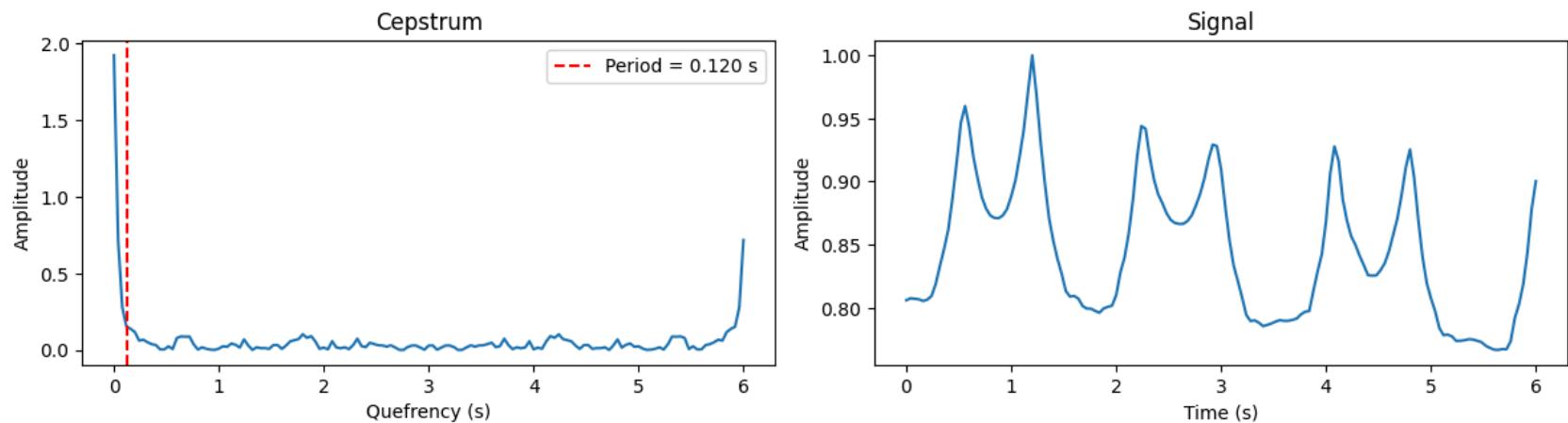


Histogram - Cepstrum



Period: 1.800 seconds    Period: 45.000 frames

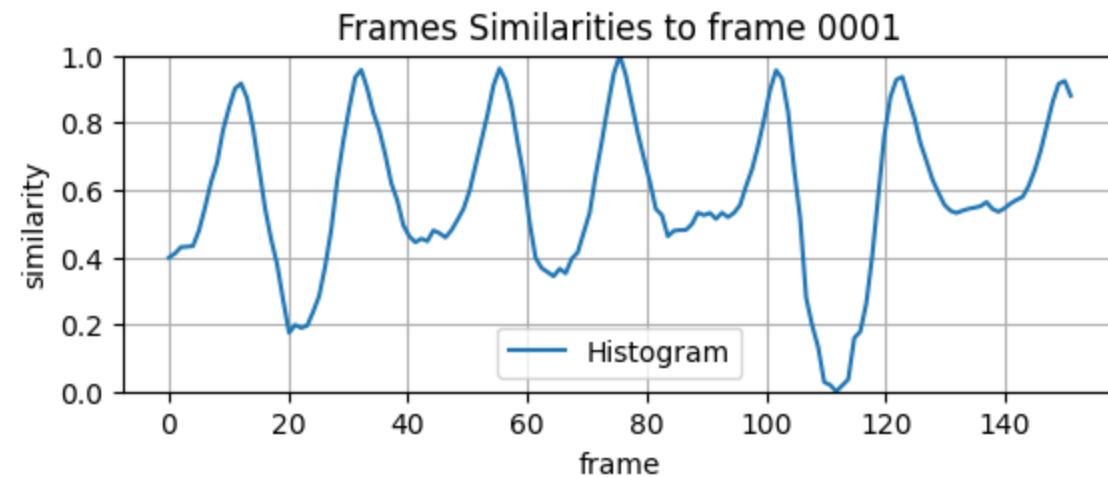
#### PCC - Cepstrum



Period: 0.120 seconds    Period: 3.000 frames

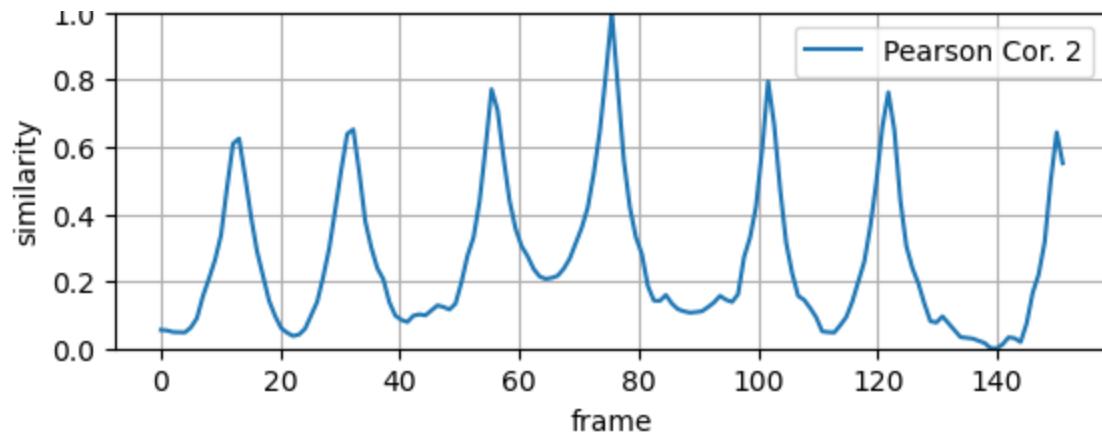
\* \* \* \* \* Video: 4 Reference frame at: (50%) 75 \* \* \* \* \*

#### Similarity Signal - Histogram

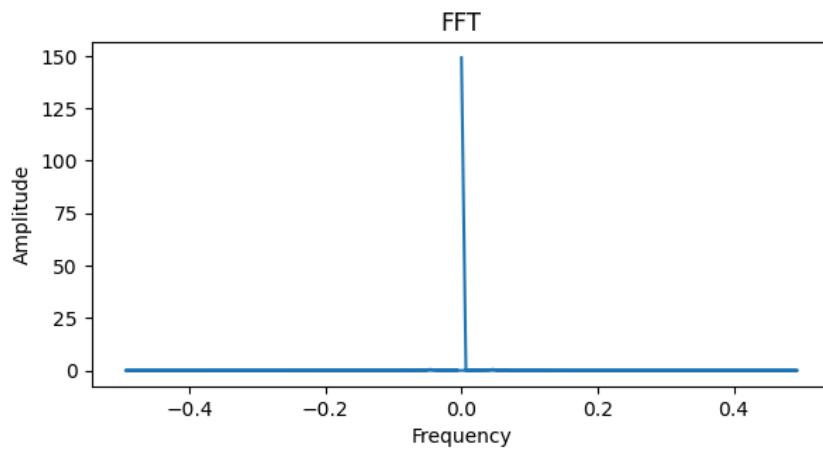


#### Similarity Signal - Pearson Correlation

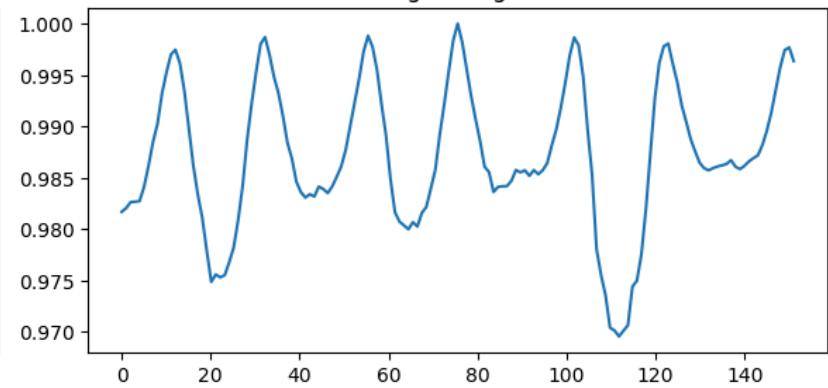
#### Frames Similarities to frame 0001



Histogram - FFT

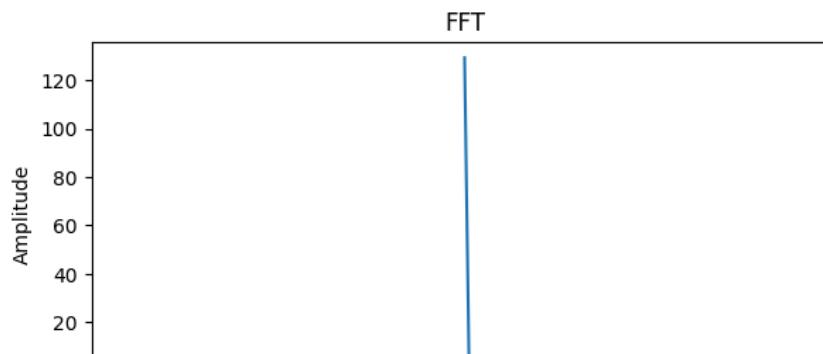


Original Signal

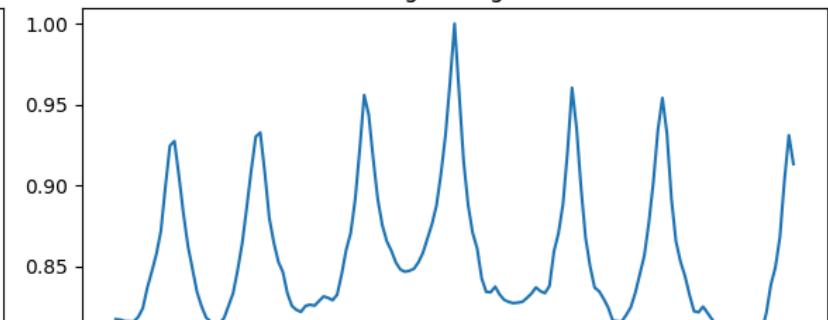


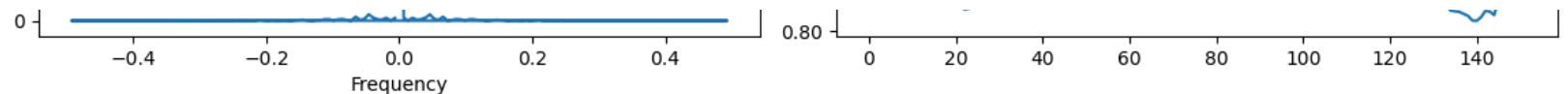
Dominant Frequency: 0.046 , Period: 21.715

PCC - FFT

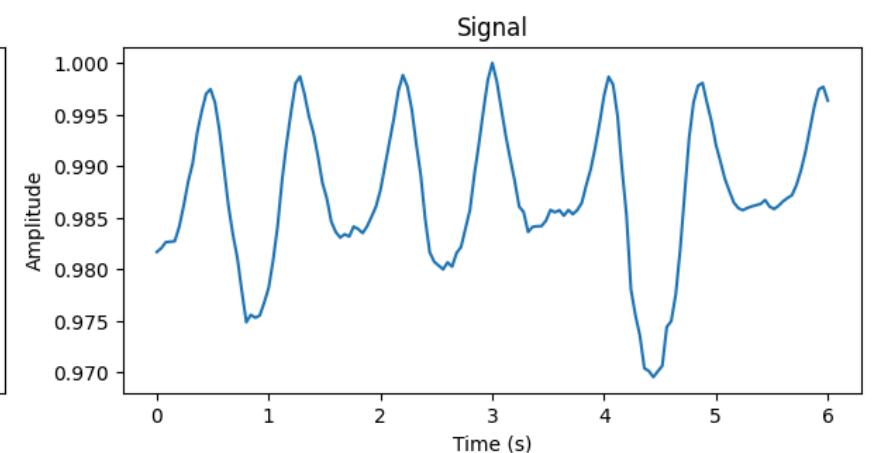
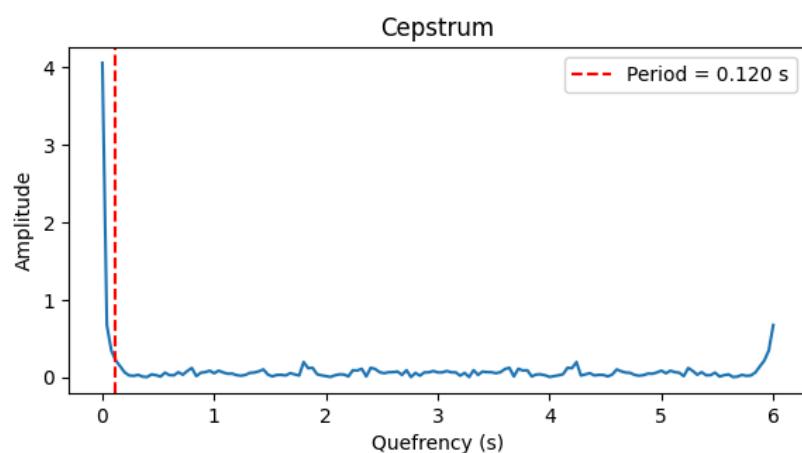


Original Signal



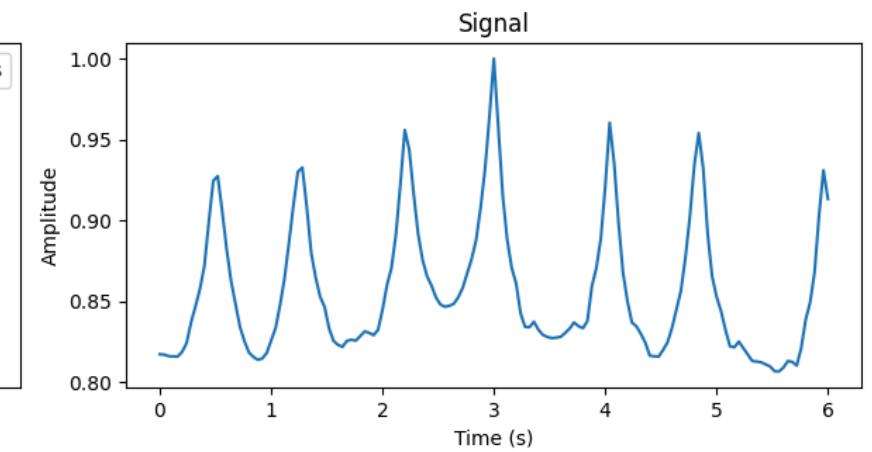
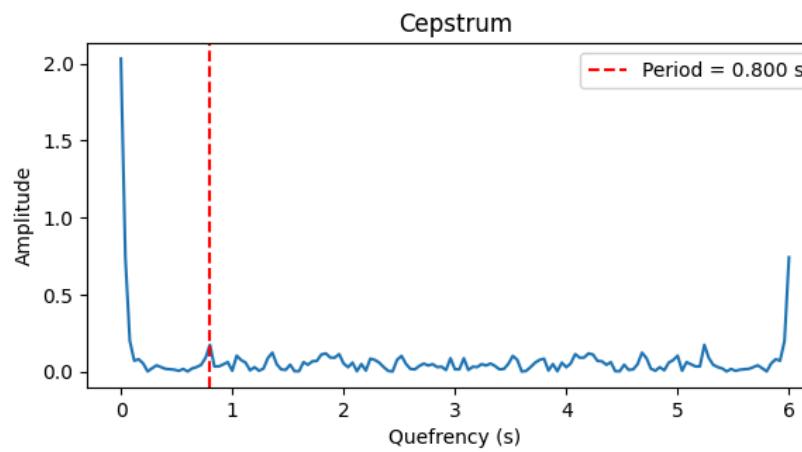


Histogram - Cepstrum



Period: 0.120 seconds      Period: 3.000 frames

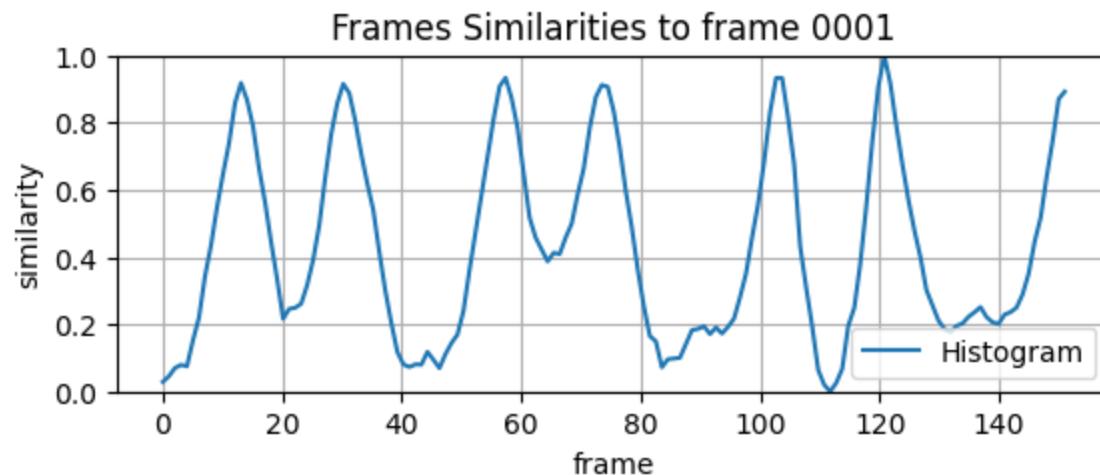
PCC - Cepstrum



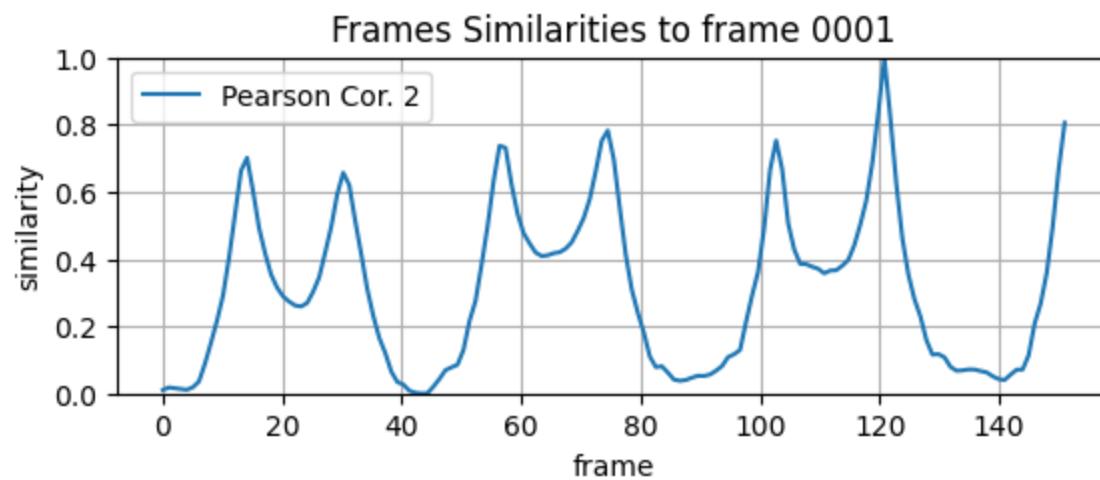
Period: 0.800 seconds      Period: 20.000 frames

\* \* \* \* \* Video: 4 Reference frame at: (79%) 120 \* \* \* \* \*

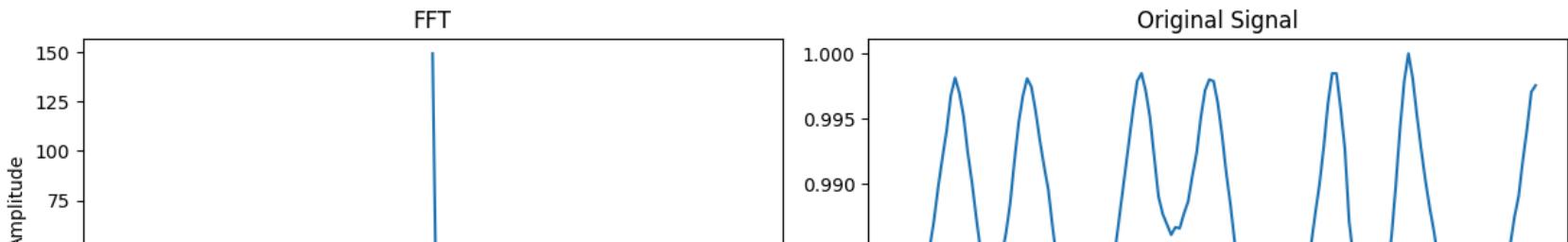
Similarity Signal - Histogram

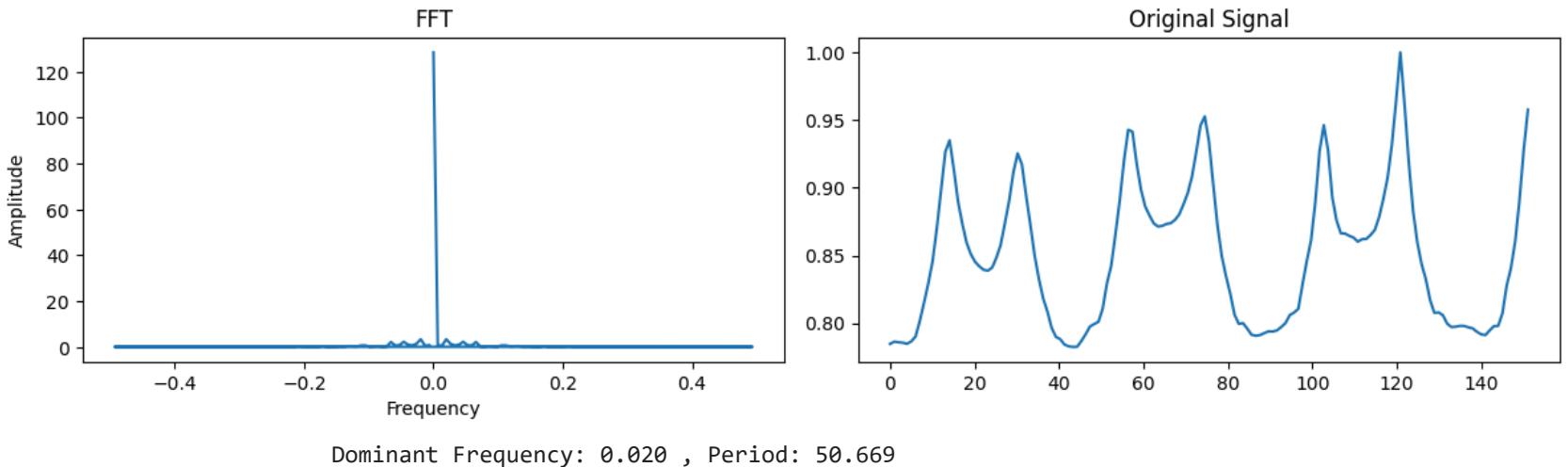
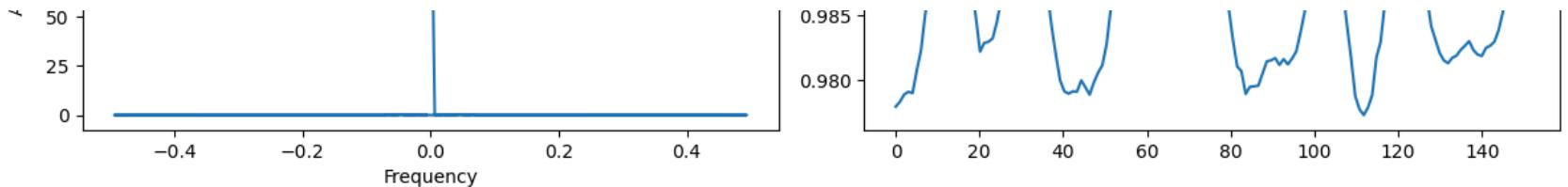


Similarity Signal - Pearson Correlation

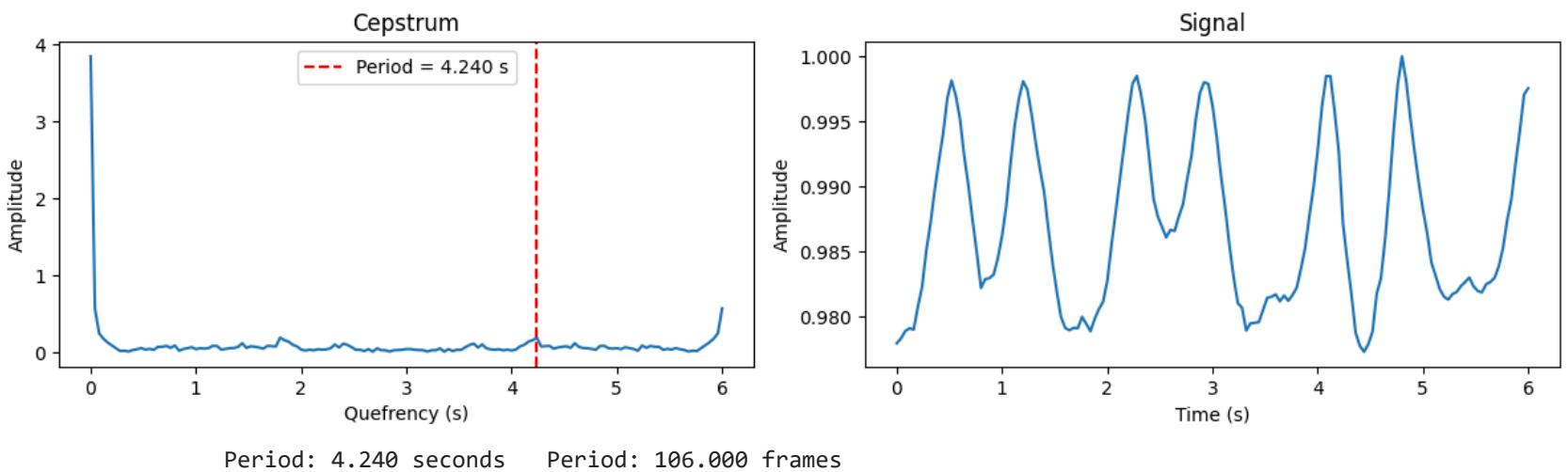


Histogram - FFT

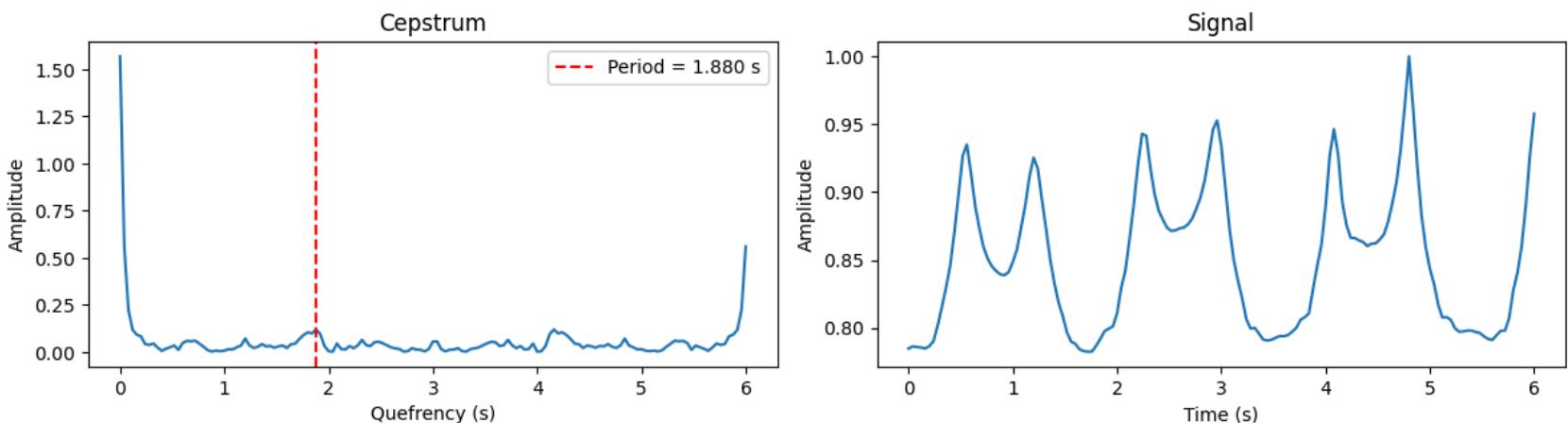




Histogram - Cepstrum



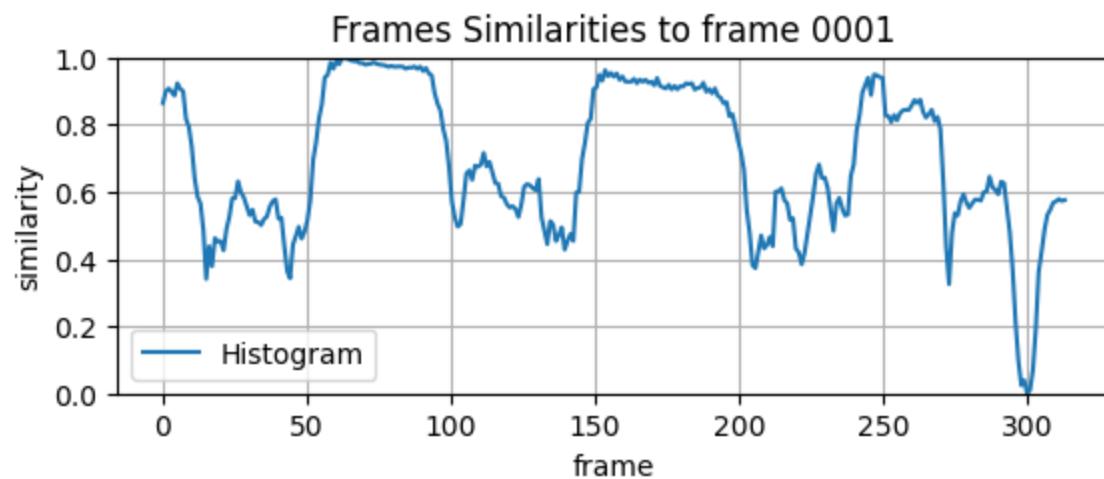
## PCC - Cepstrum



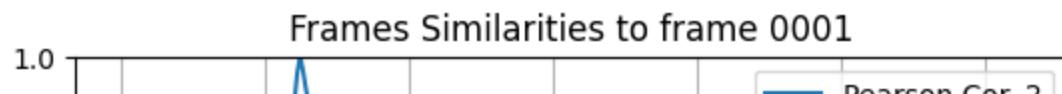
Period: 1.880 seconds      Period: 47.000 frames  
\* \* \* \* \* 5.mp4      Frames:313 FPS:29.97 \* \* \* \* \*

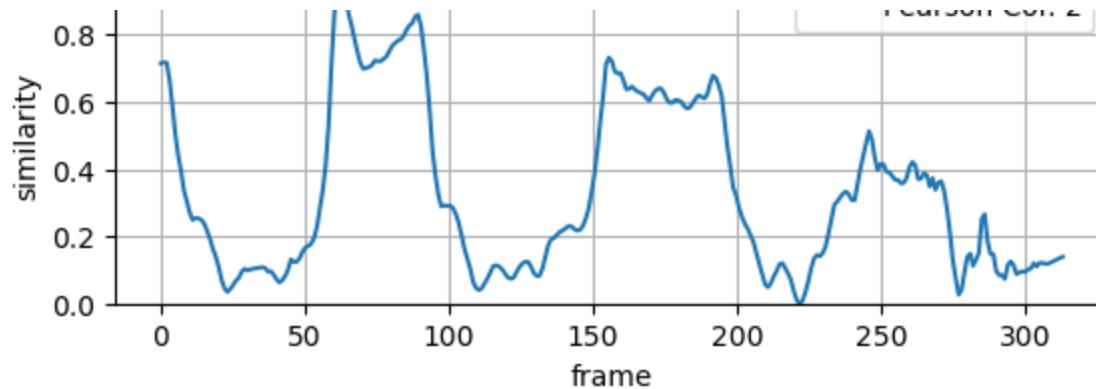
\* \* \* \* \* Video: 5 Reference frame at: (20%) 62 \* \* \* \* \*

## Similarity Signal - Histogram

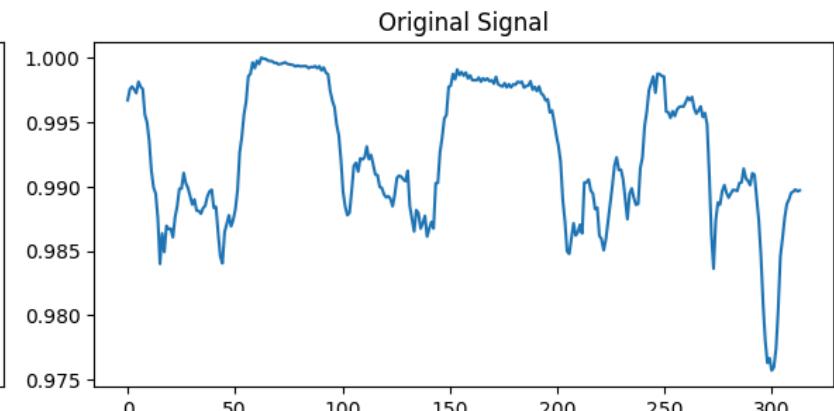
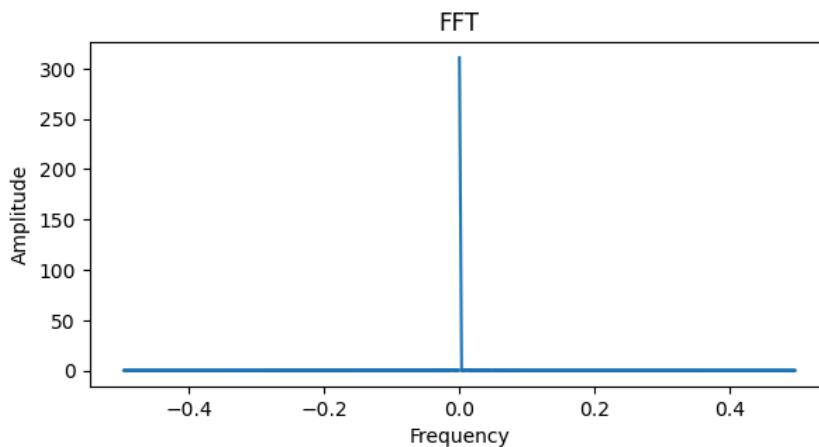


## Similarity Signal - Pearson Correlation



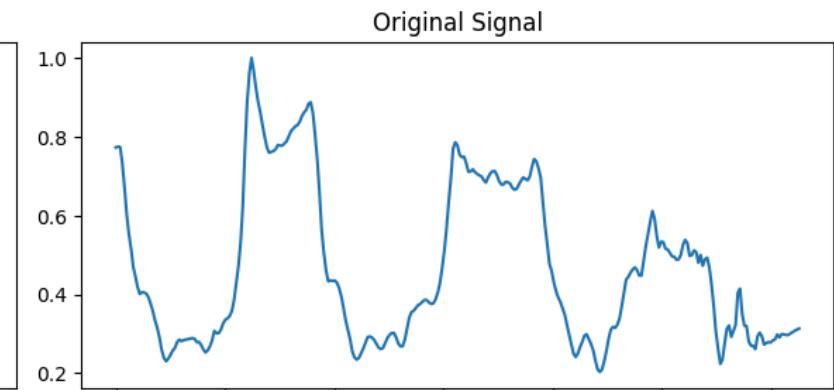
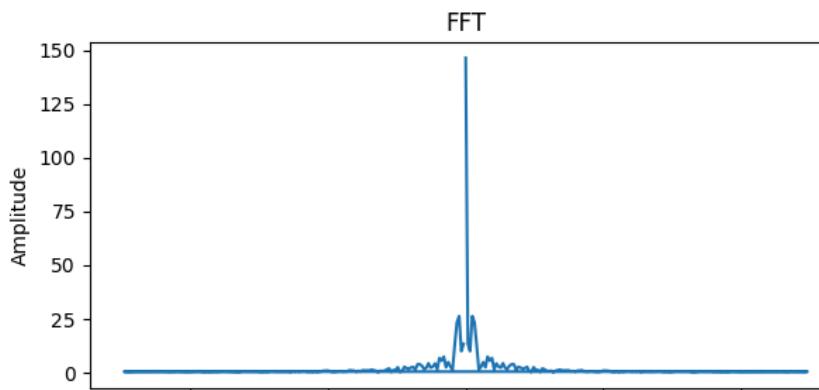


Histogram - FFT



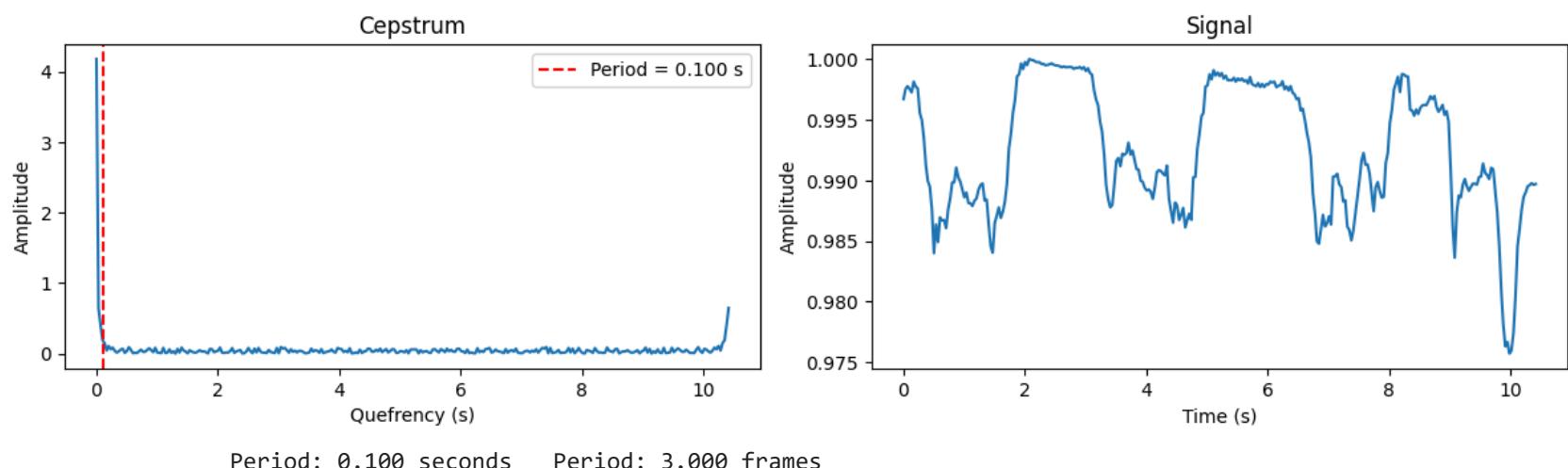
Dominant Frequency: 0.013 , Period: 78.501

PCC - FFT

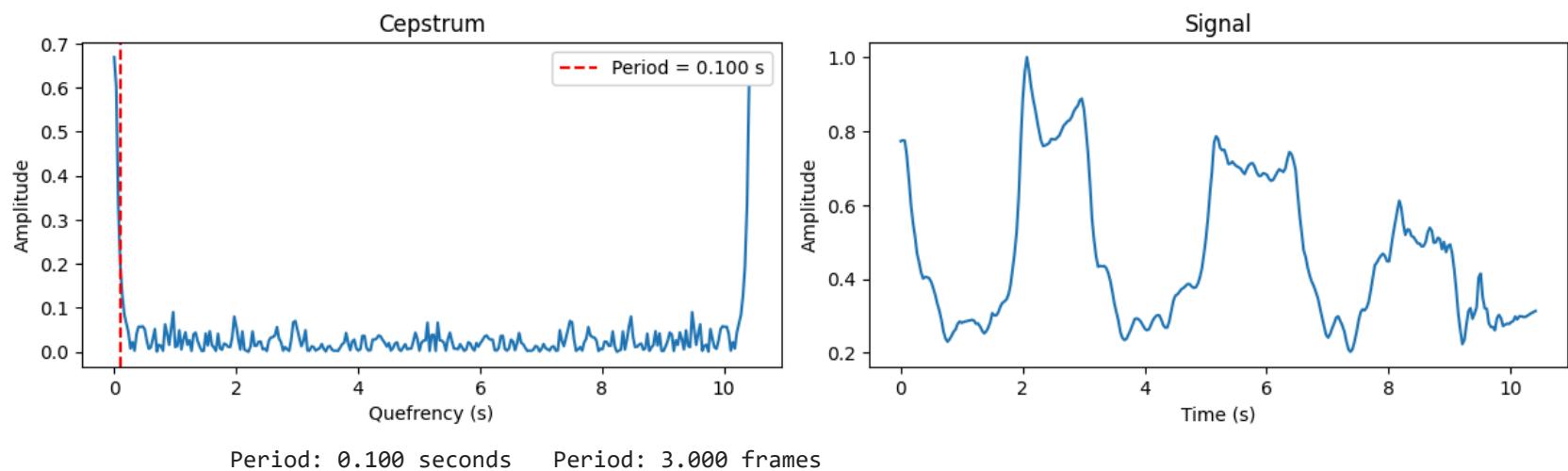




Histogram - Cepstrum

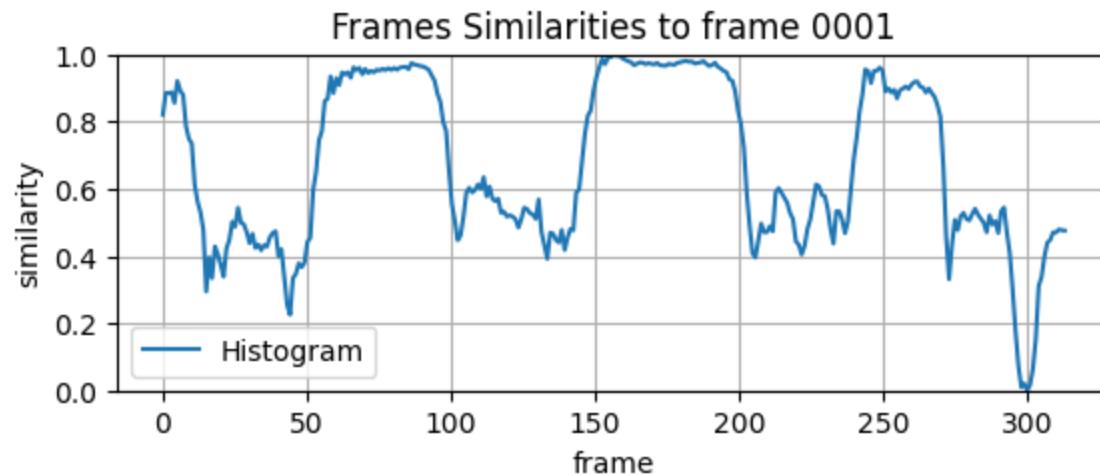


PCC - Cepstrum

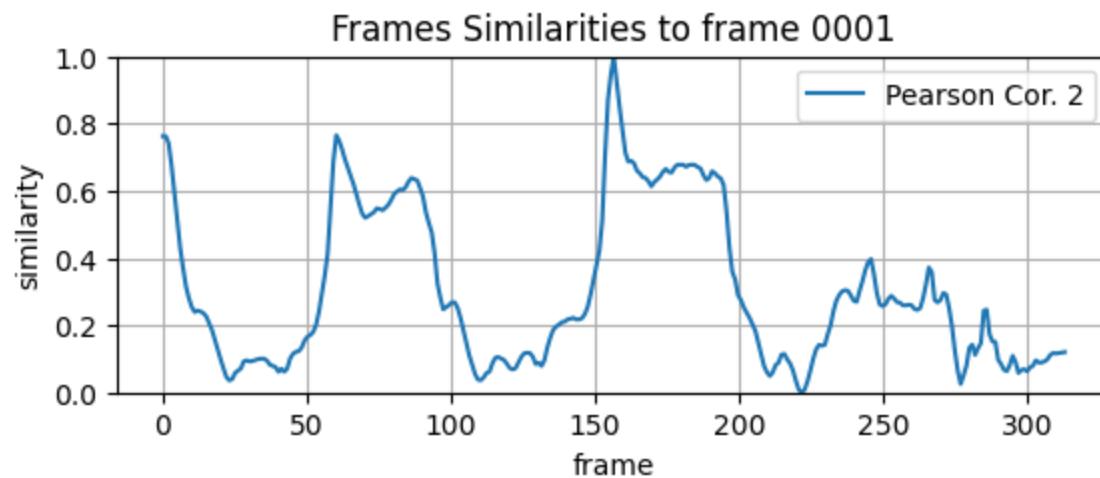


\* \* \* \* \* Video: 5 Reference frame at: (50%) 156 \* \* \* \* \*

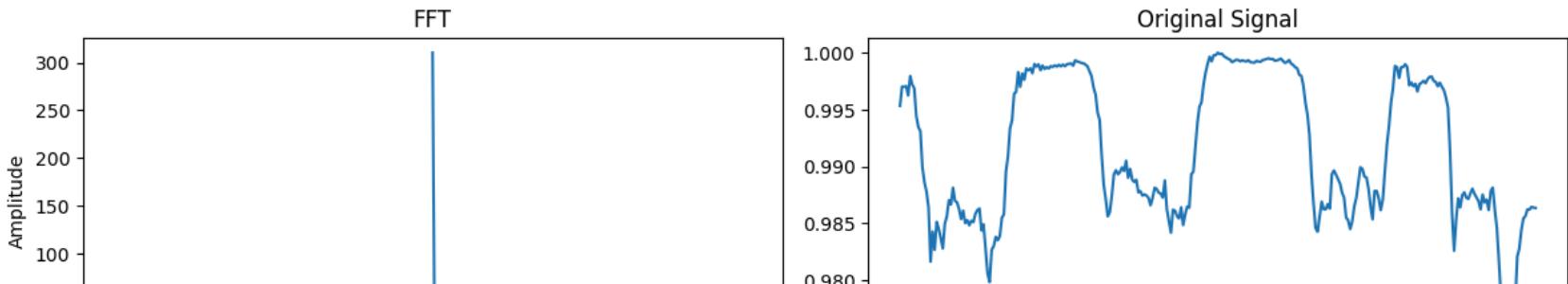
Similarity Signal - Histogram

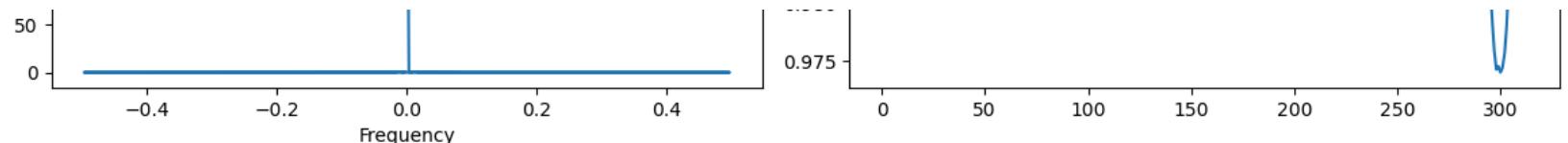


Similarity Signal - Pearson Correlation



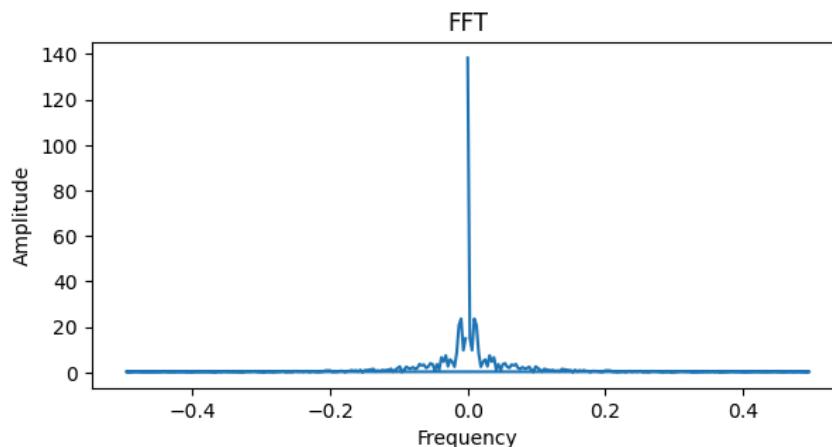
Histogram - FFT





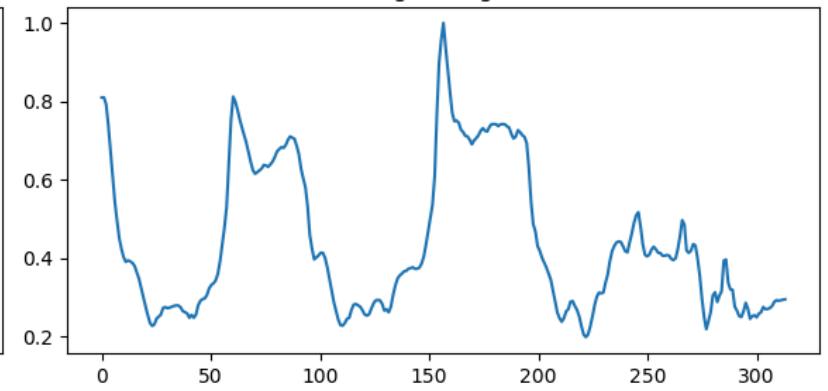
Dominant Frequency: 0.013 , Period: 78.501

PCC - FFT

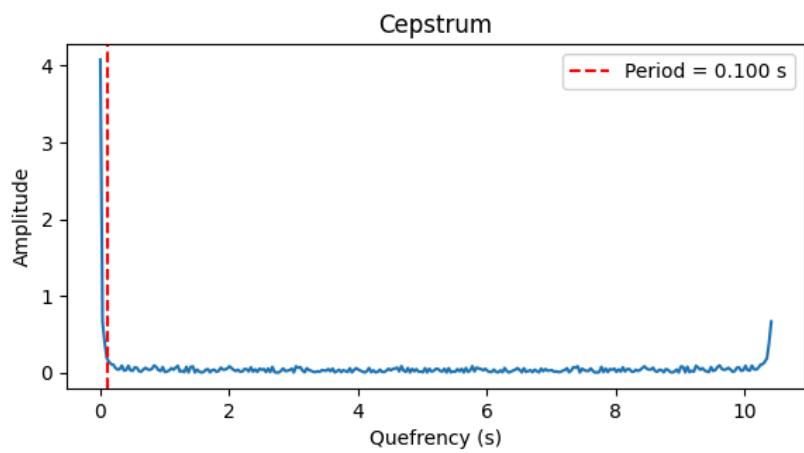


Dominant Frequency: 0.010 , Period: 104.668

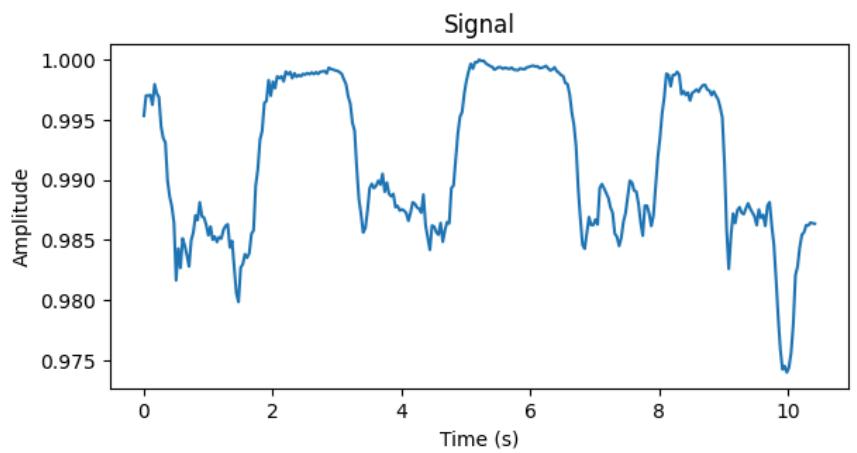
Original Signal



Histogram - Cepstrum

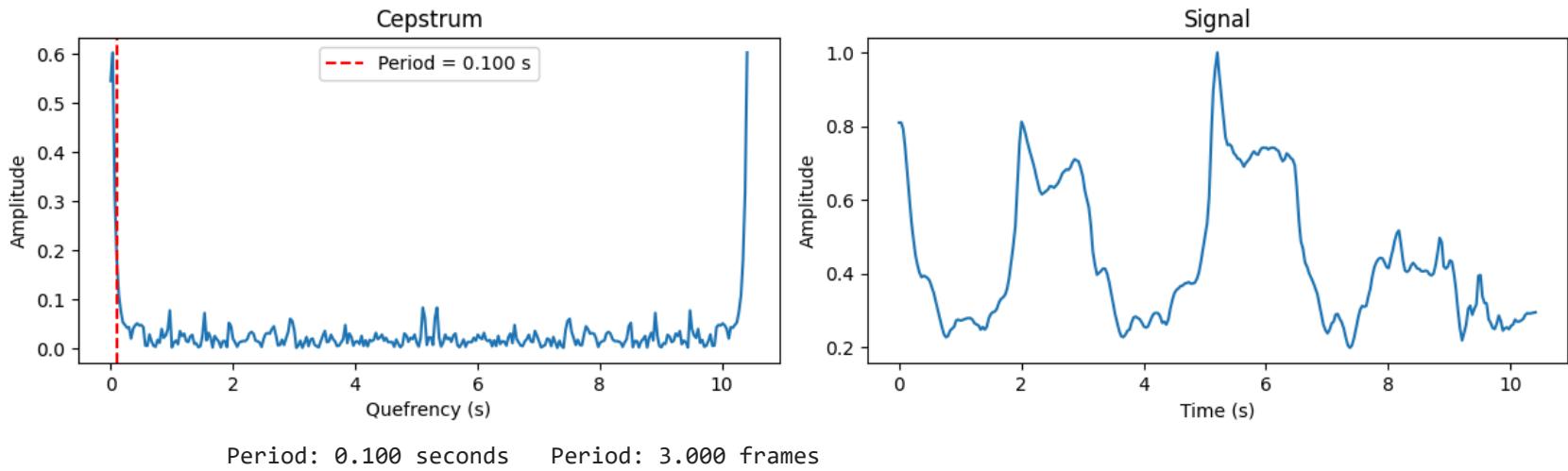


Period = 0.100 s



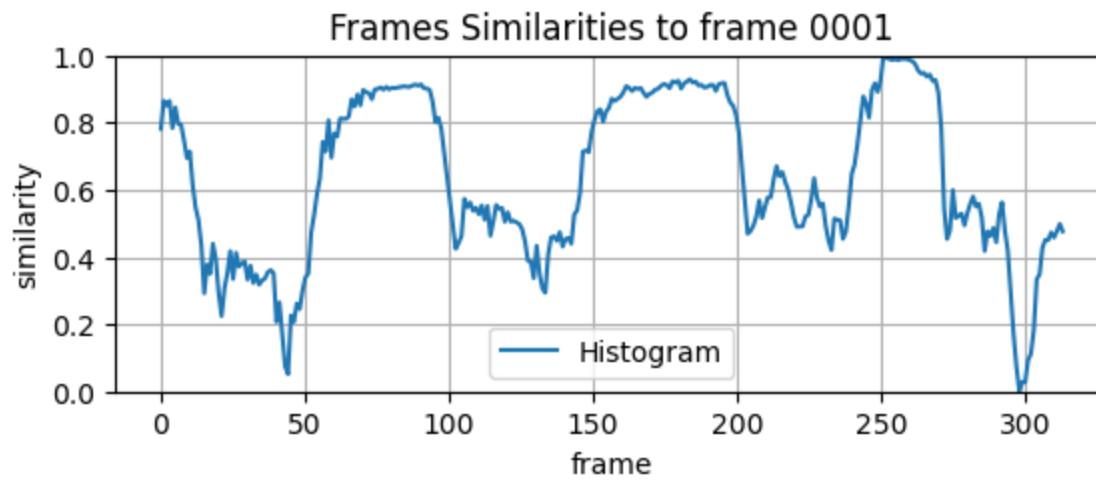
Period: 0.100 seconds      Period: 3.000 frames

PCC - Cepstrum

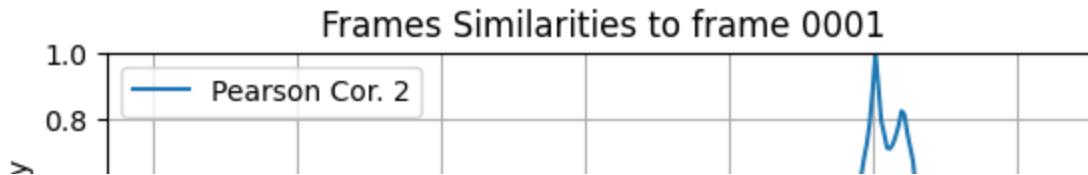


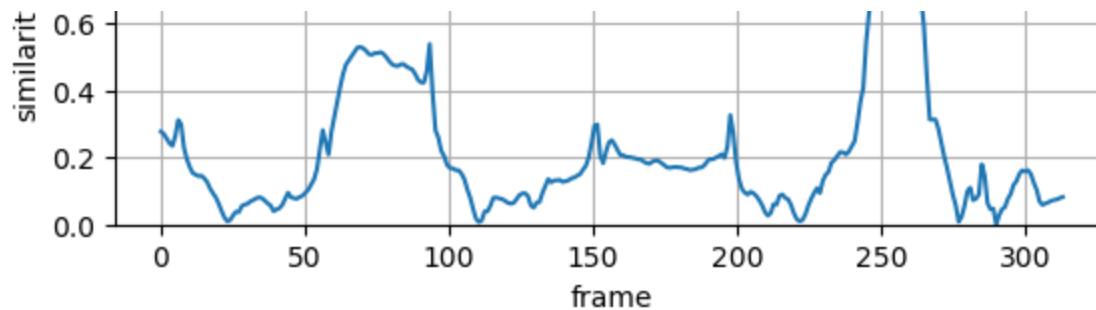
\* \* \* \* \* Video: 5 Reference frame at: (80%) 250 \* \* \* \* \*

Similarity Signal - Histogram

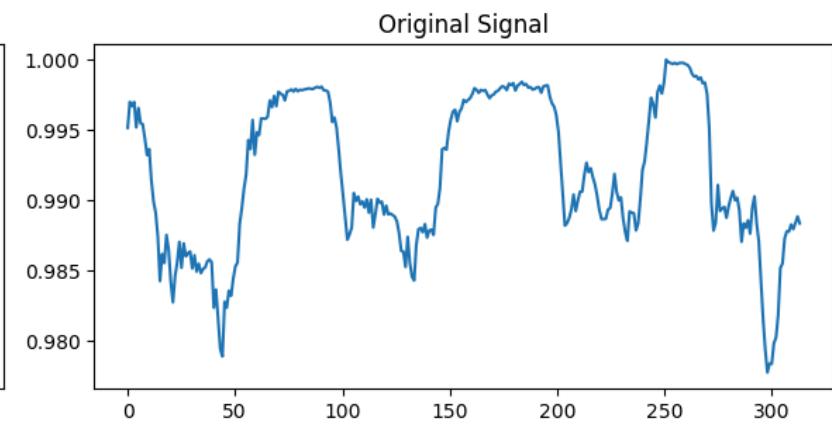
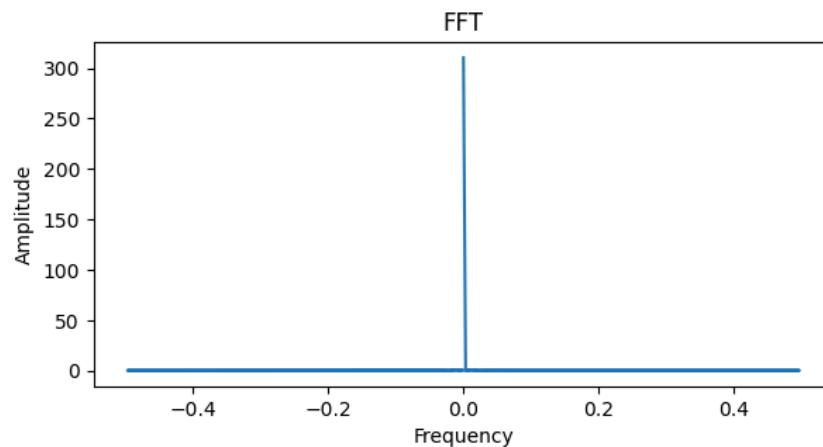


Similarity Signal - Pearson Correlation



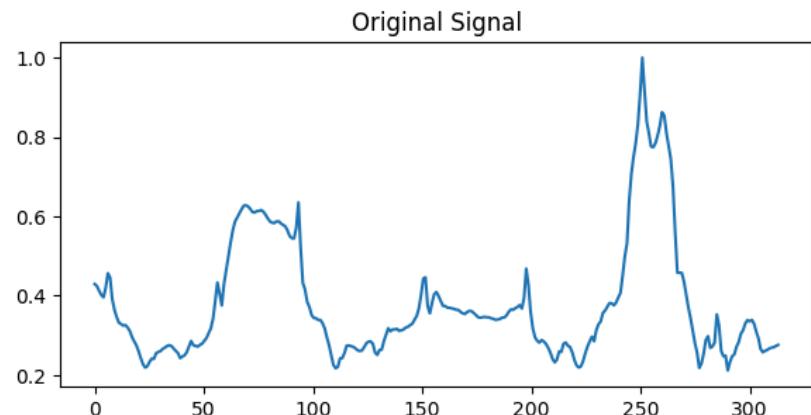
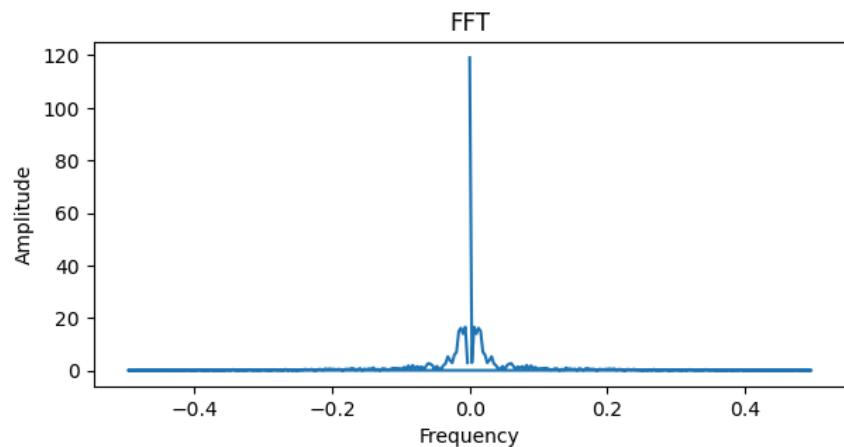


Histogram - FFT



Dominant Frequency: 0.013 , Period: 78.501

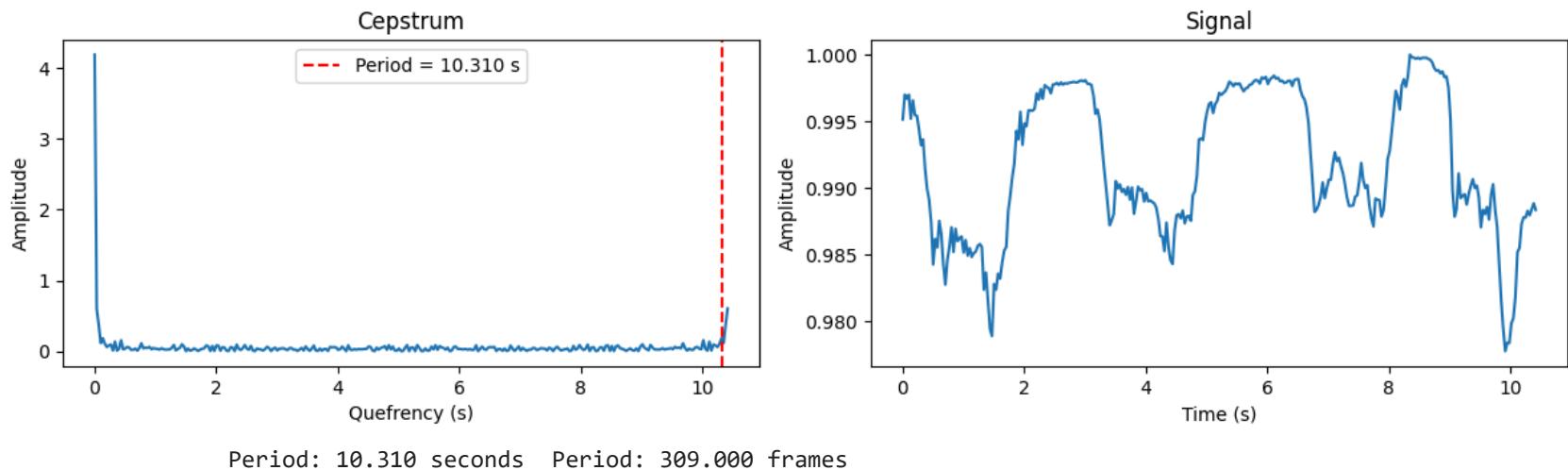
PCC - FFT



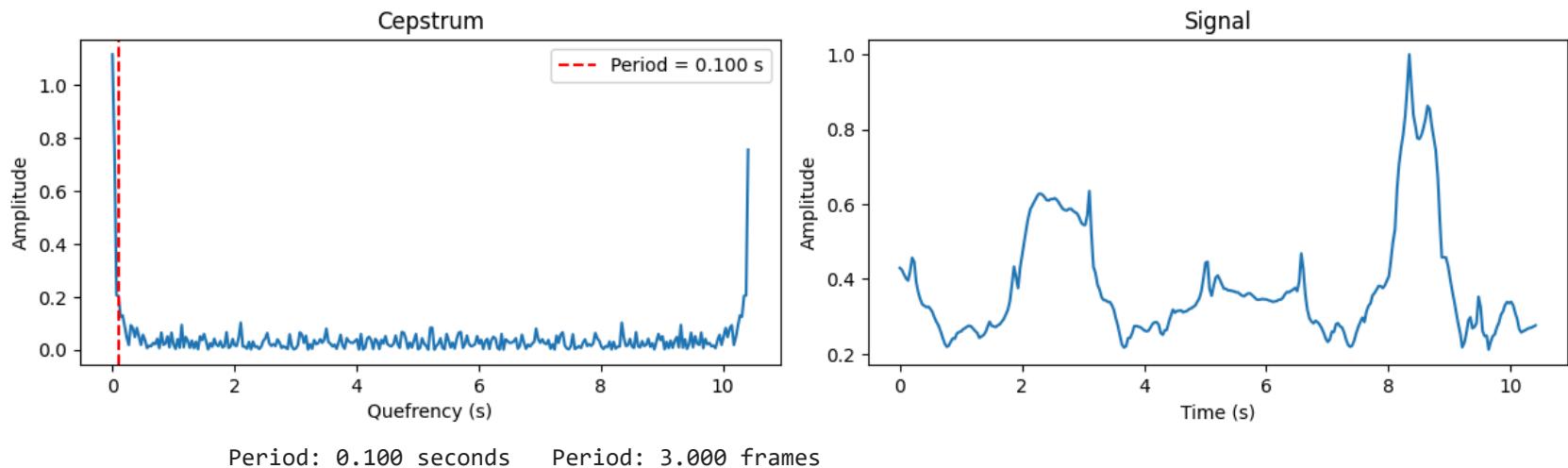
Dominant Frequency: 0.006 , Period: 157.002

Dominant Frequency: 0.000 , Period: 700.000

### Histogram - Cepstrum



### PCC - Cepstrum

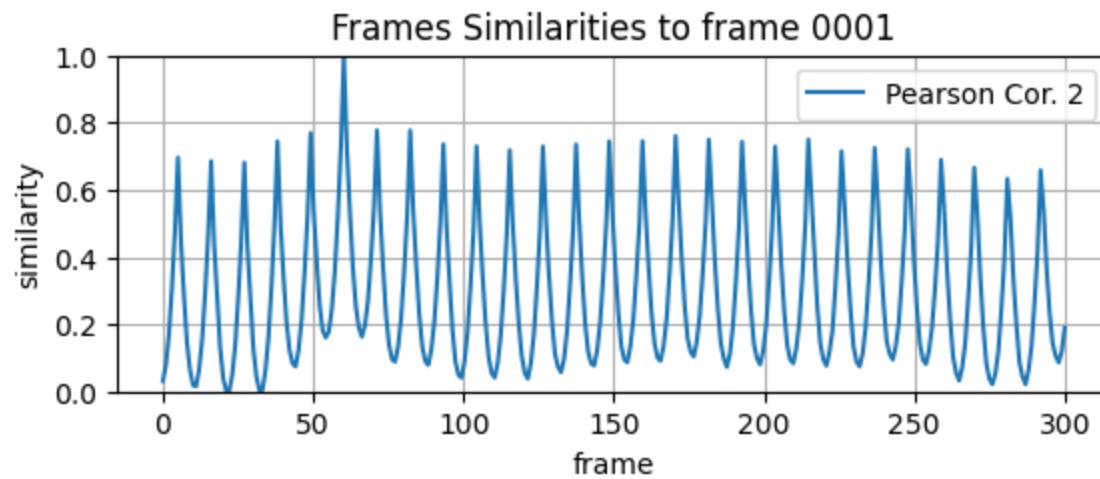


\* \* \* \* \* Video: 6 Reference frame at: (20%) 60 \* \* \* \* \*

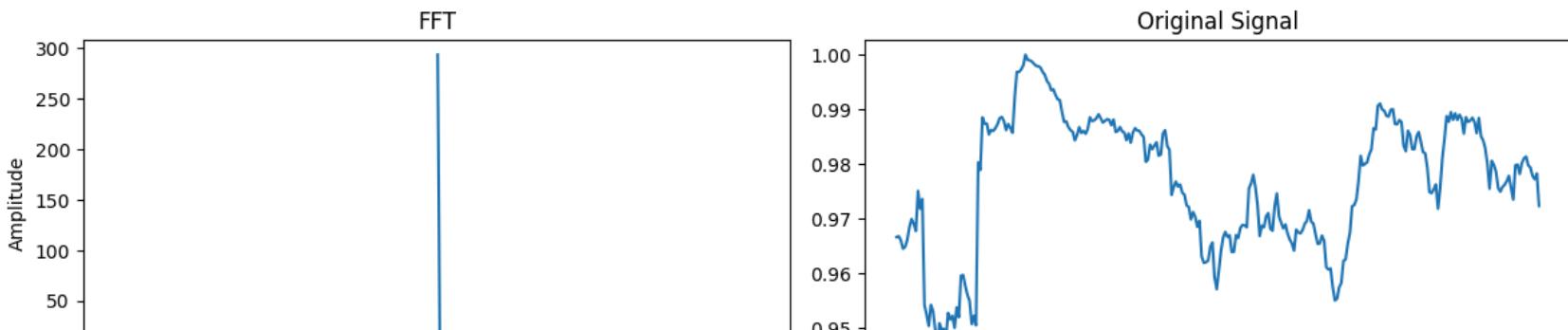
### Similarity Signal - Histogram

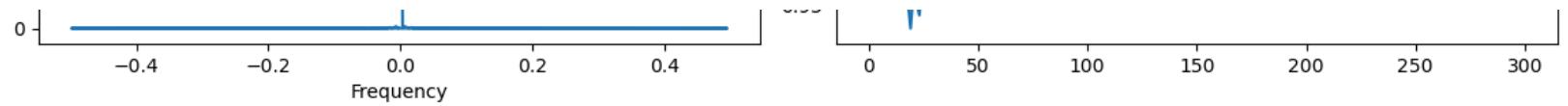


Similarity Signal - Pearson Correlation



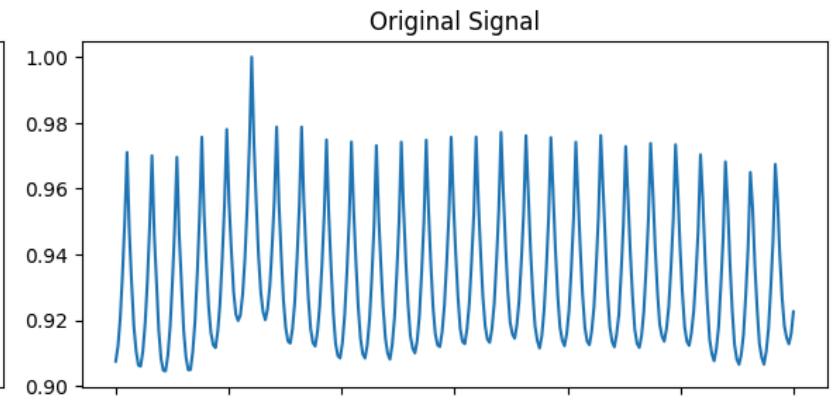
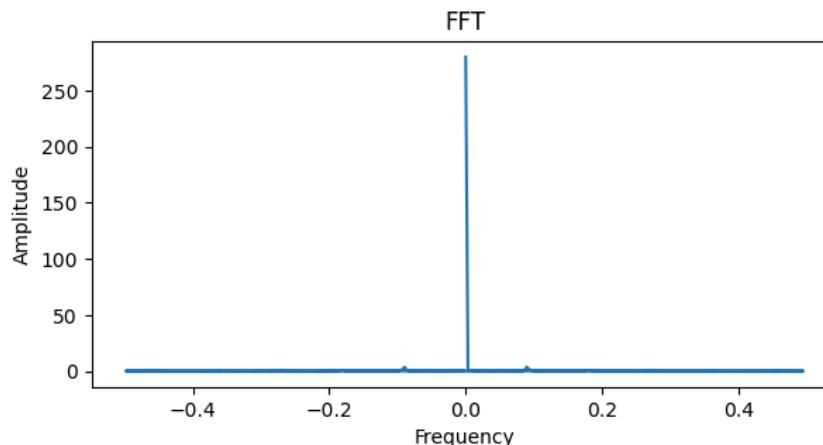
Histogram - FFT





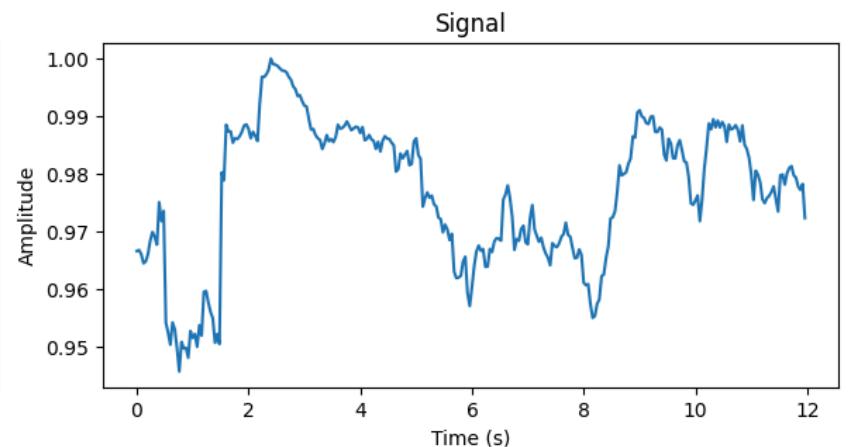
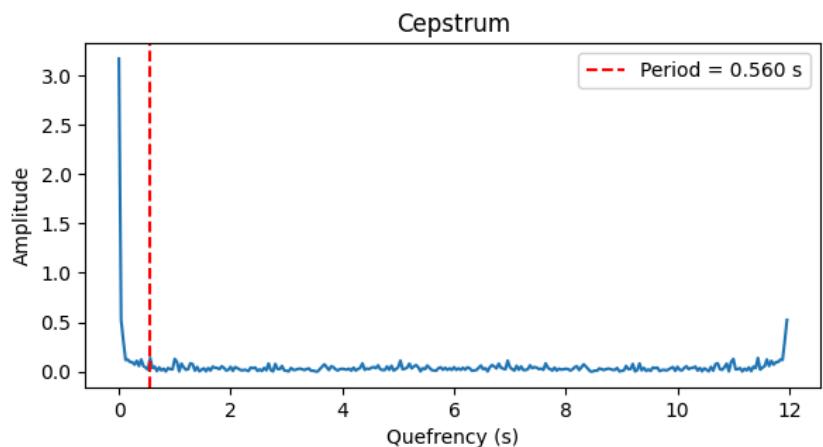
Dominant Frequency: 0.007 , Period: 150.502

PCC - FFT



Dominant Frequency: 0.090 , Period: 11.148

Histogram - Cepstrum

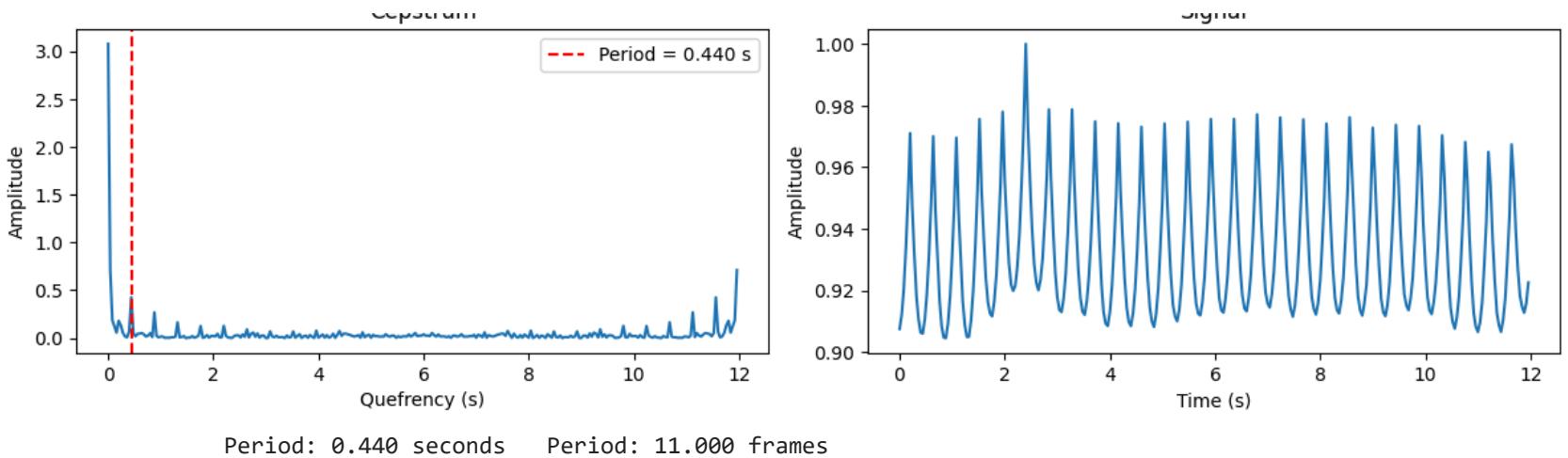


Period: 0.560 seconds      Period: 14.000 frames

PCC - Cepstrum

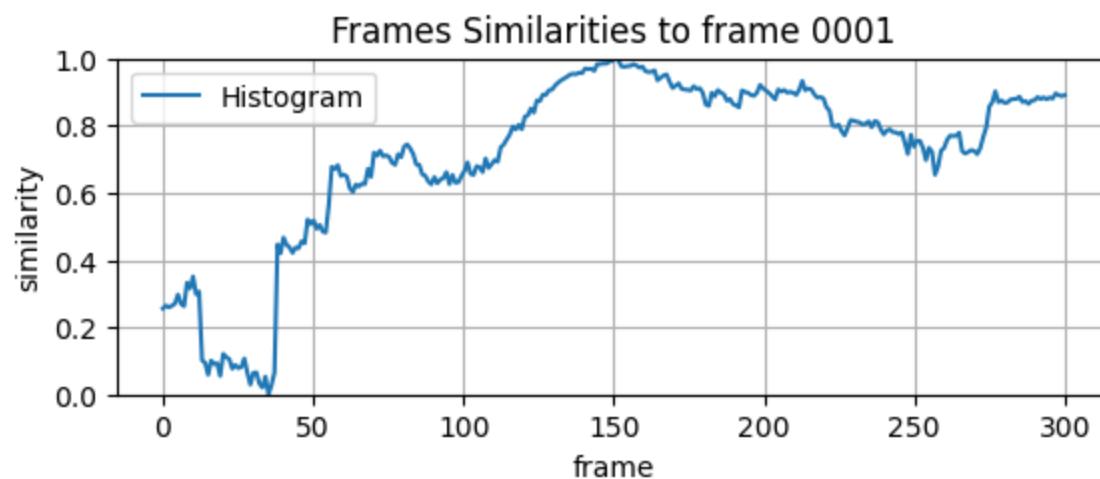
Cepstrum

Signal

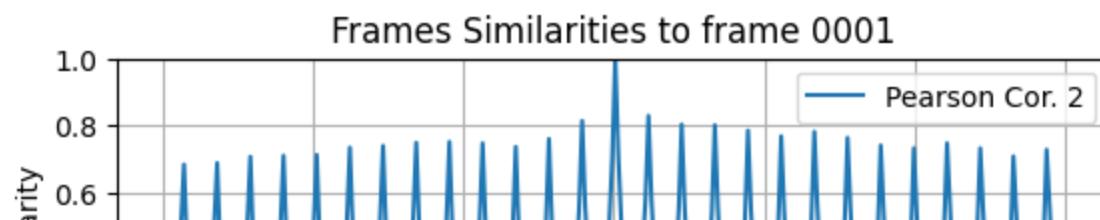


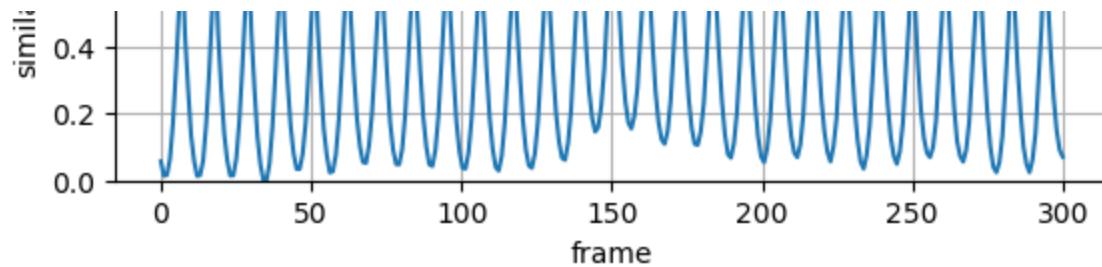
\* \* \* \* \* Video: 6 Reference frame at: (50%) 150 \* \* \* \* \*

Similarity Signal - Histogram

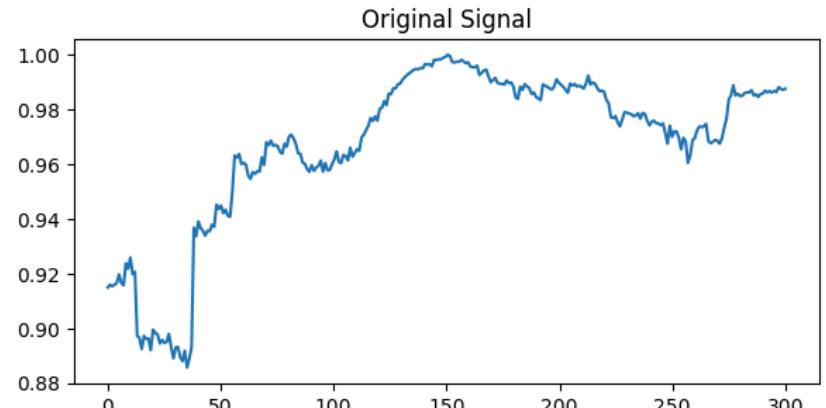
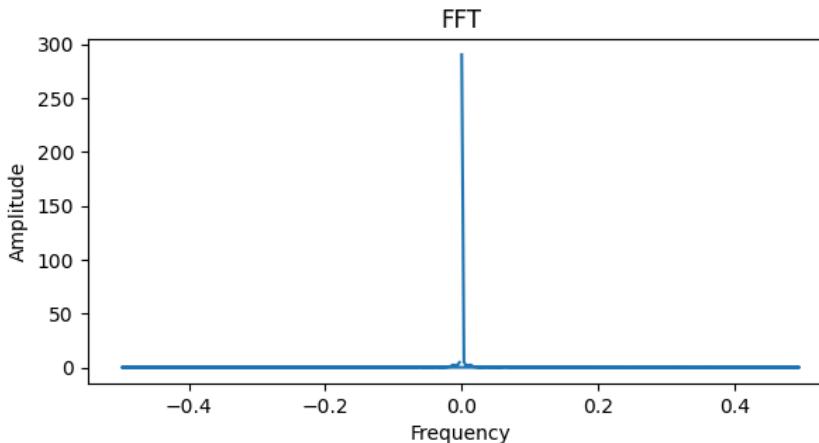


Similarity Signal - Pearson Correlation



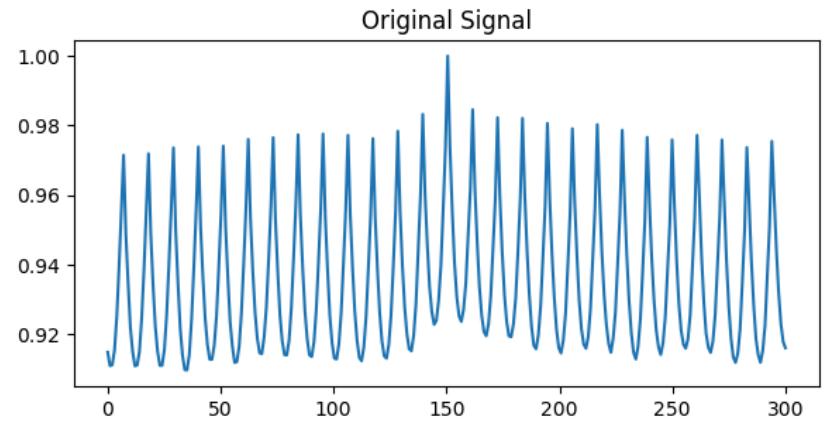
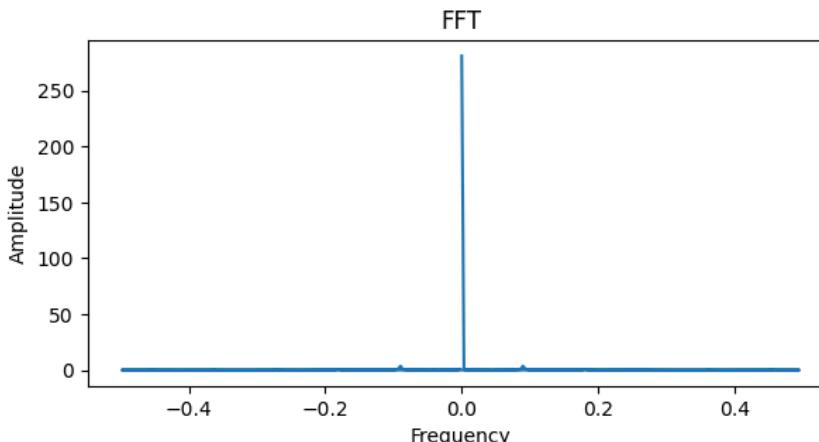


Histogram - FFT



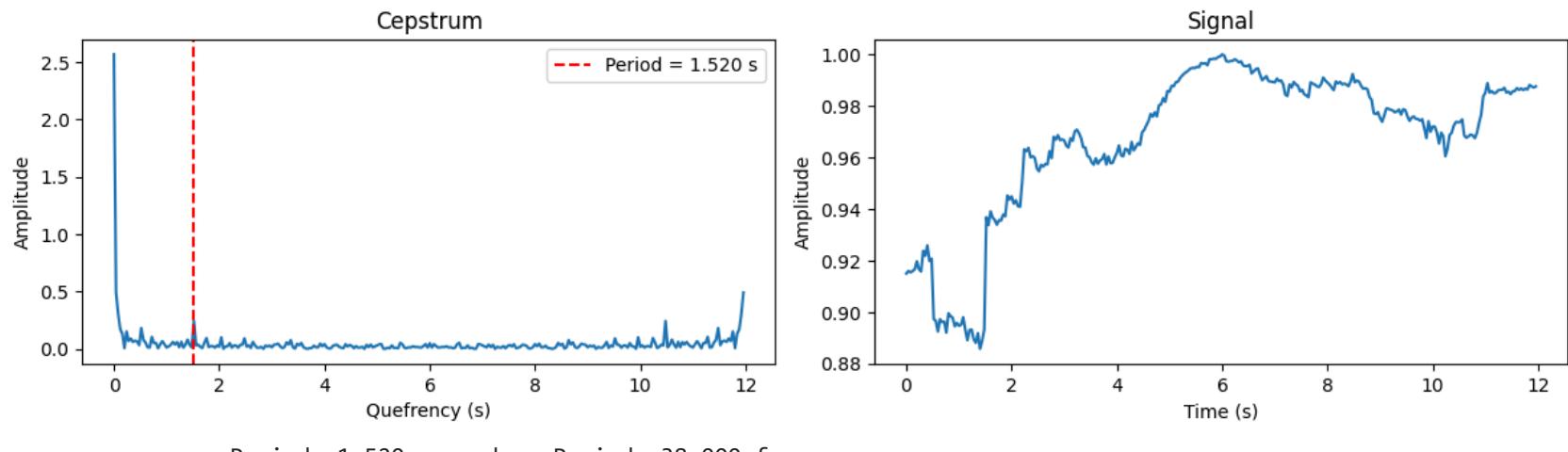
Dominant Frequency: 0.003 , Period: 301.003

PCC - FFT

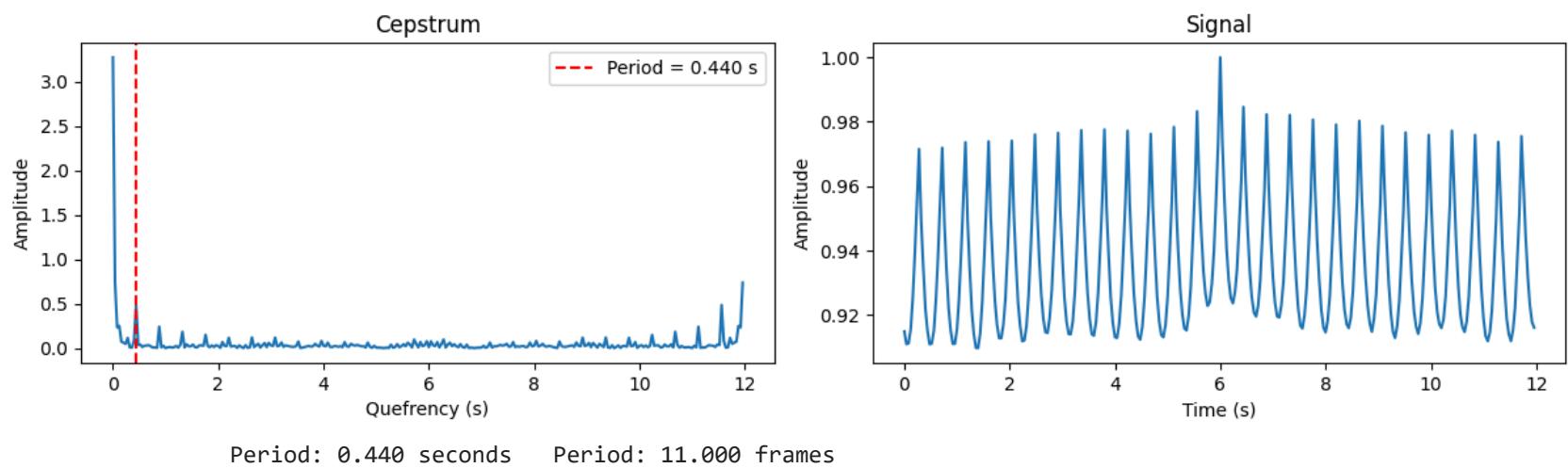


Dominant Frequency: 0.090 , Period: 11.148

### Histogram - Cepstrum



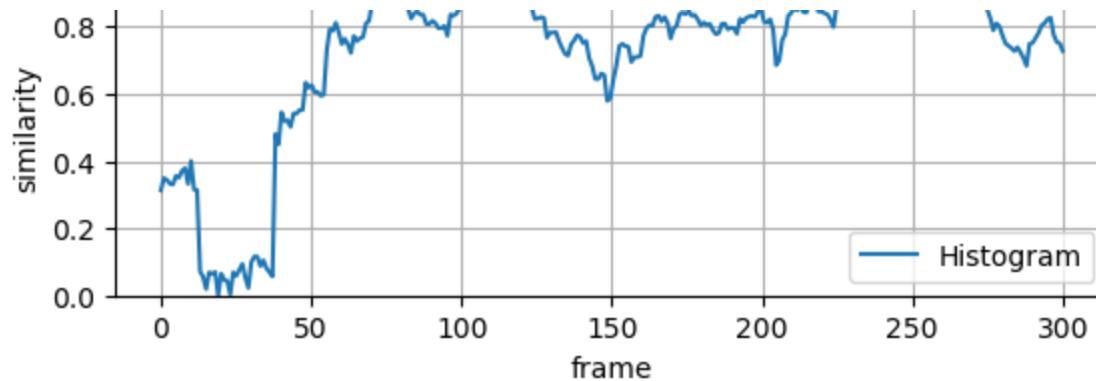
### PCC - Cepstrum



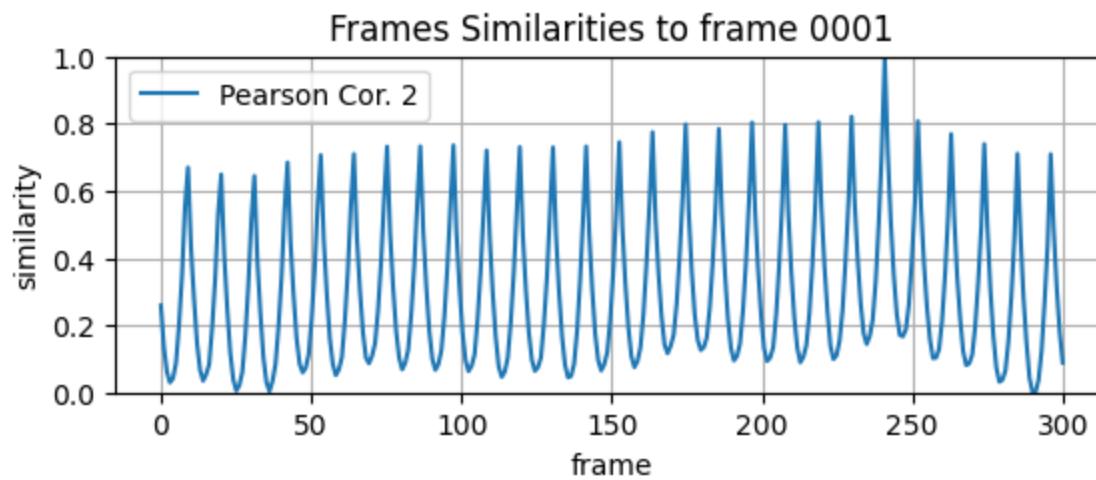
\* \* \* \* \* Video: 6 Reference frame at: (80%) 240 \* \* \* \* \*

### Similarity Signal - Histogram

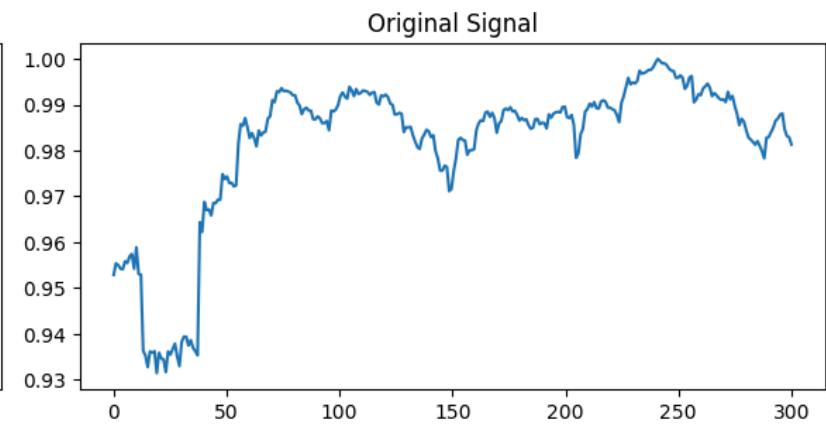
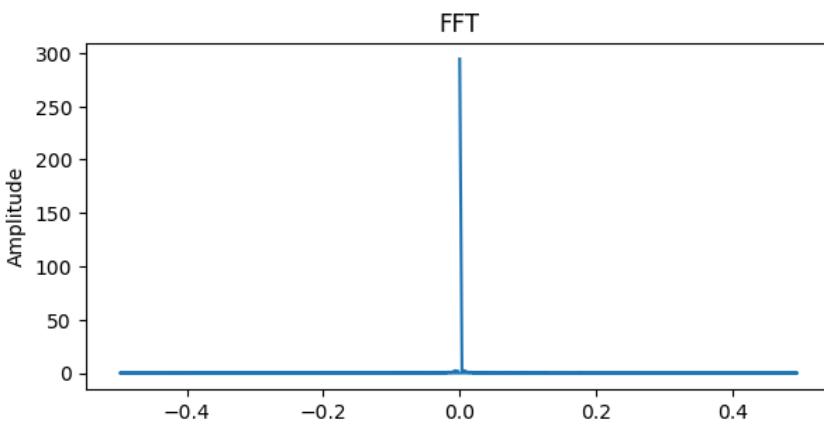




Similarity Signal - Pearson Correlation



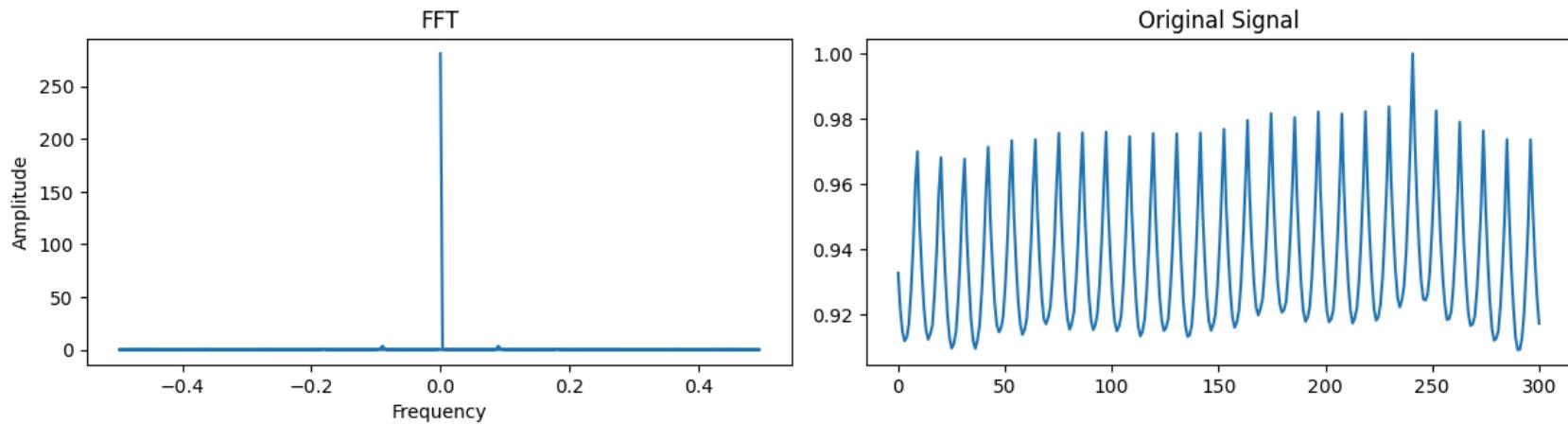
Histogram - FFT



frequency

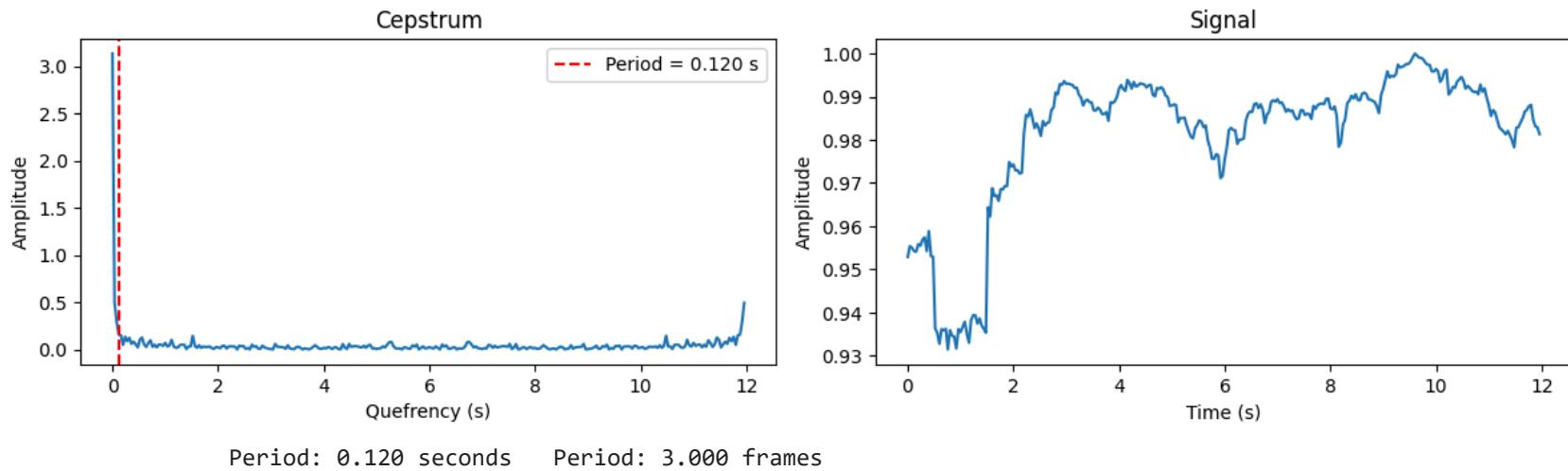
Dominant Frequency: 0.007 , Period: 150.502

PCC - FFT

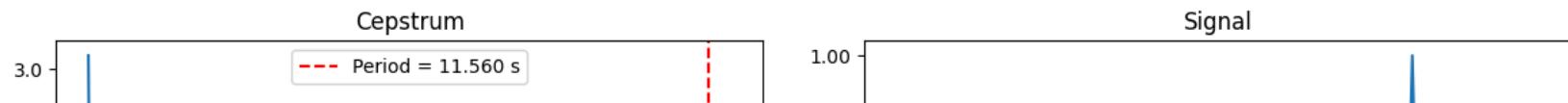


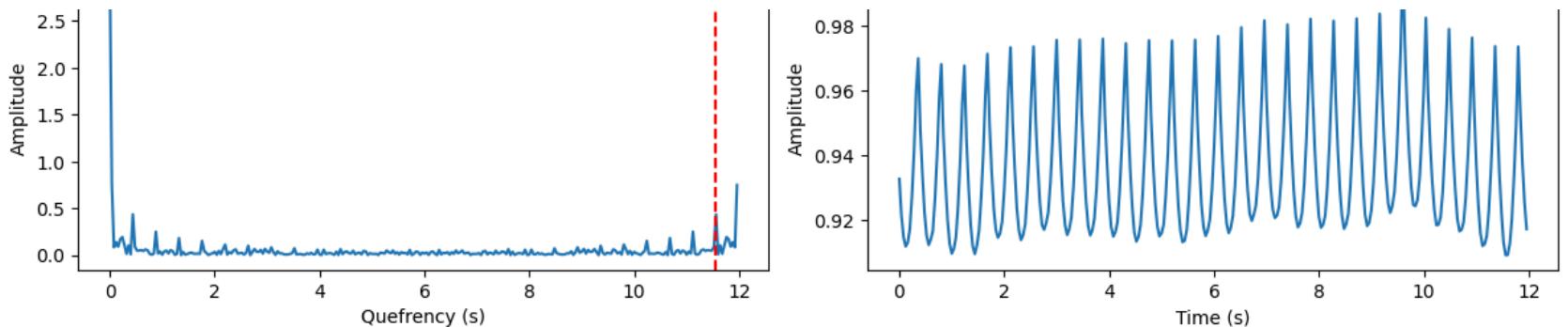
Dominant Frequency: 0.090 , Period: 11.148

Histogram - Cepstrum



PCC - Cepstrum



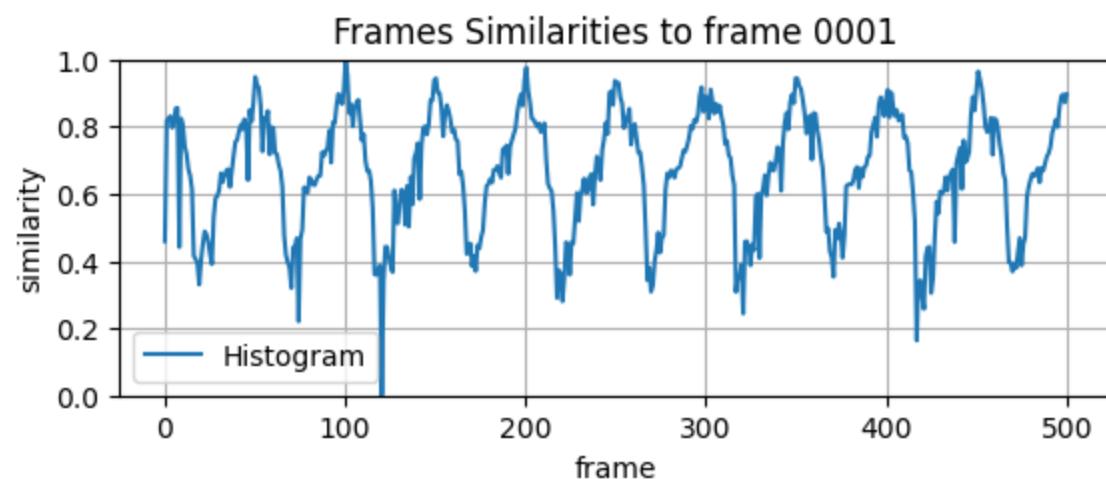


Period: 11.560 seconds Period: 289.000 frames

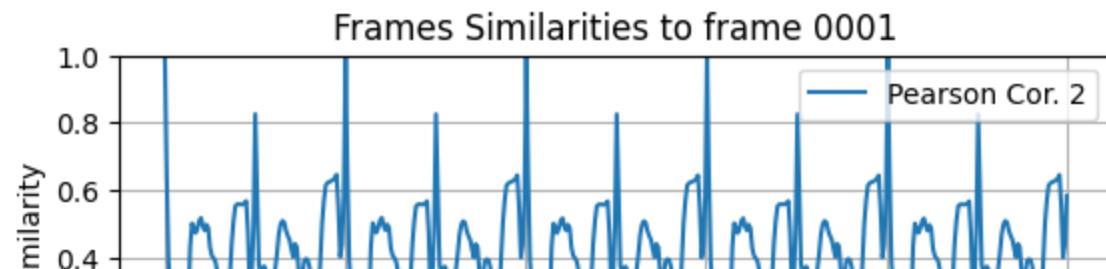
\* \* \* \* \* 7.webm Frames:500 FPS:25.0 \* \* \* \* \*

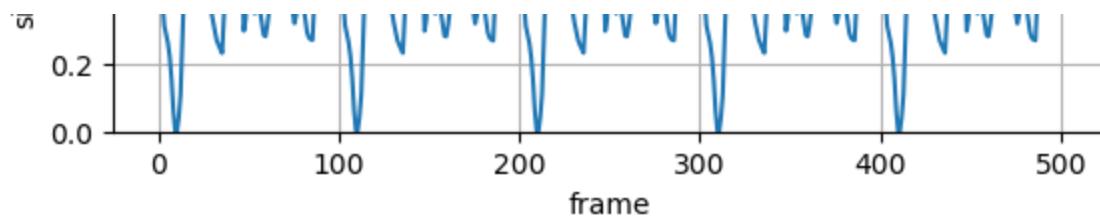
\* \* \* \* \* Video: 7 Reference frame at: (20%) 100 \* \* \* \* \*

#### Similarity Signal - Histogram

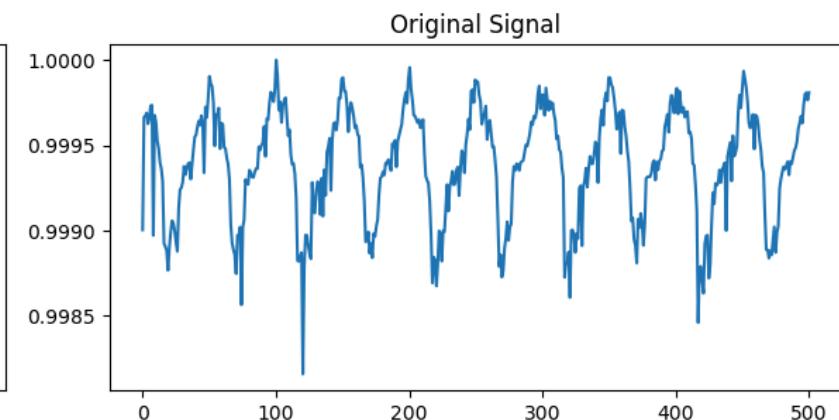
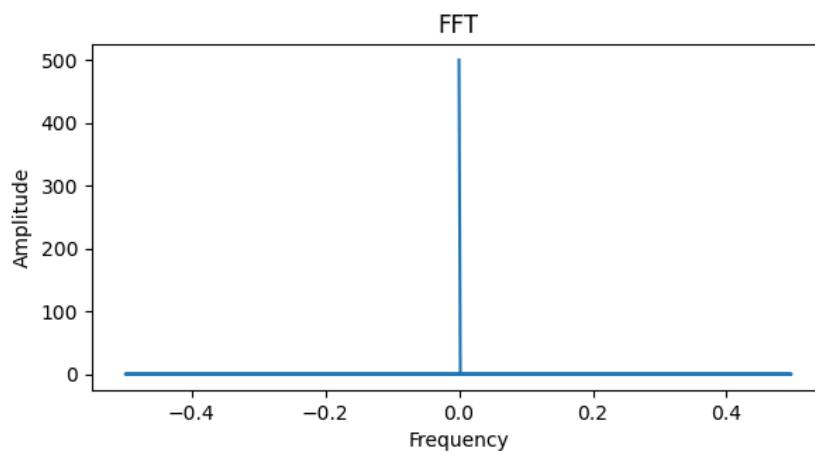


#### Similarity Signal - Pearson Correlation



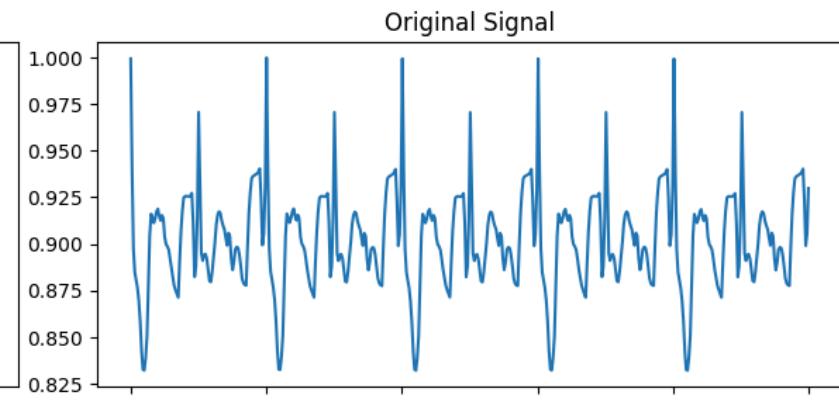
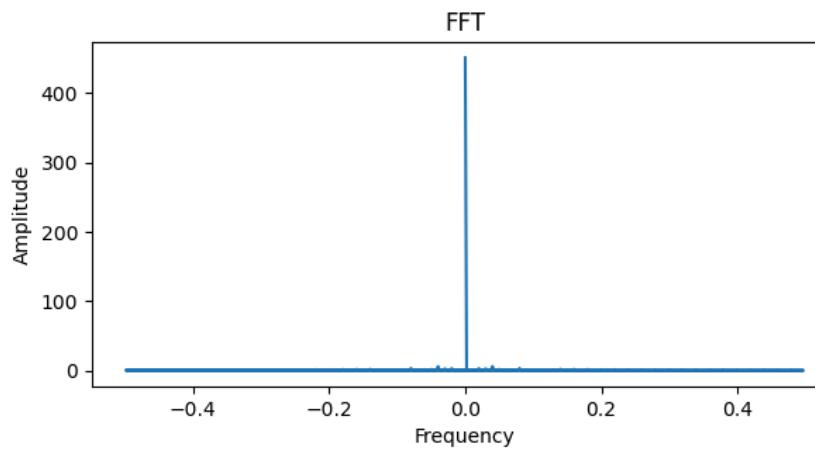


Histogram - FFT



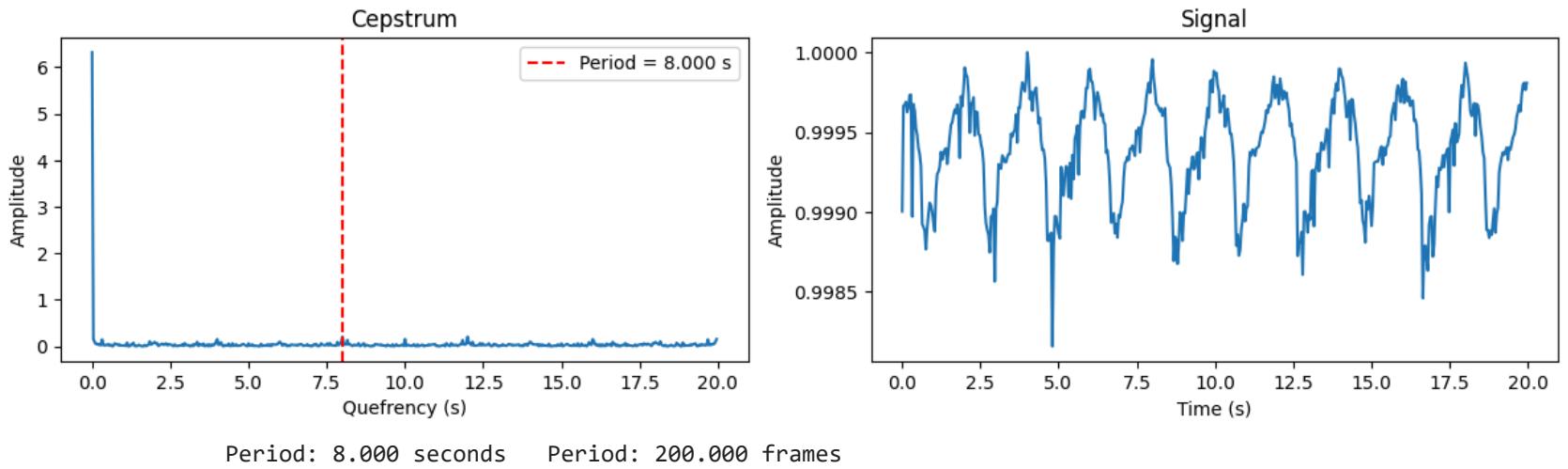
Dominant Frequency: 0.020 , Period: 50.100

PCC - FFT

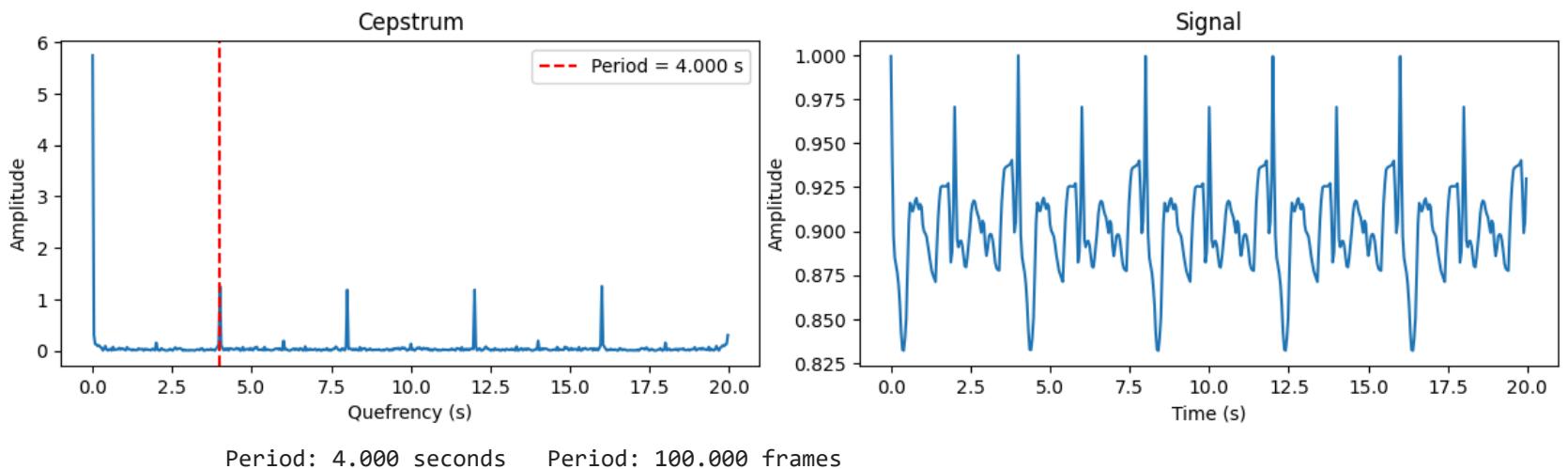


Dominant Frequency: 0.040 , Period: 25.050

Histogram - Cepstrum



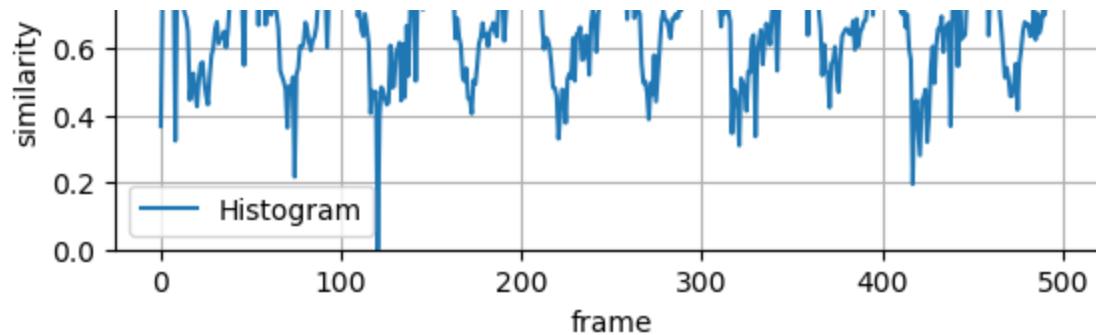
PCC - Cepstrum



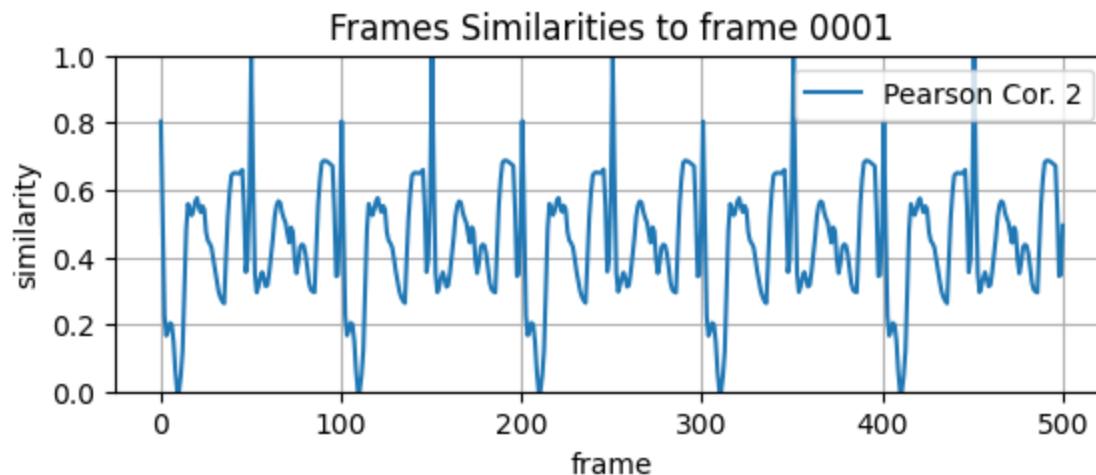
\* \* \* \* \* Video: 7 Reference frame at: (50%) 250 \* \* \* \* \*

Similarity Signal - Histogram

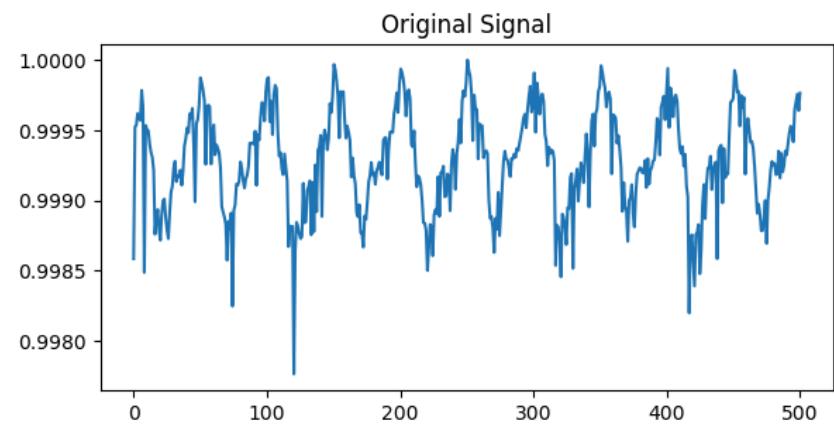
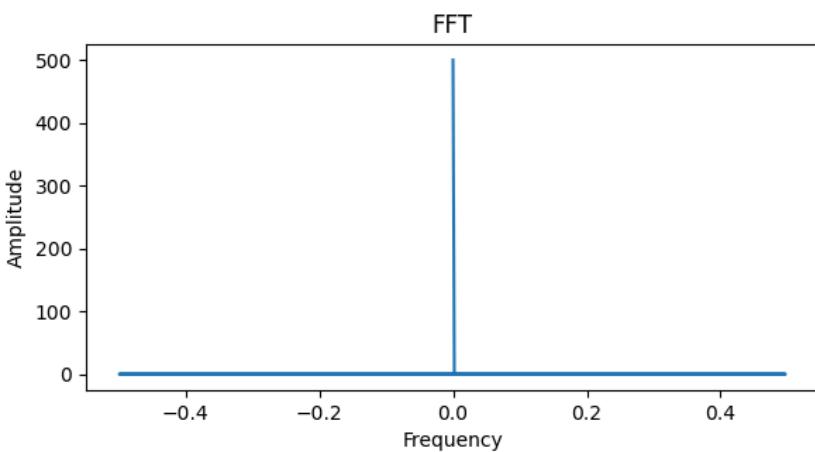




Similarity Signal - Pearson Correlation

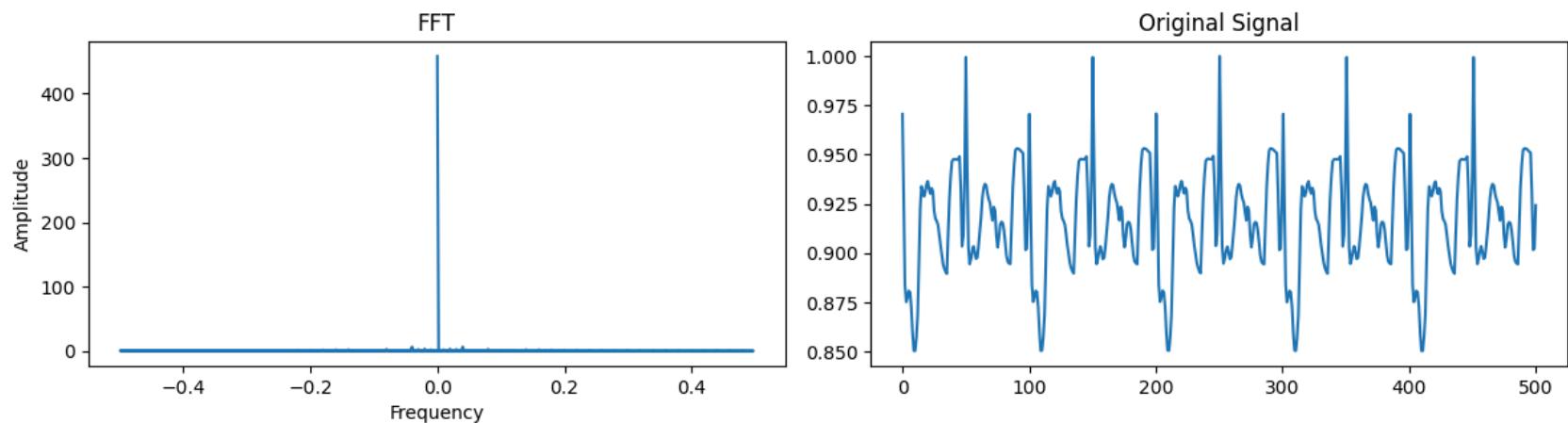


Histogram - FFT



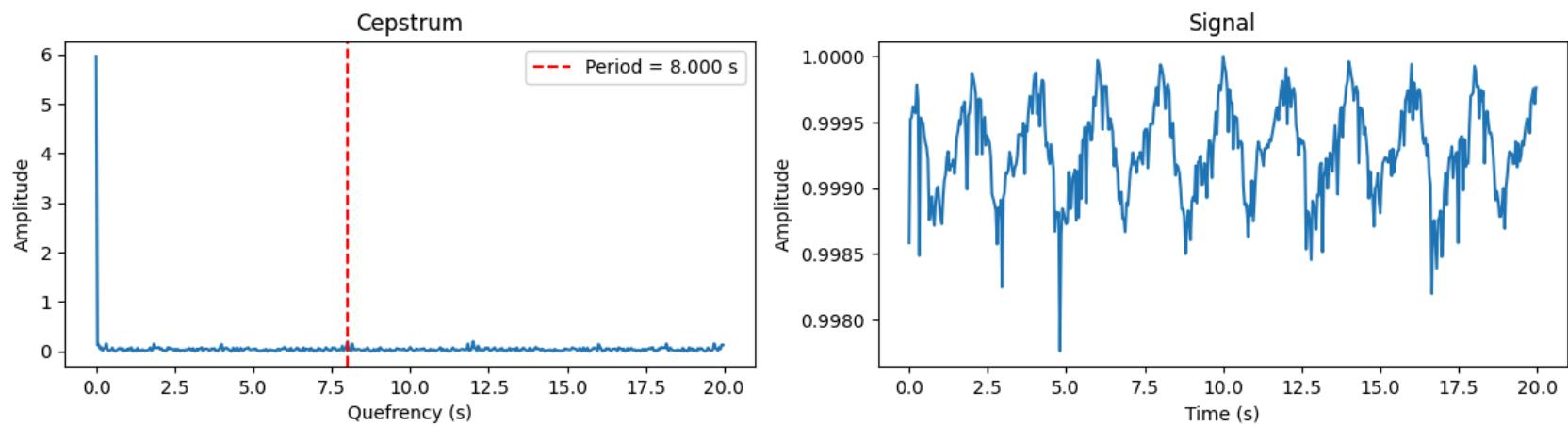
Dominant Frequency: 0.020 , Period: 50.100

#### PCC - FFT



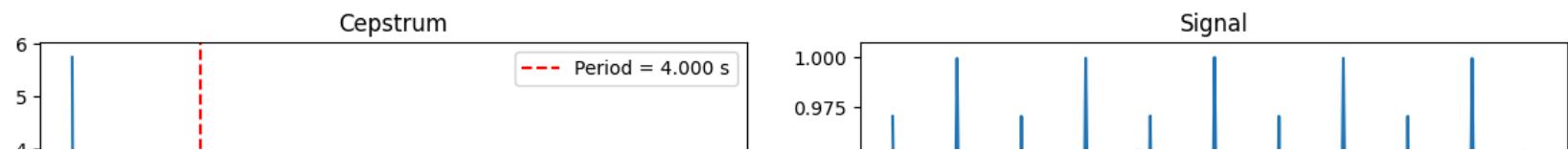
Dominant Frequency: 0.040 , Period: 25.050

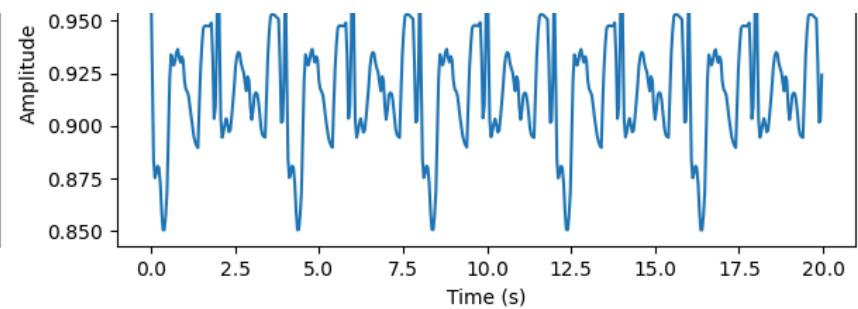
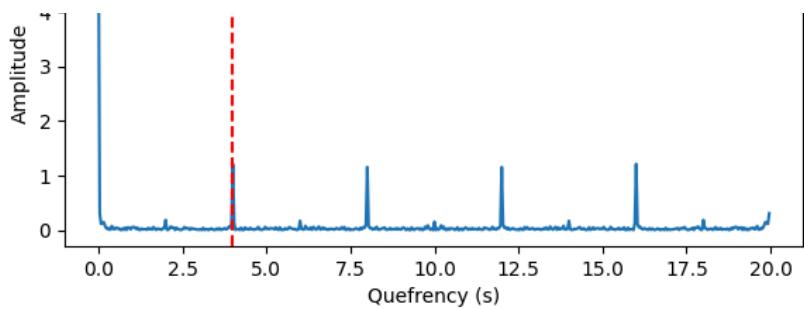
#### Histogram - Cepstrum



Period: 8.000 seconds      Period: 200.000 frames

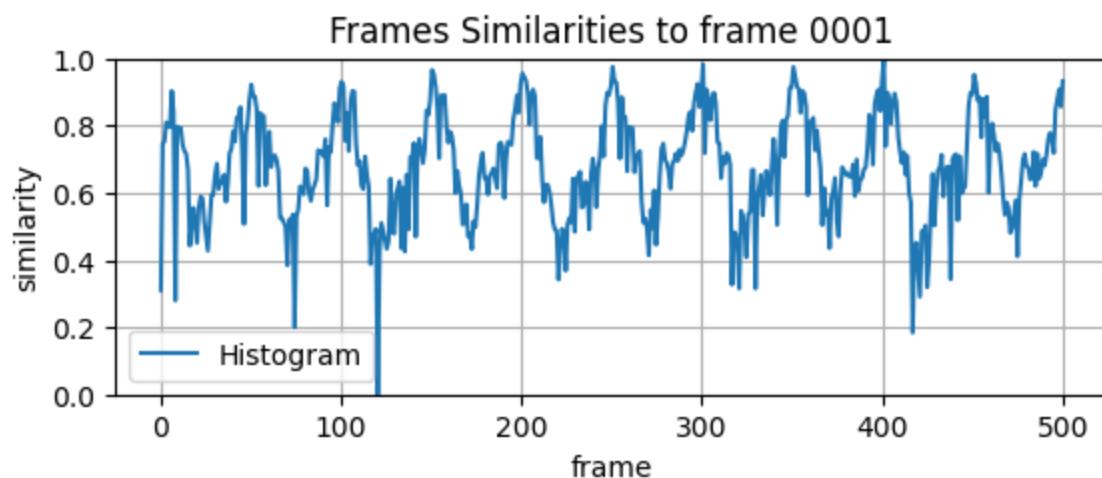
#### PCC - Cepstrum



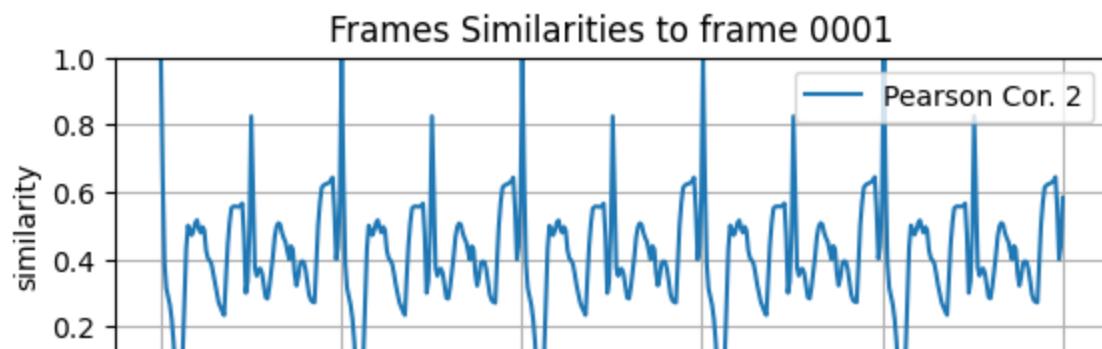


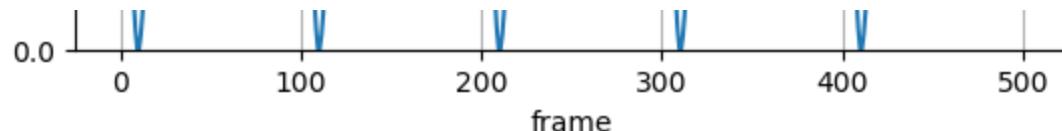
\* \* \* \* \* Video: 7 Reference frame at: (80%) 400 \* \* \* \* \*

#### Similarity Signal - Histogram

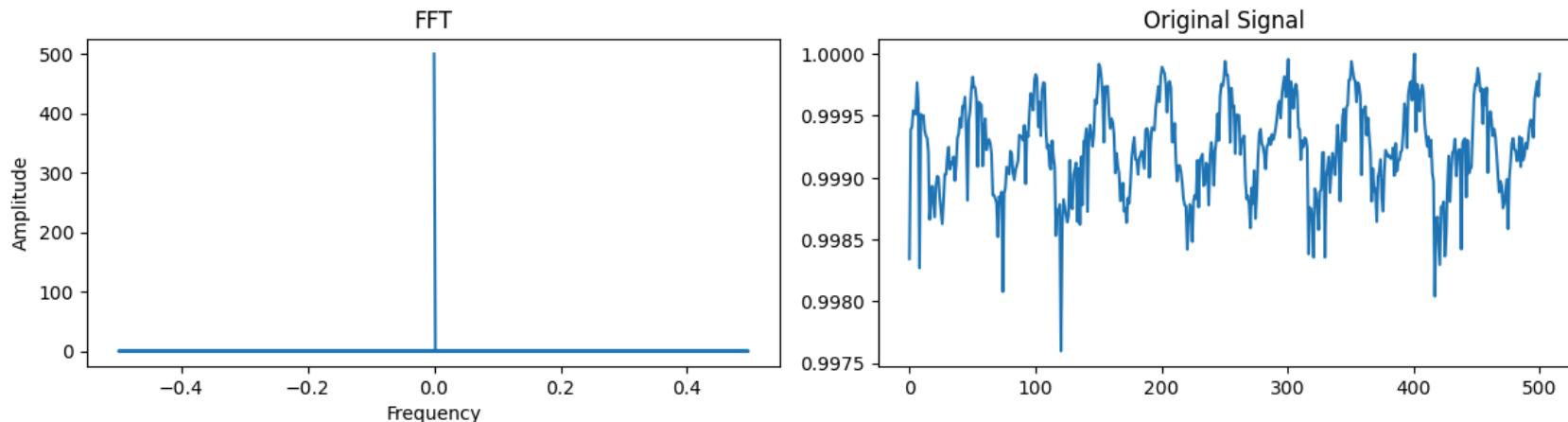


#### Similarity Signal - Pearson Correlation



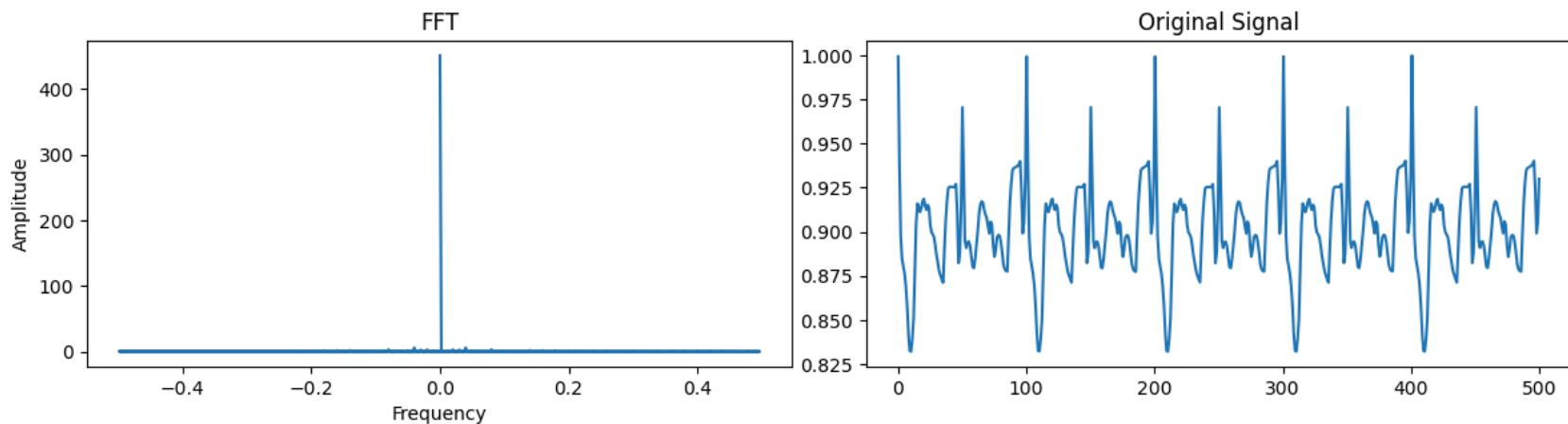


Histogram - FFT



Dominant Frequency: 0.020 , Period: 50.100

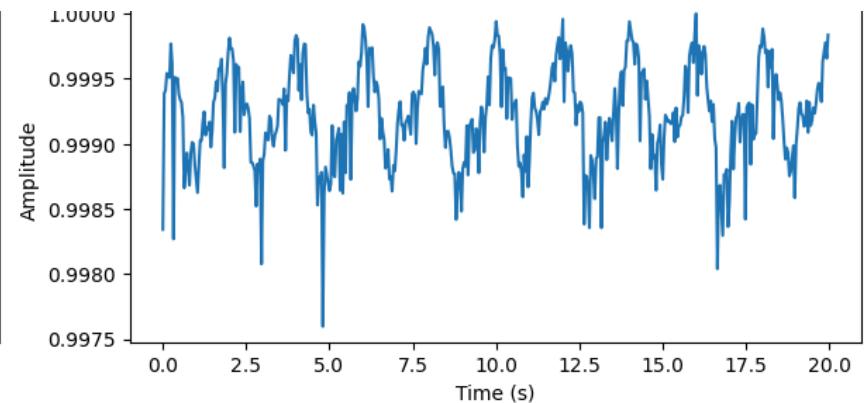
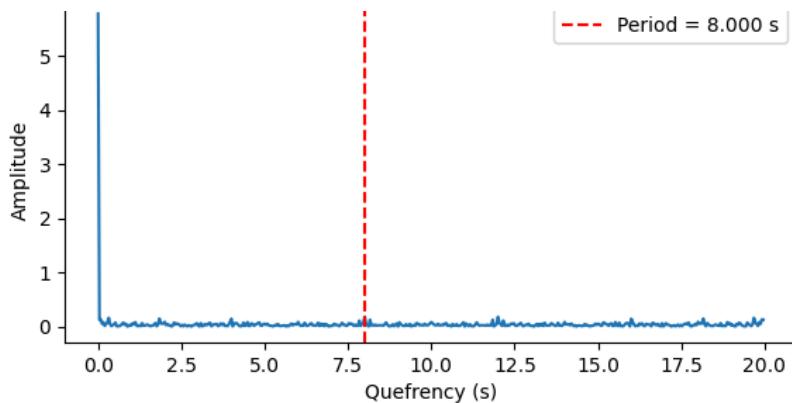
PCC - FFT



Dominant Frequency: 0.040 , Period: 25.050

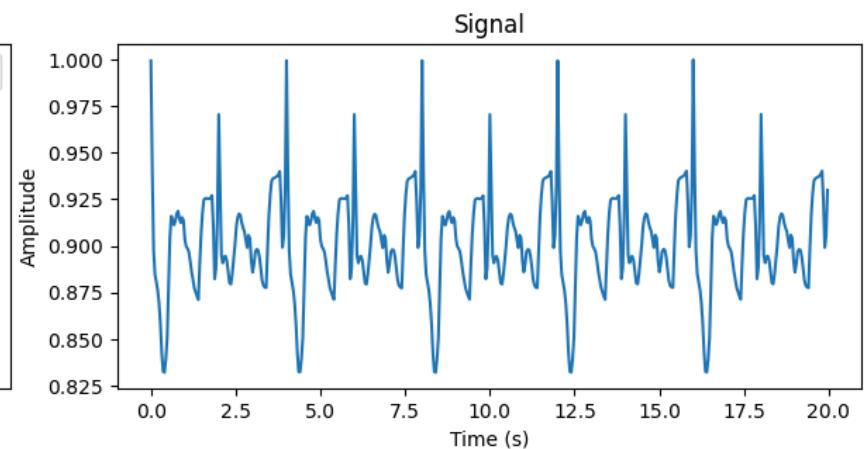
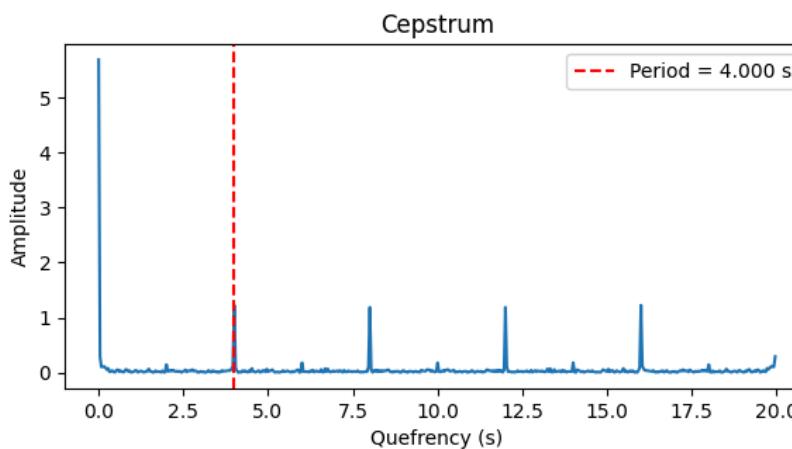
Histogram - Cepstrum





Period: 200.000 frames

PCC - Cepstrum

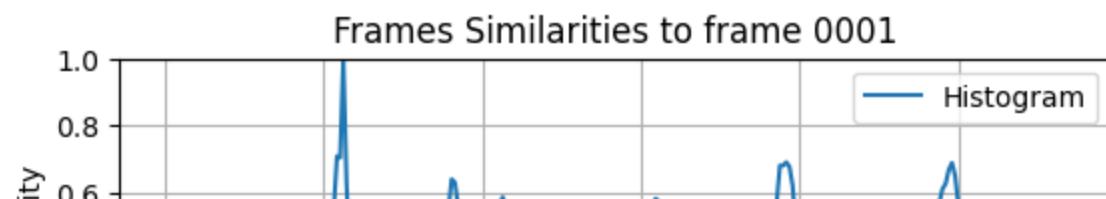


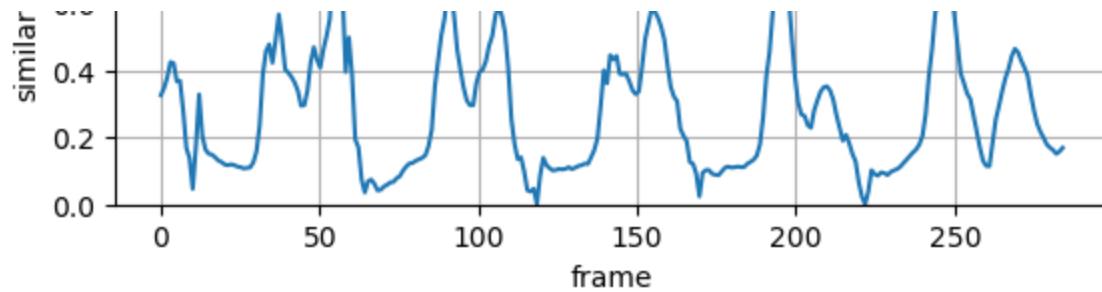
Period: 100.000 frames

\* \* \* \* \* 8.webm Frames:284 FPS:29.97002997002997 \* \* \* \* \*

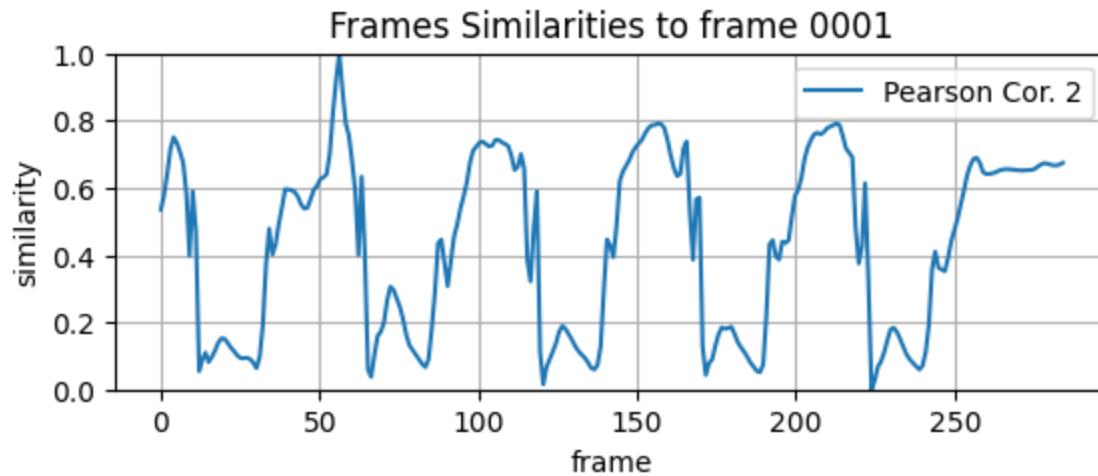
\* \* \* \* \* Video: 8 Reference frame at: (20%) 56 \* \* \* \* \*

Similarity Signal - Histogram

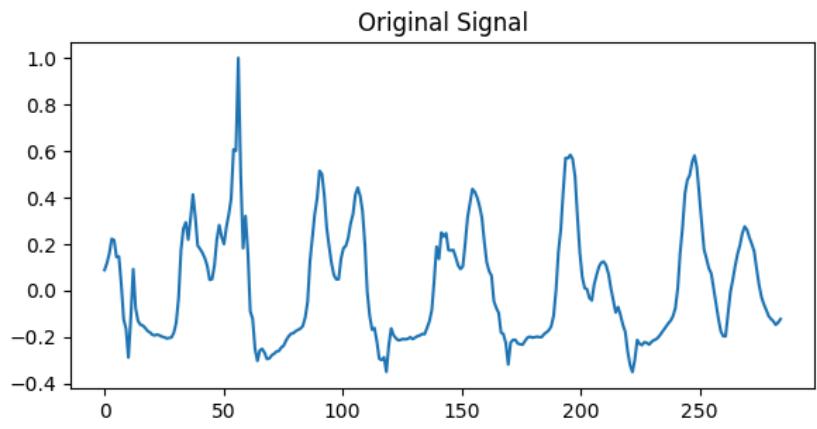
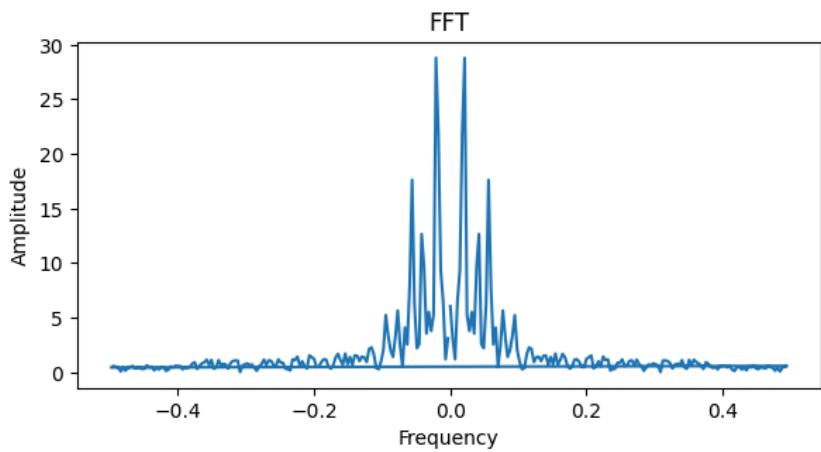




Similarity Signal - Pearson Correlation

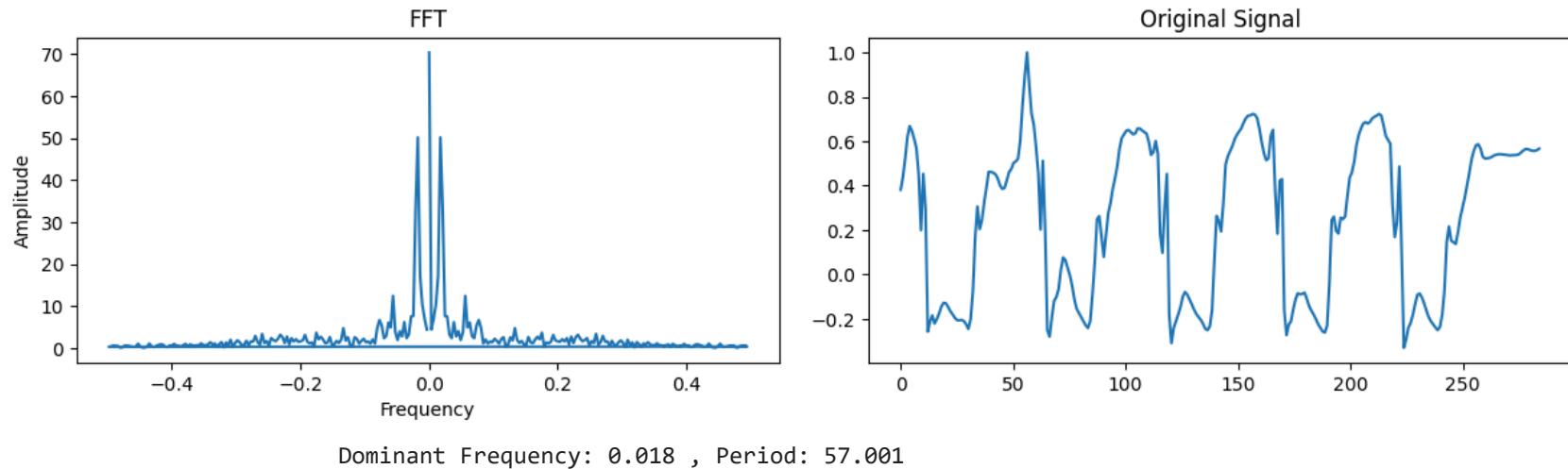


Histogram - FFT

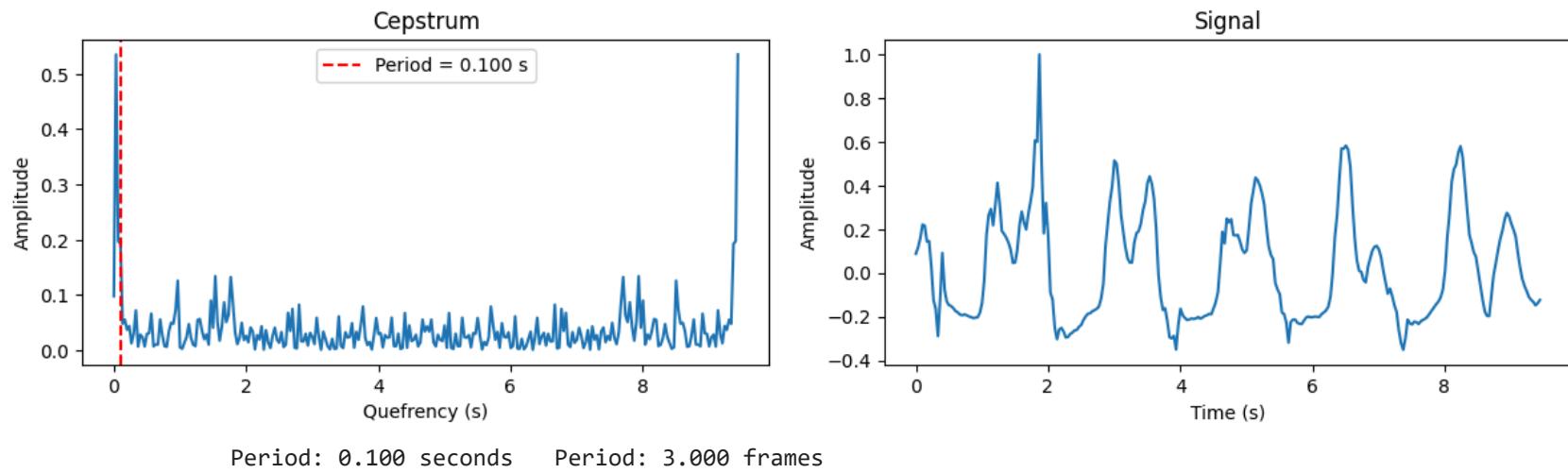


Dominant Frequency: -0.021 , Period: -47.501

### PCC - FFT

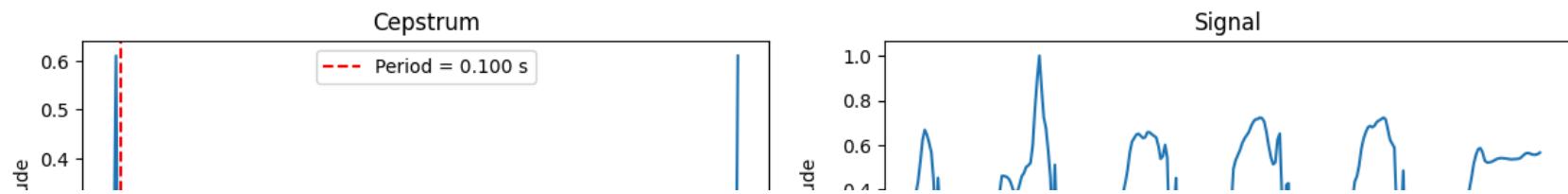


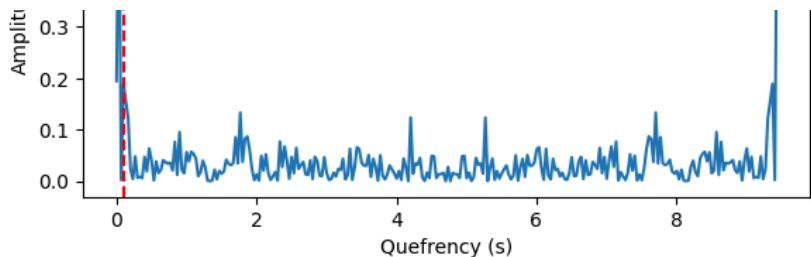
### Histogram - Cepstrum



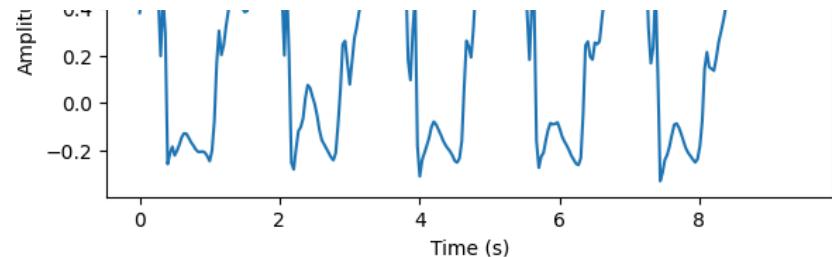
Period: 3.000 frames

### PCC - Cepstrum



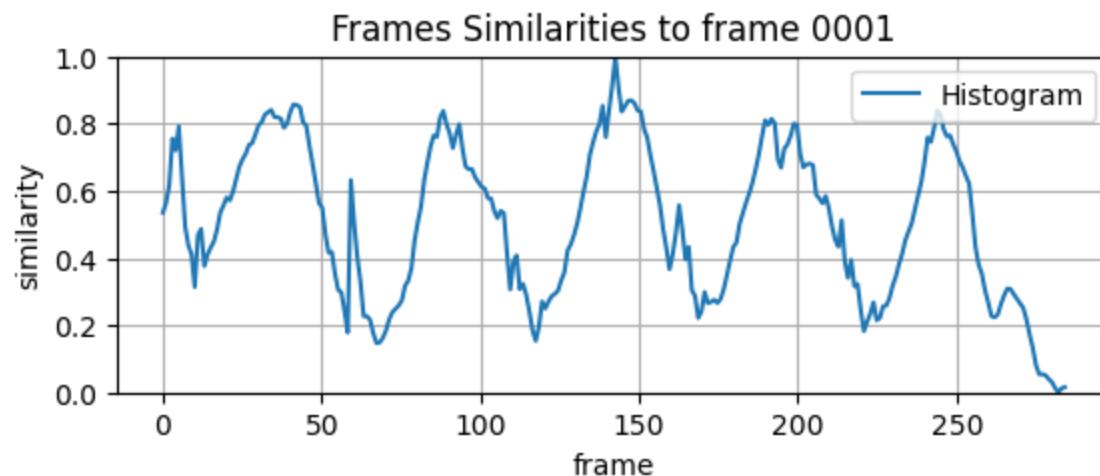


Period: 0.100 seconds      Period: 3.000 frames

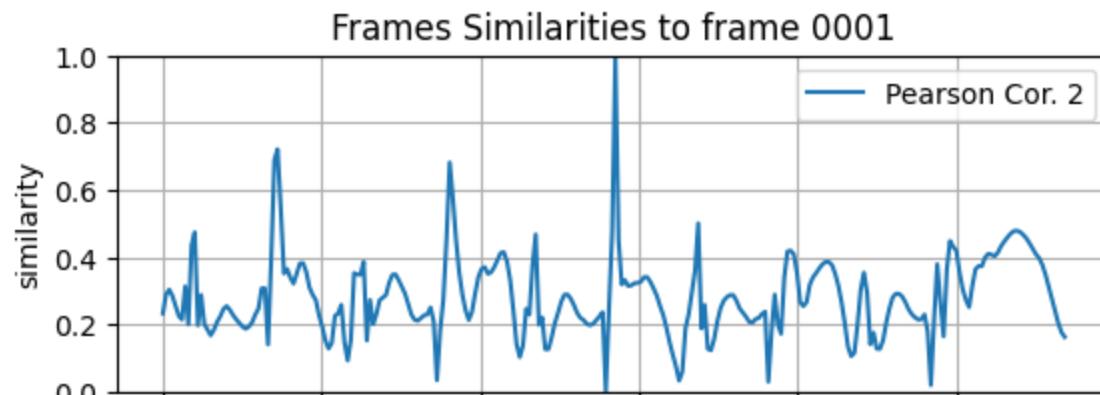


\* \* \* \* \* Video: 8 Reference frame at: (50%) 142 \* \* \* \* \*

Similarity Signal - Histogram

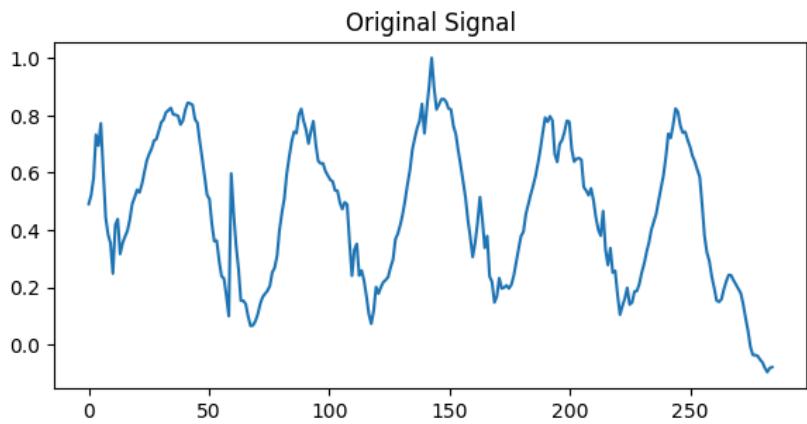
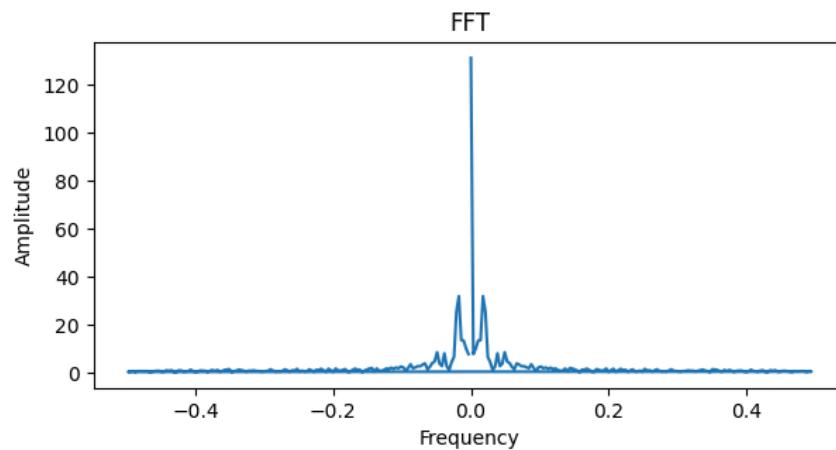


Similarity Signal - Pearson Correlation



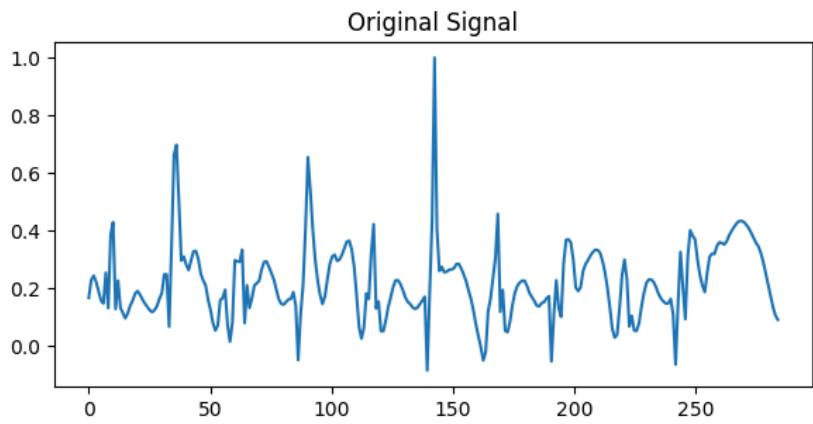
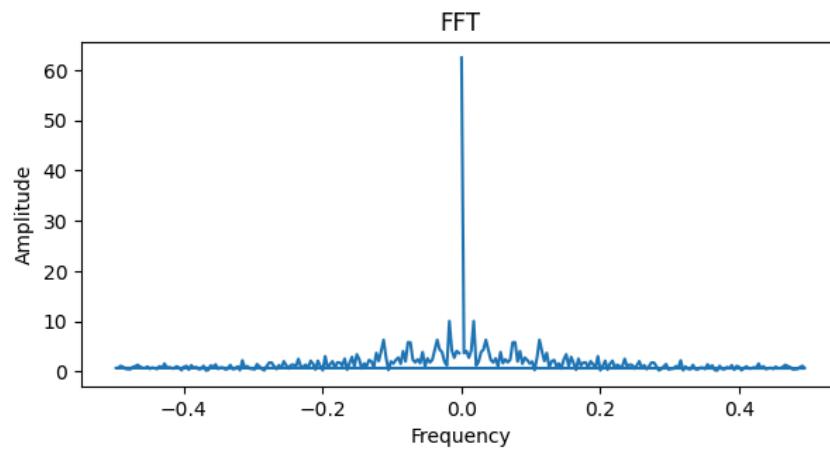


Histogram - FFT



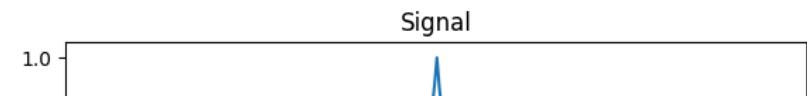
Dominant Frequency: 0.018 , Period: 57.001

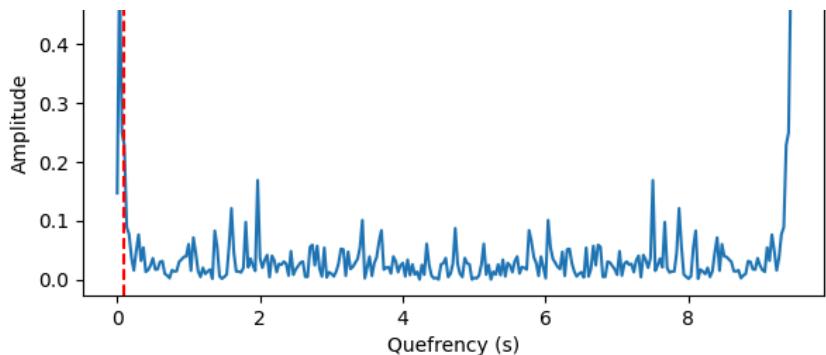
PCC - FFT



Dominant Frequency: 0.018 , Period: 57.001

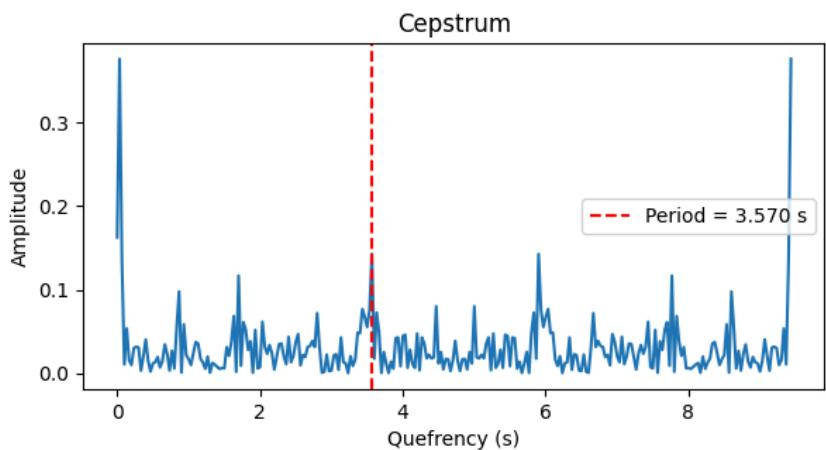
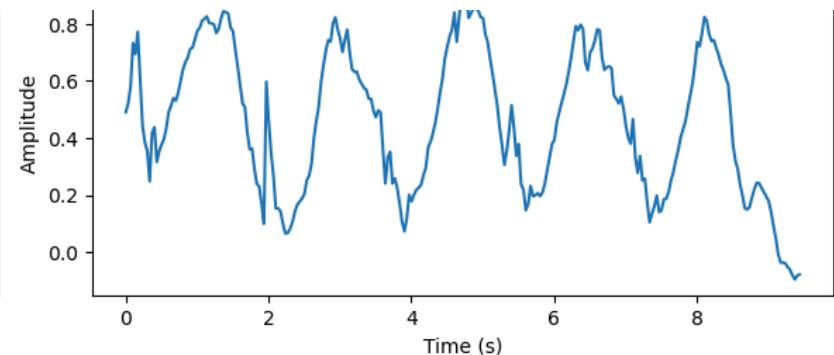
Histogram - Cepstrum



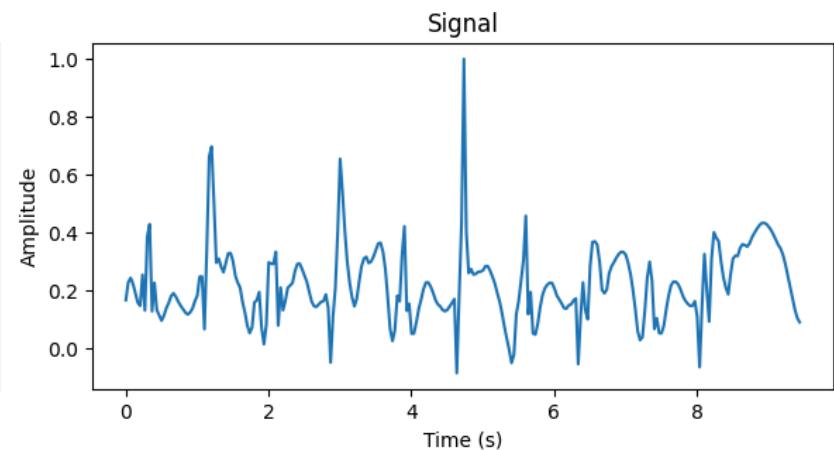


Period: 0.100 seconds      Period: 3.000 frames

PCC - Cepstrum

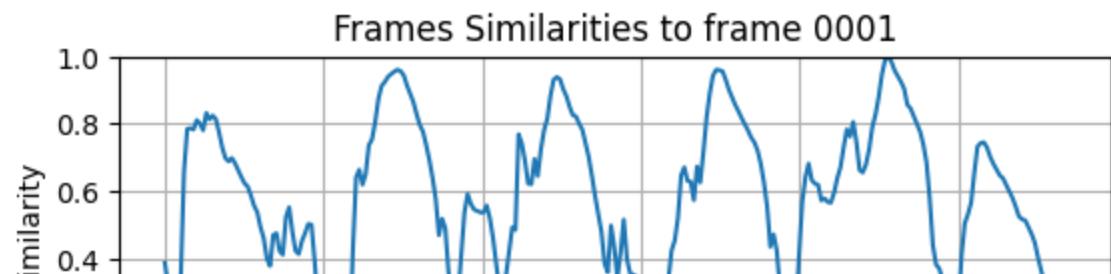


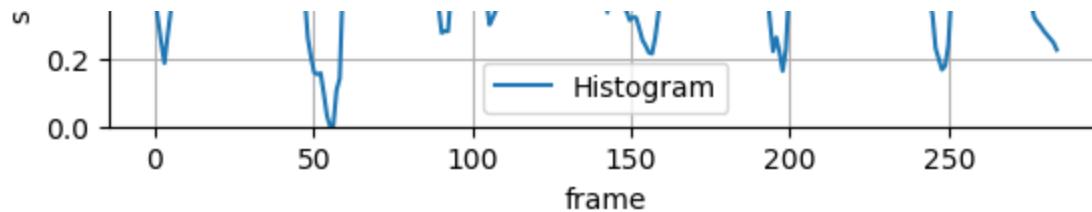
Period: 3.570 seconds      Period: 107.000 frames



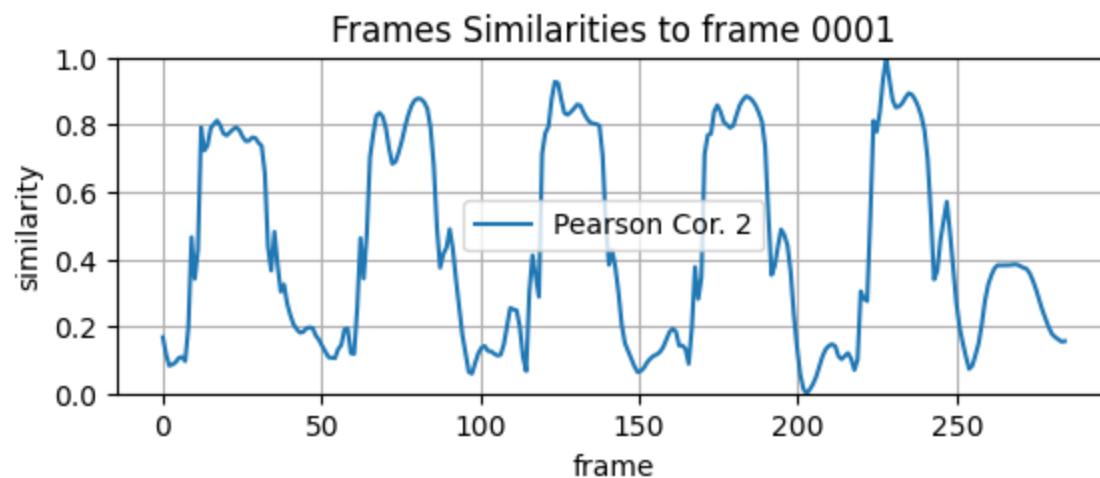
\* \* \* \* \* Video: 8 Reference frame at: (80%) 227 \* \* \* \* \*

Similarity Signal - Histogram

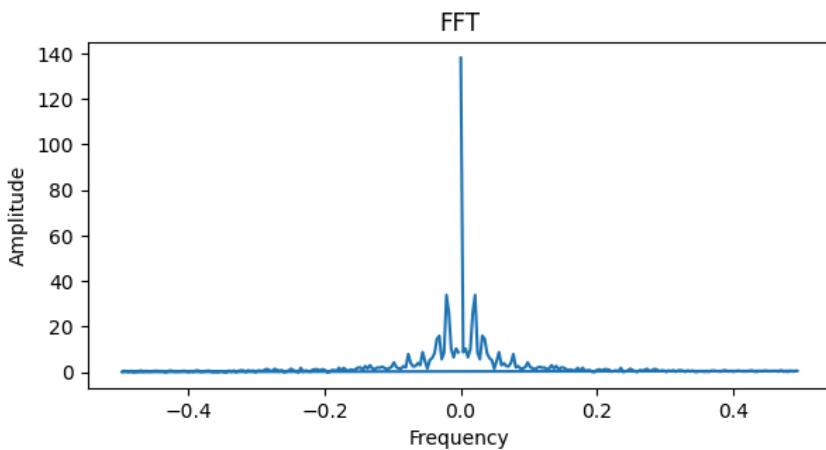




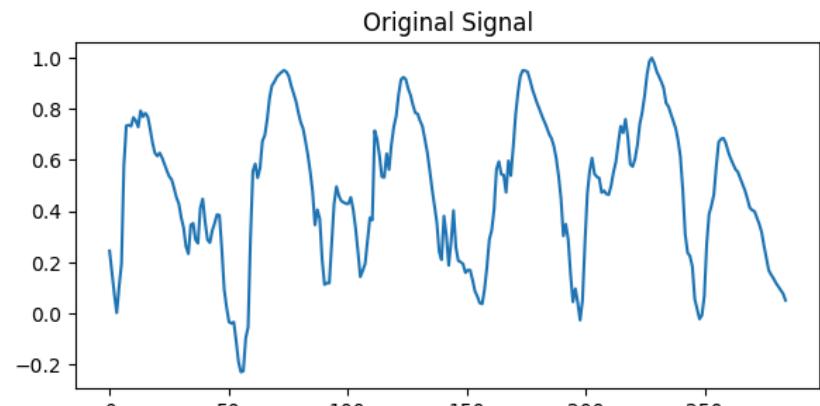
Similarity Signal - Pearson Correlation



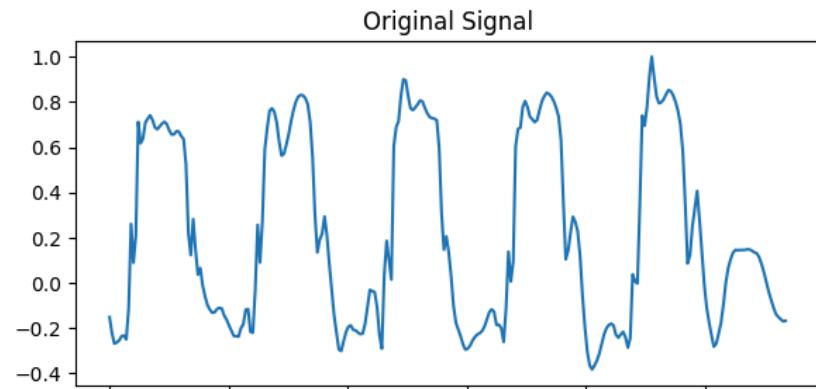
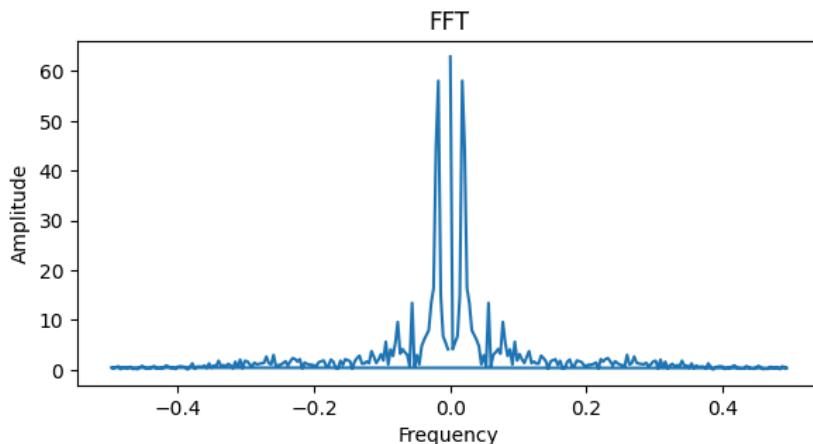
Histogram - FFT



Dominant Frequency: 0.021 , Period: 47.501

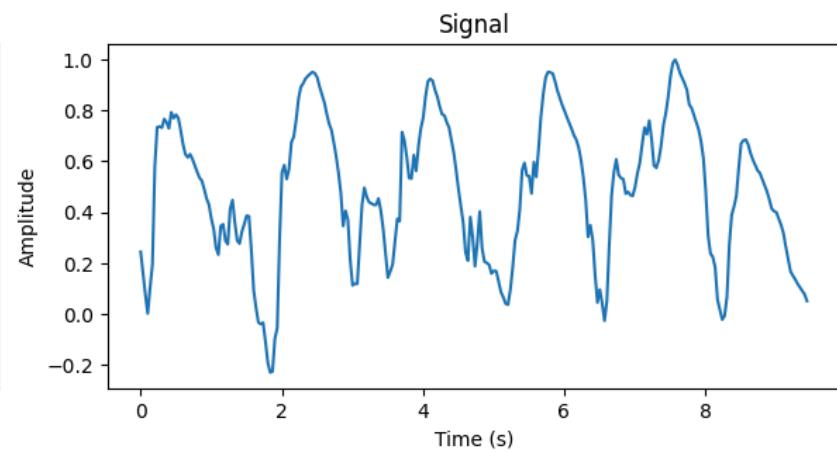
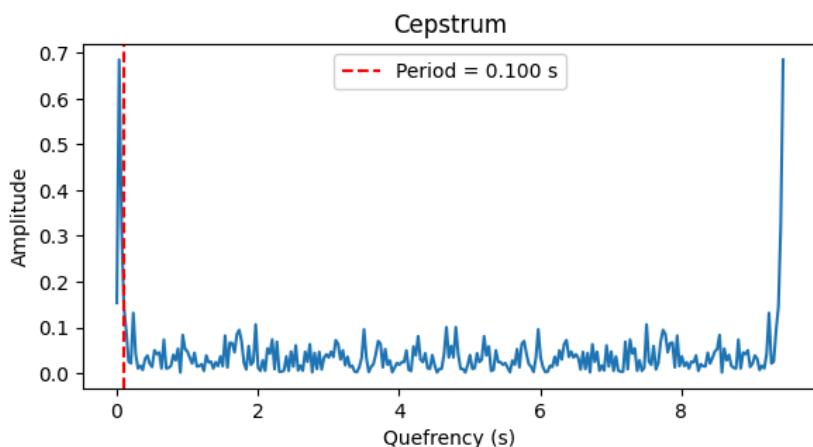


PCC - FFT



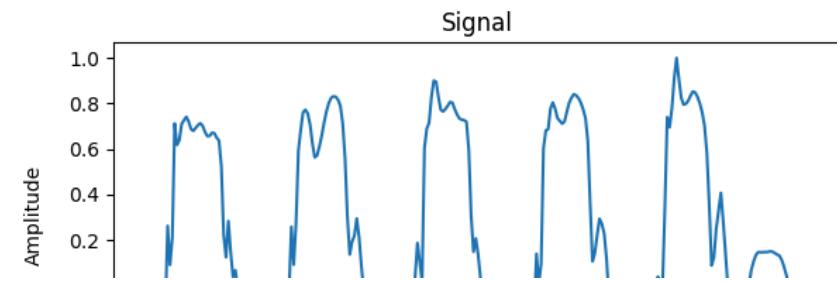
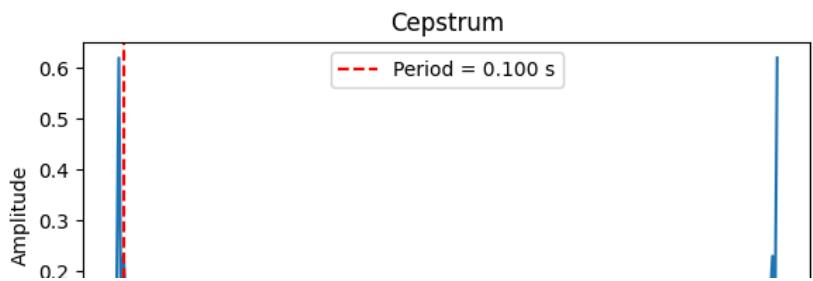
Dominant Frequency: 0.018 , Period: 57.001

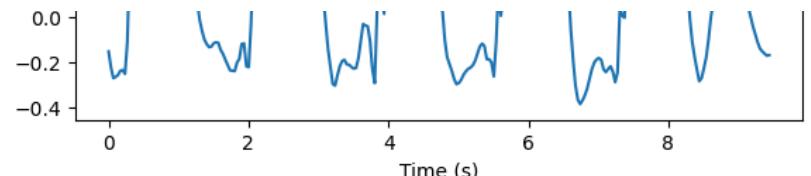
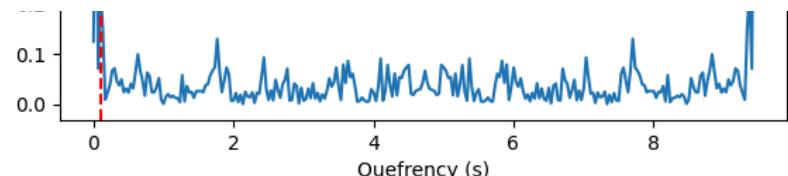
#### Histogram - Cepstrum



Period: 0.100 seconds      Period: 3.000 frames

#### PCC - Cepstrum

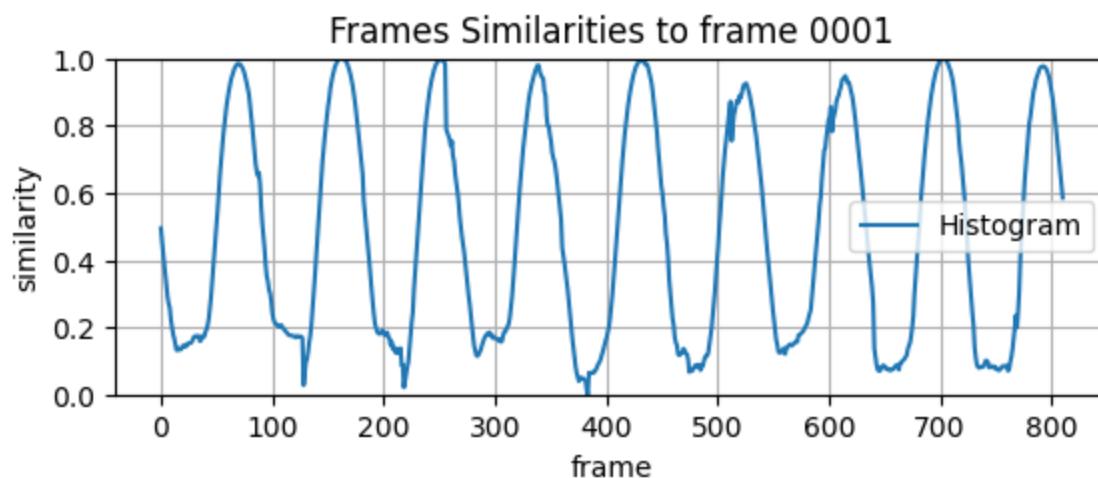




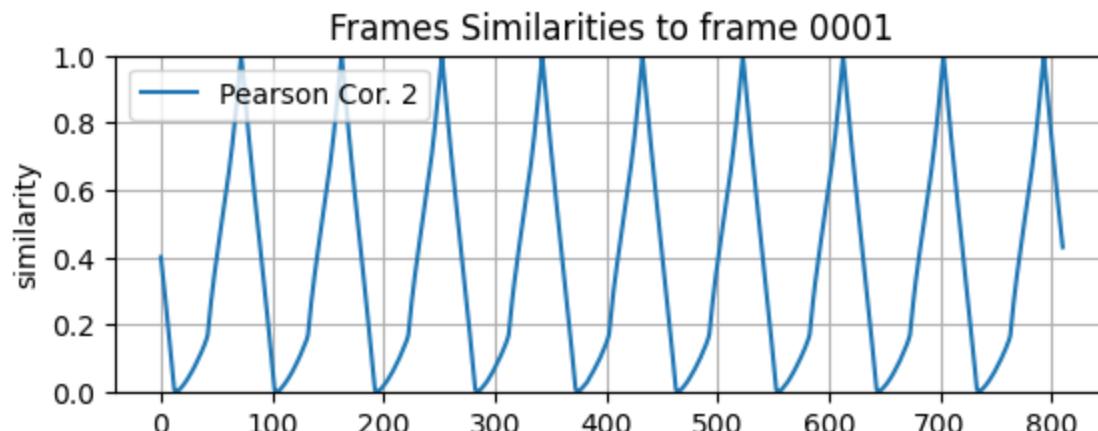
Period: 0.100 seconds    Period: 3.000 frames  
 \* \* \* \* \* 9.webm    Frames:810 FPS:29.97002997002997 \* \* \* \* \*

\* \* \* \* \* Video: 9 Reference frame at: (20%) 162 \* \* \* \* \*

Similarity Signal - Histogram

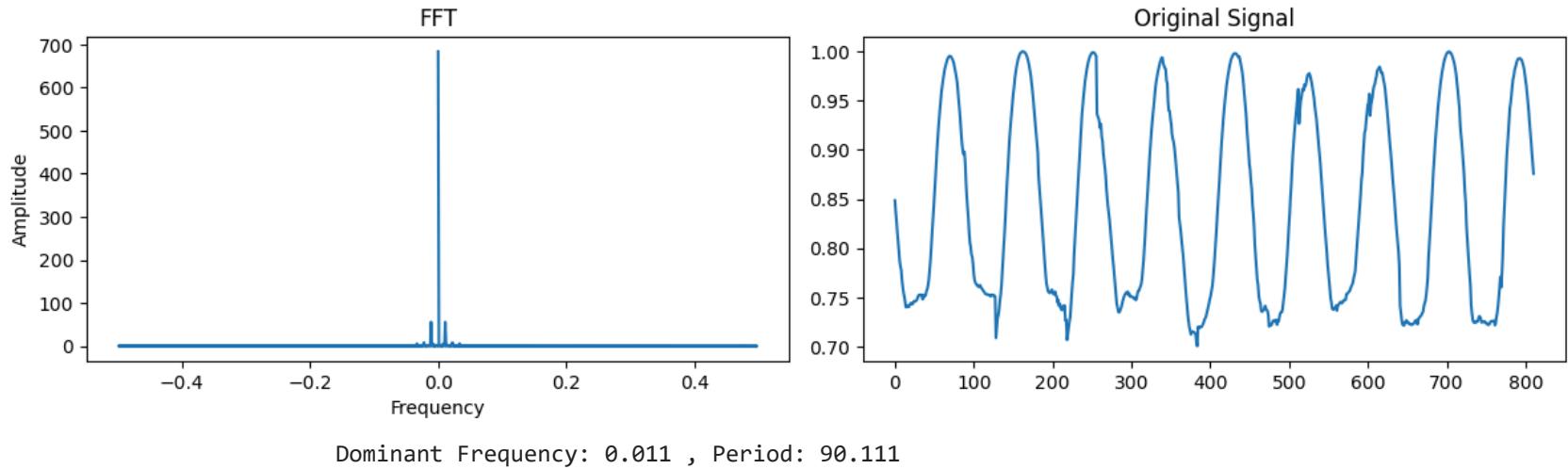


Similarity Signal - Pearson Correlation

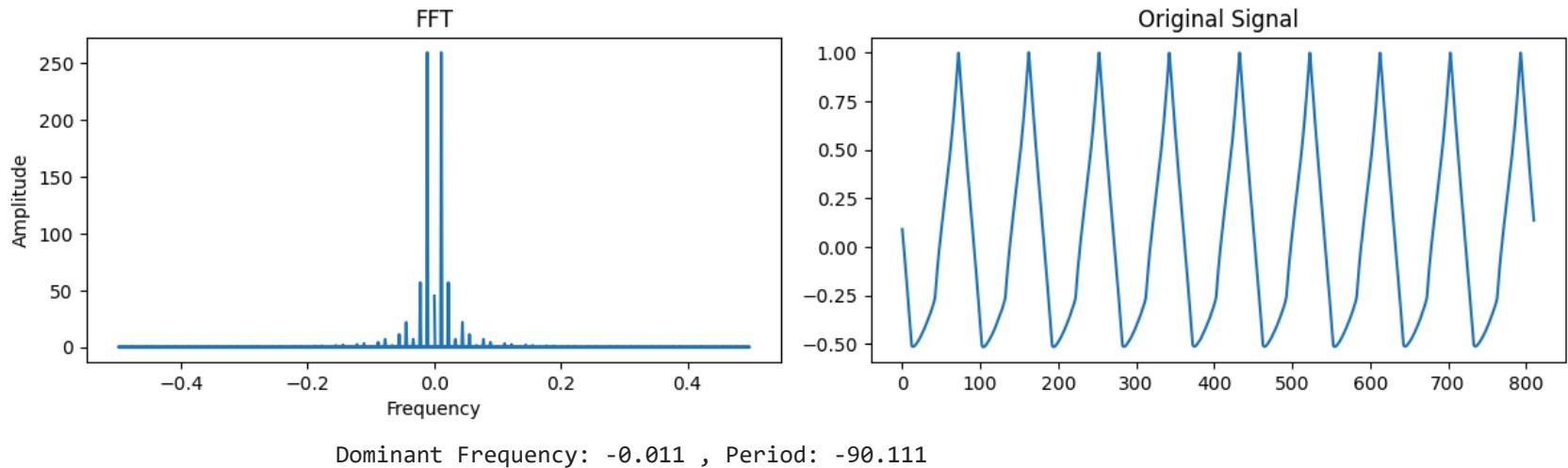


frame

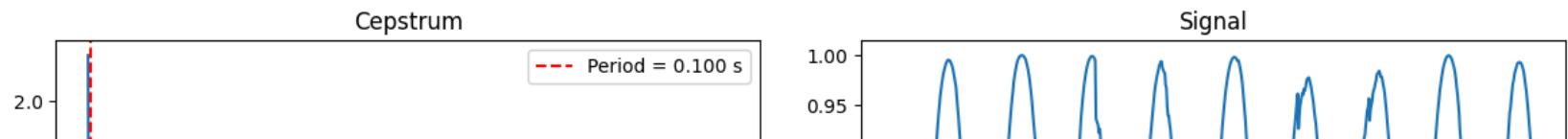
Histogram - FFT

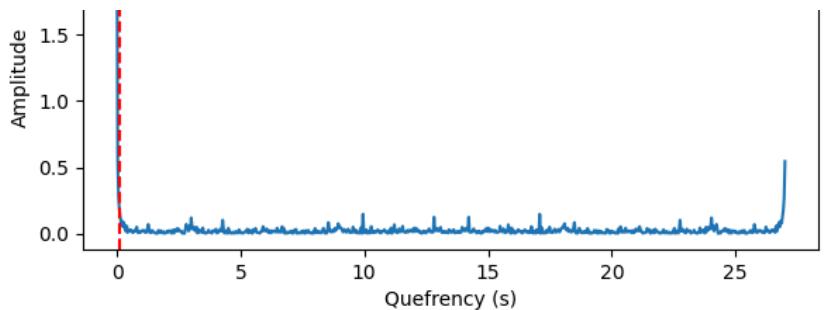


PCC - FFT

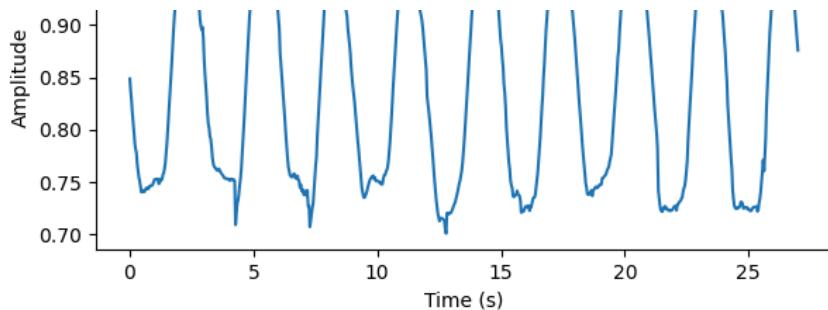


Histogram - Cepstrum



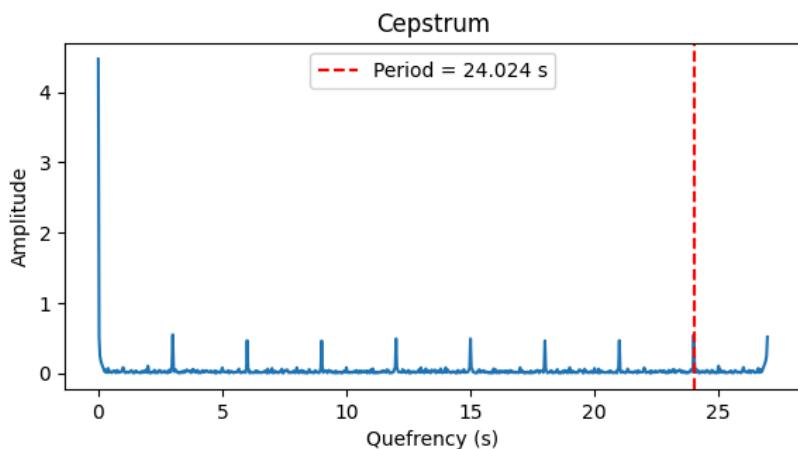


Period: 0.100 seconds

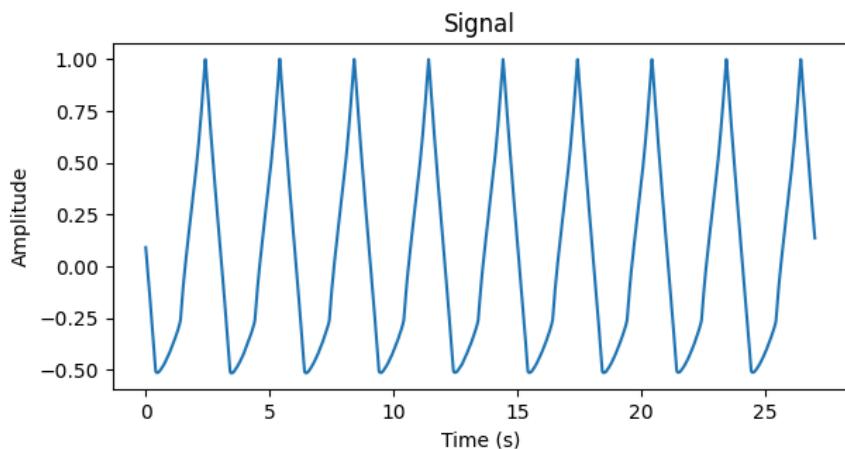


Period: 3.000 frames

PCC - Cepstrum



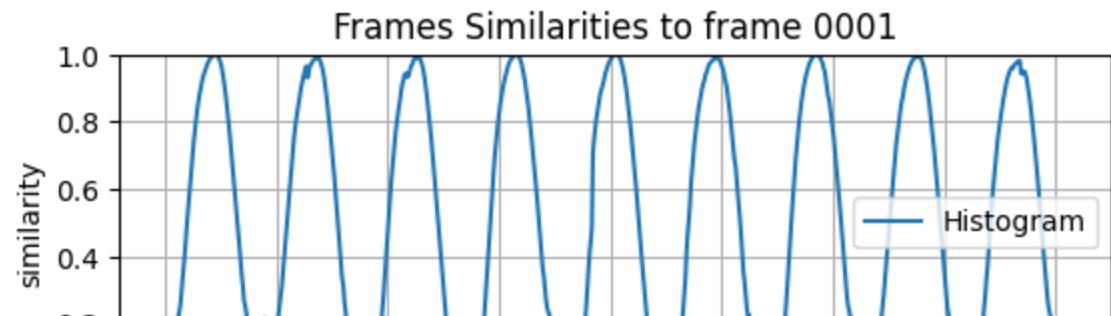
Period: 24.024 seconds

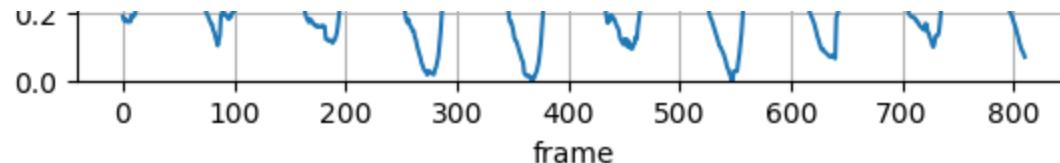


Period: 720.000 frames

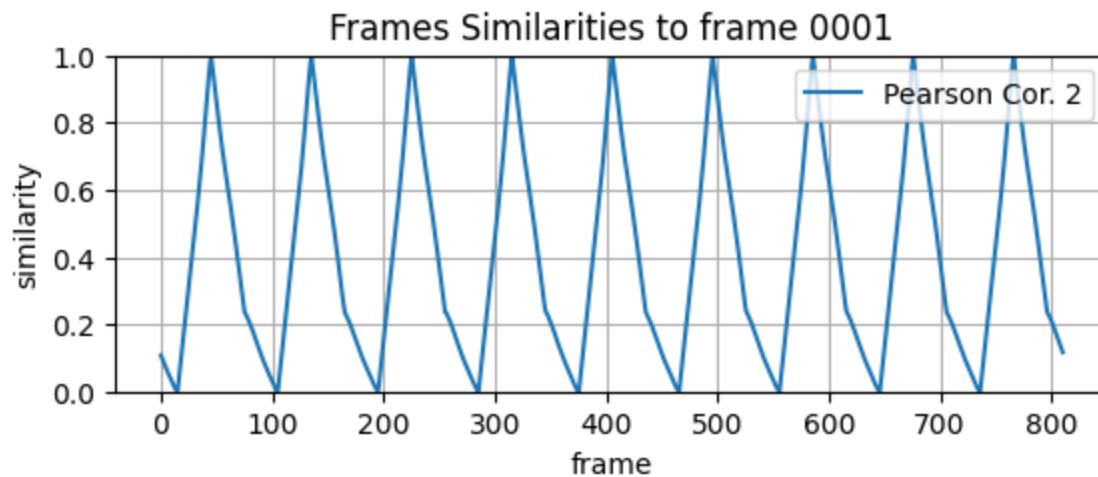
\* \* \* \* \* Video: 9 Reference frame at: (50%) 405 \* \* \* \* \*

Similarity Signal - Histogram

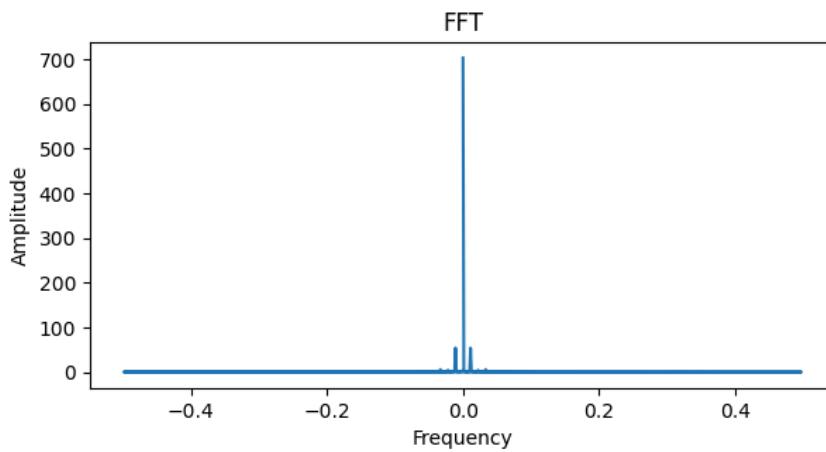




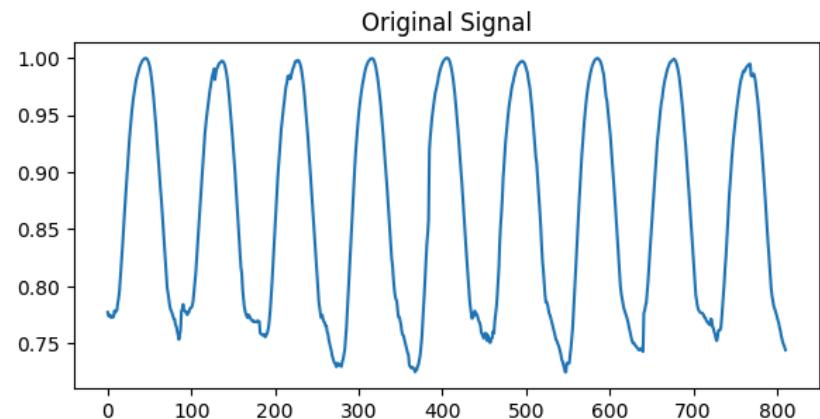
Similarity Signal - Pearson Correlation



Histogram - FFT



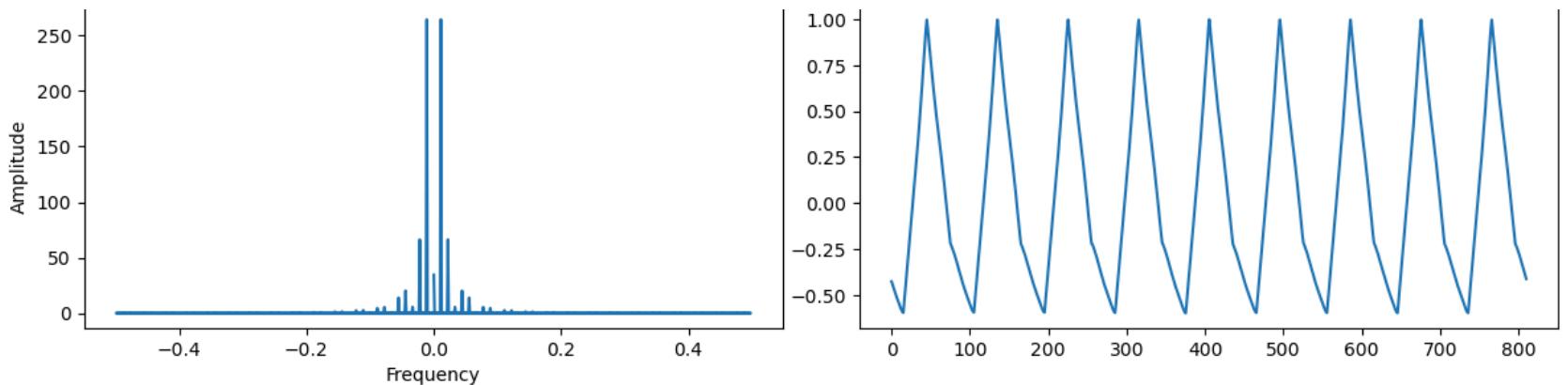
Dominant Frequency: 0.011 , Period: 90.111



PCC - FFT

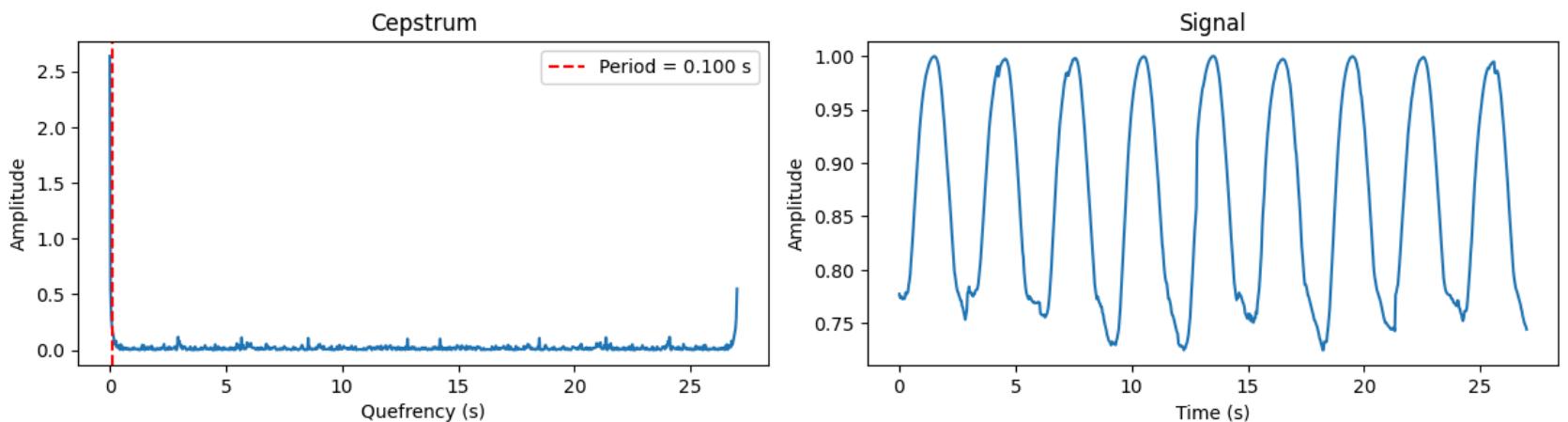
FFT

Original Signal



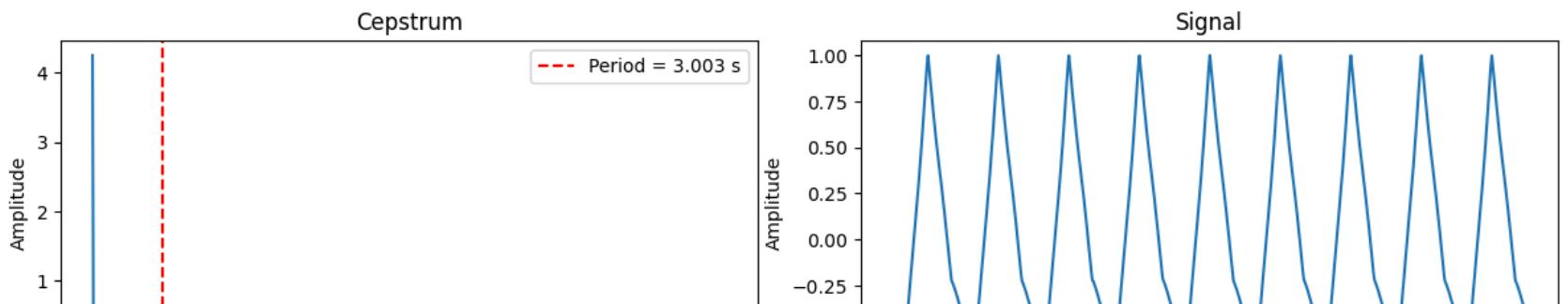
Dominant Frequency: -0.011 , Period: -90.111

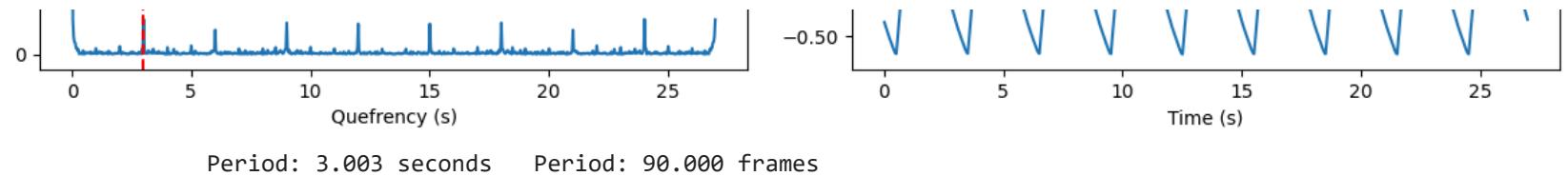
Histogram - Cepstrum



Period: 0.100 seconds      Period: 3.000 frames

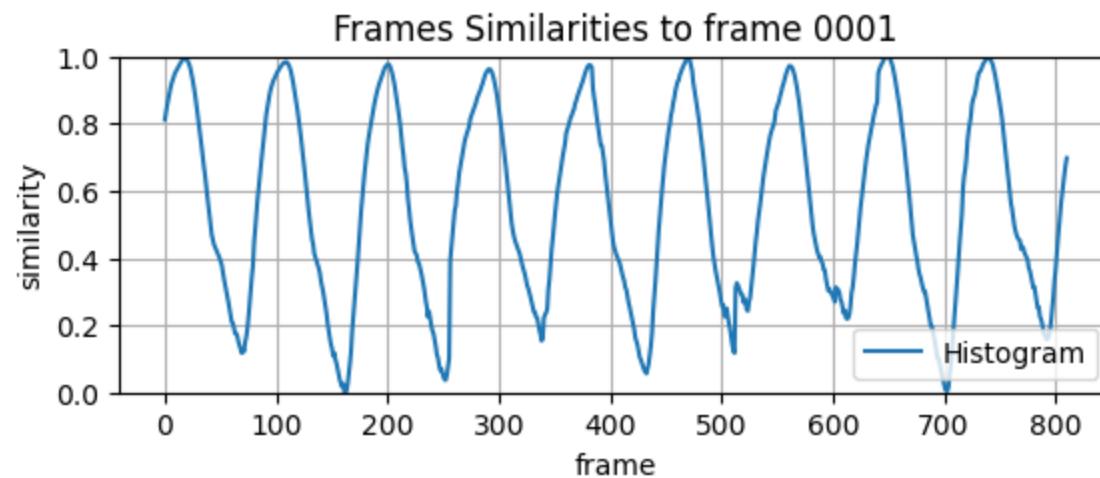
PCC - Cepstrum



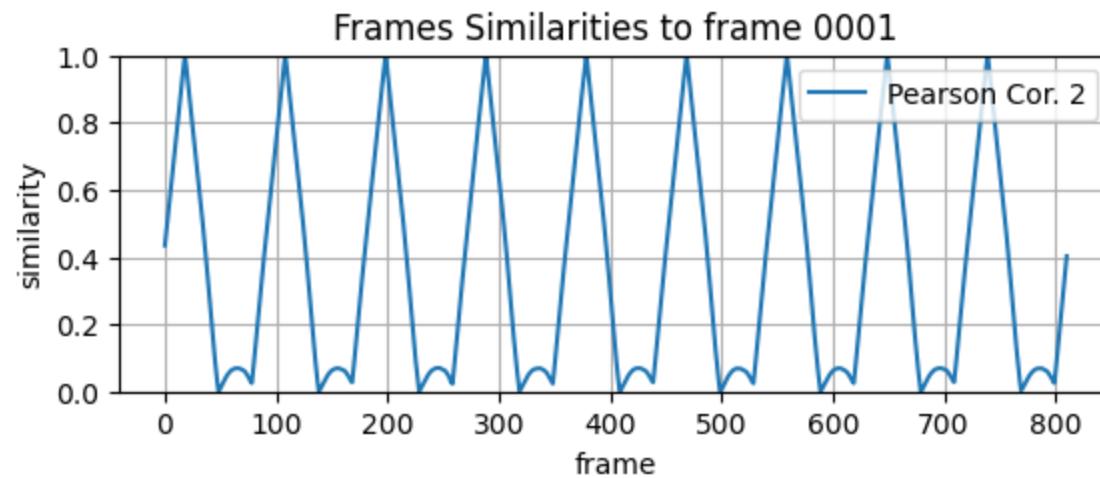


\* \* \* \* \* Video: 9 Reference frame at: (80%) 648 \* \* \* \* \*

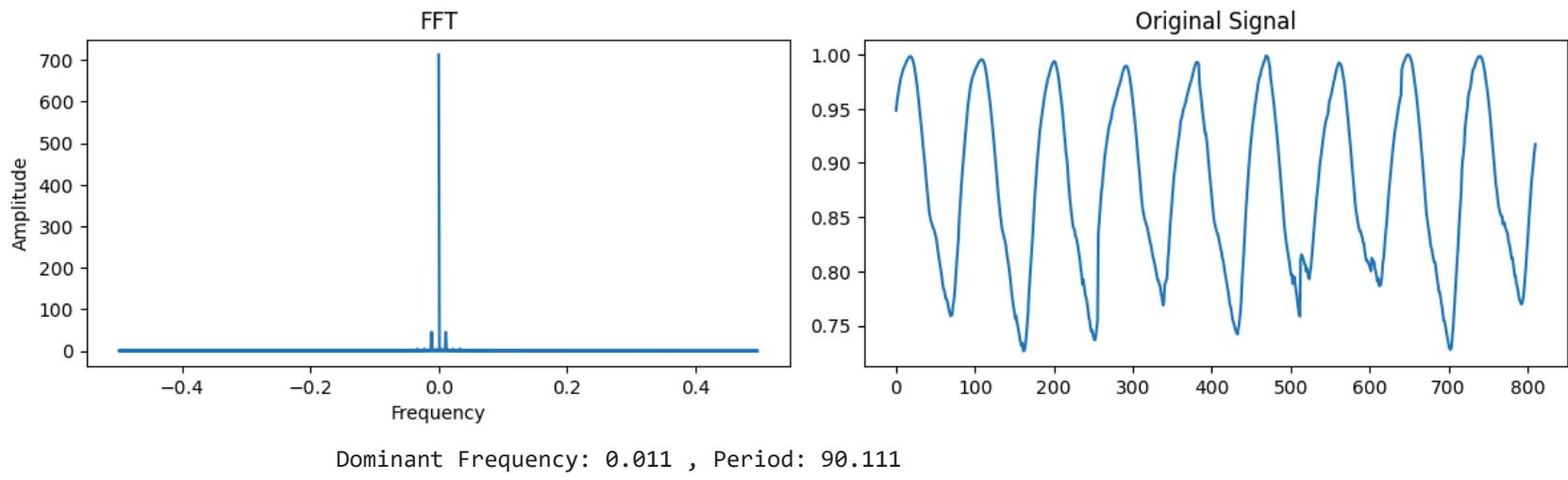
Similarity Signal - Histogram



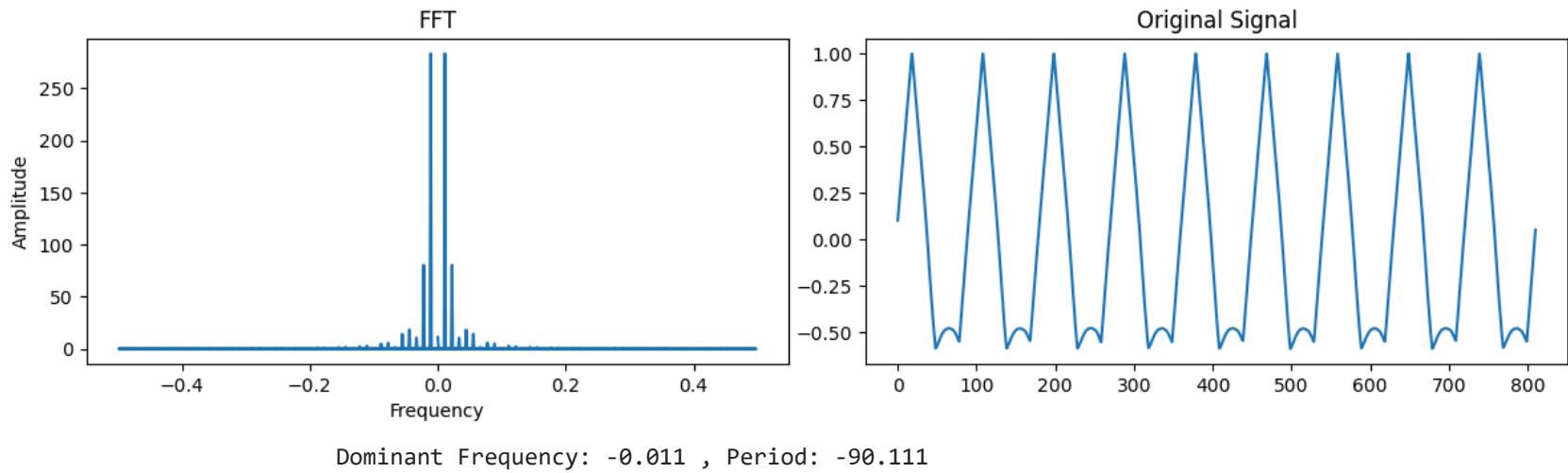
Similarity Signal - Pearson Correlation



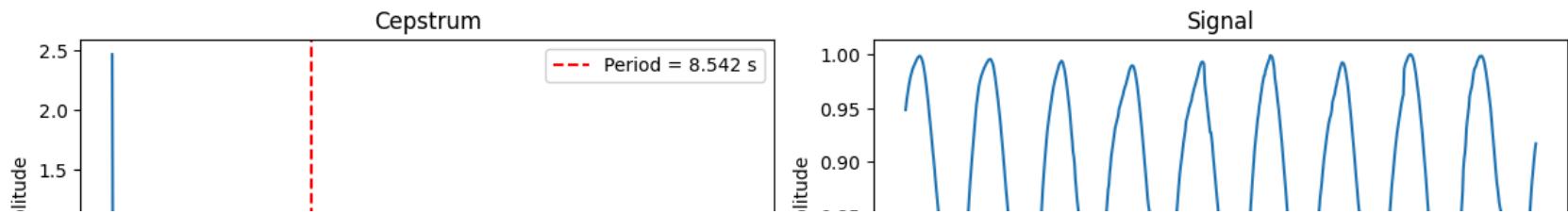
#### PSD Logram - FFT

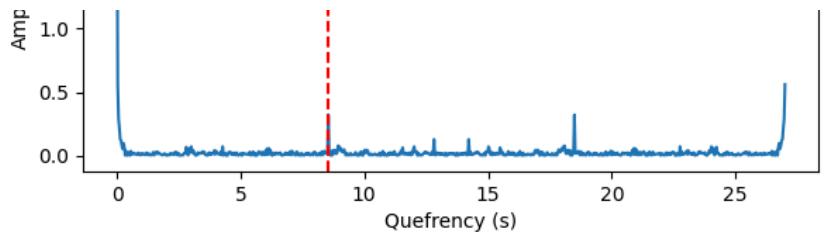


#### PCC - FFT

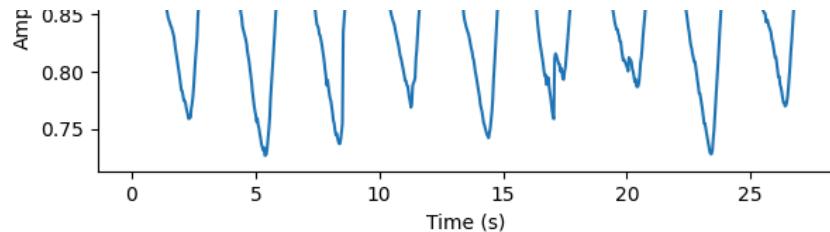


#### Histogram - Cepstrum



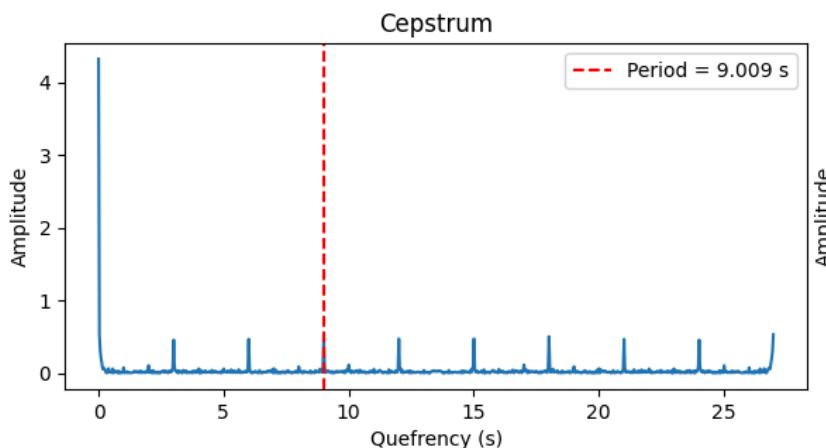


Period: 8.542 seconds

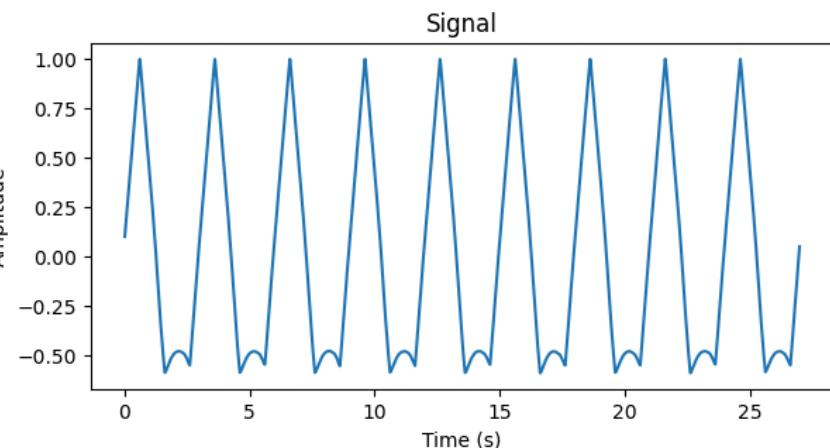


Period: 256.000 frames

PCC - Cepstrum



Period: 9.009 seconds

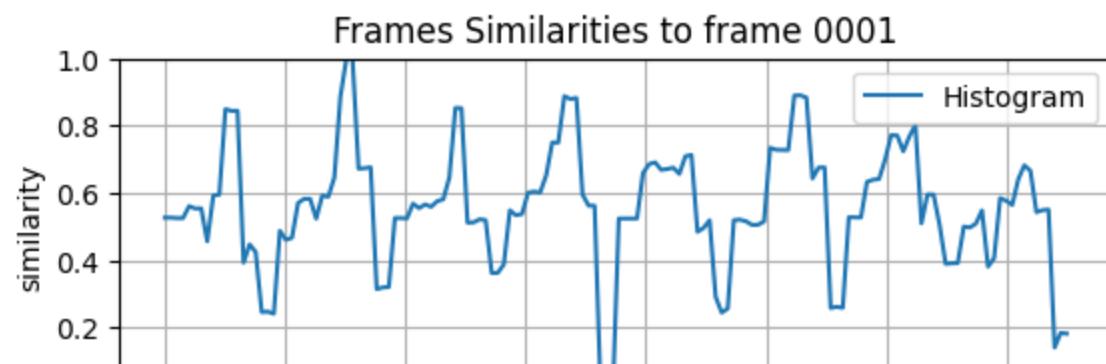


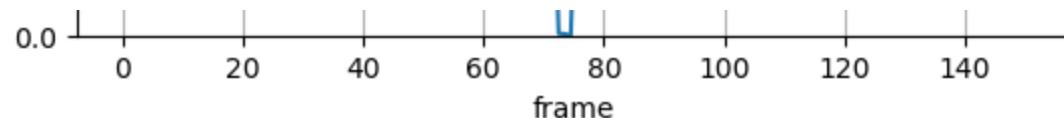
Period: 270.000 frames

\* \* \* \* \* 10.webm Frames:150 FPS:25.0 \* \* \* \* \*

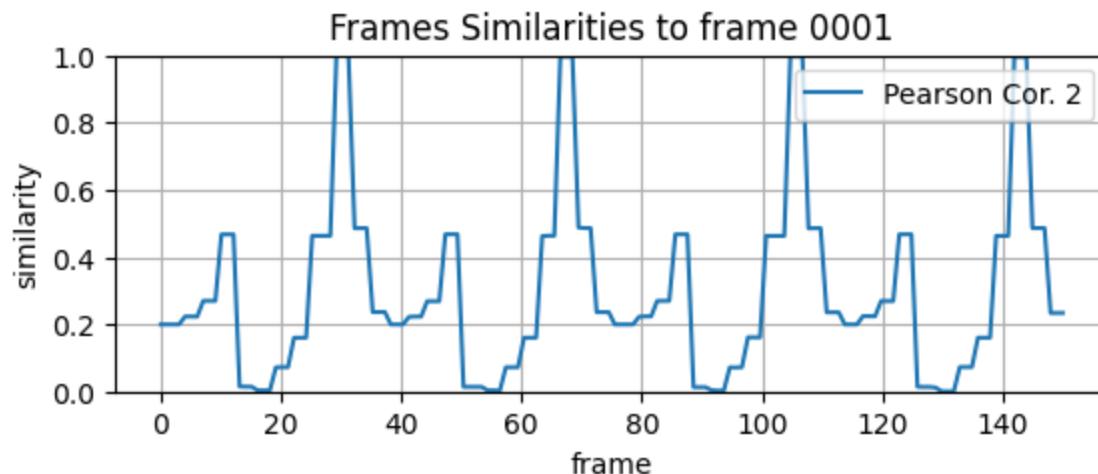
\* \* \* \* \* Video: 10 Reference frame at: (20%) 30 \* \* \* \* \*

Similarity Signal - Histogram

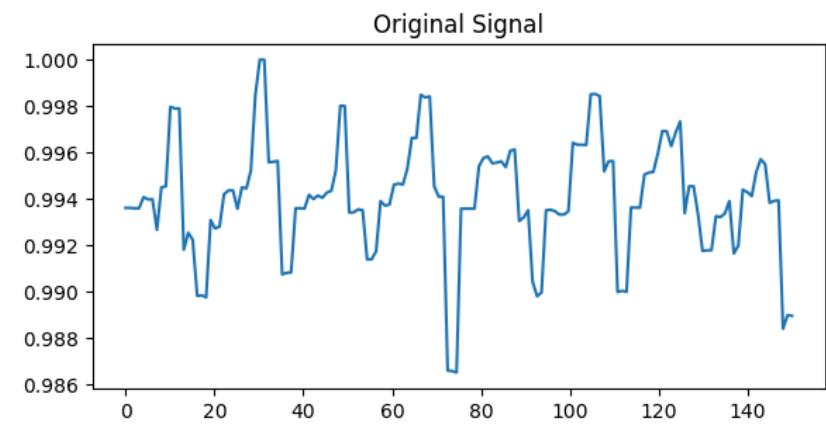
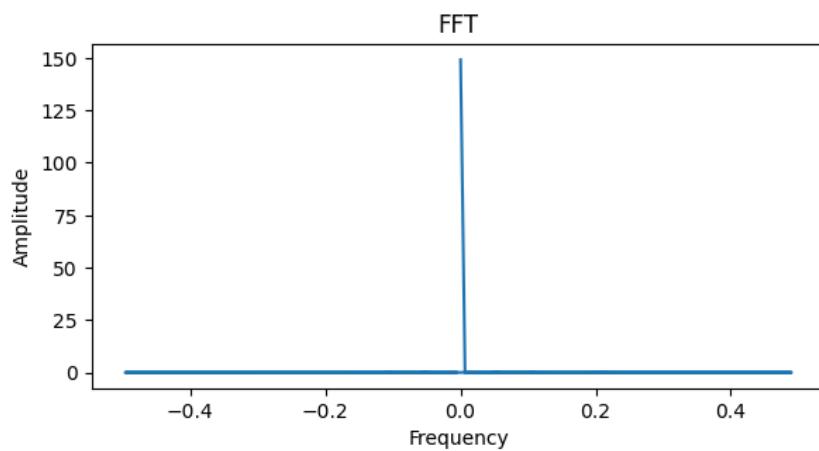




Similarity Signal - Pearson Correlation

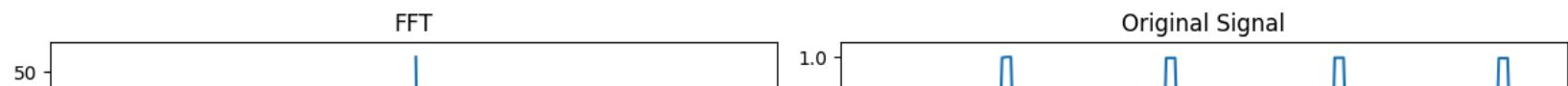


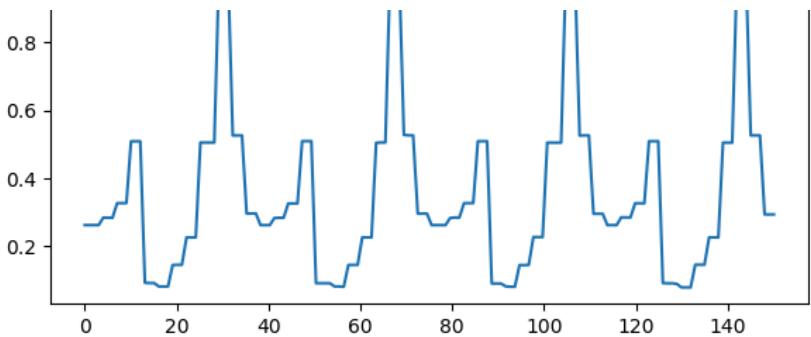
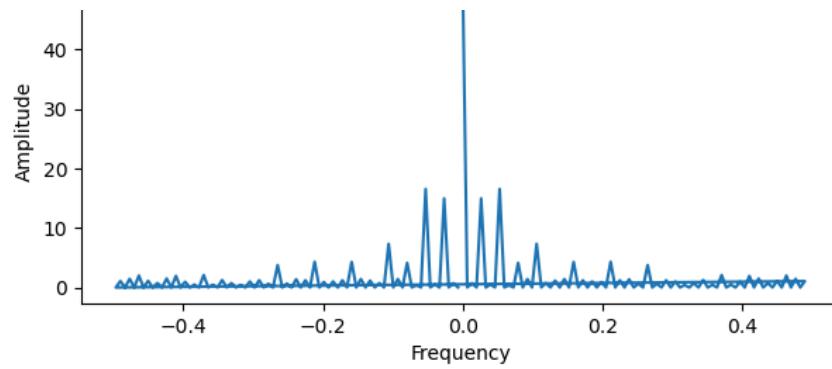
Histogram - FFT



Dominant Frequency: 0.053 , Period: 18.876

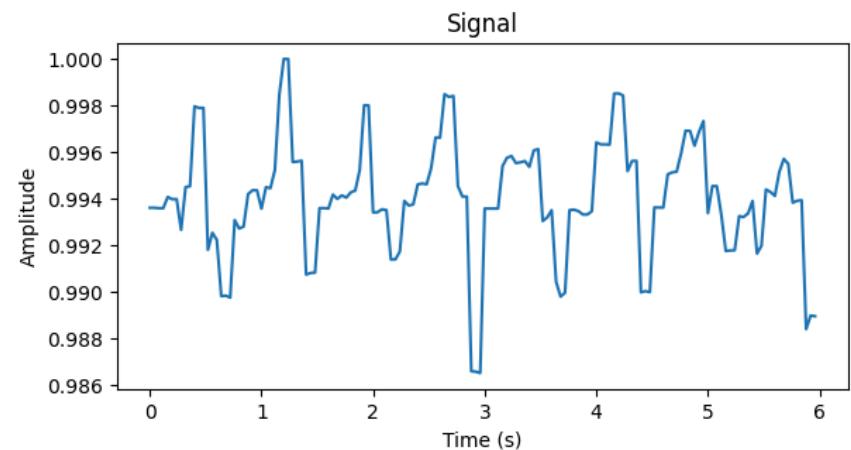
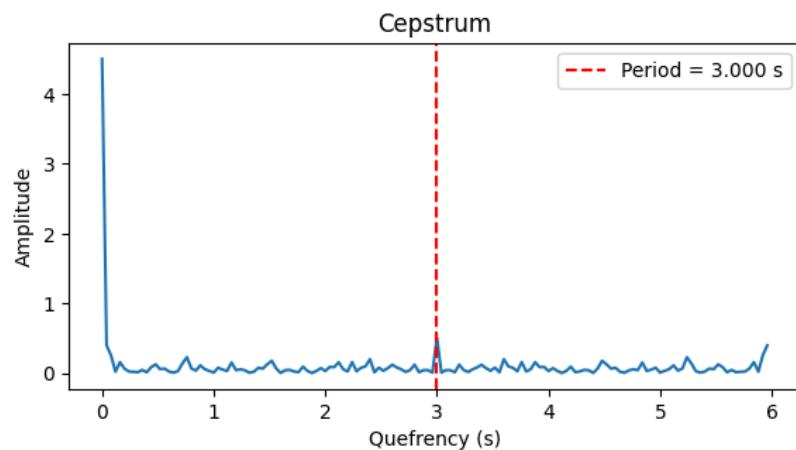
PCC - FFT





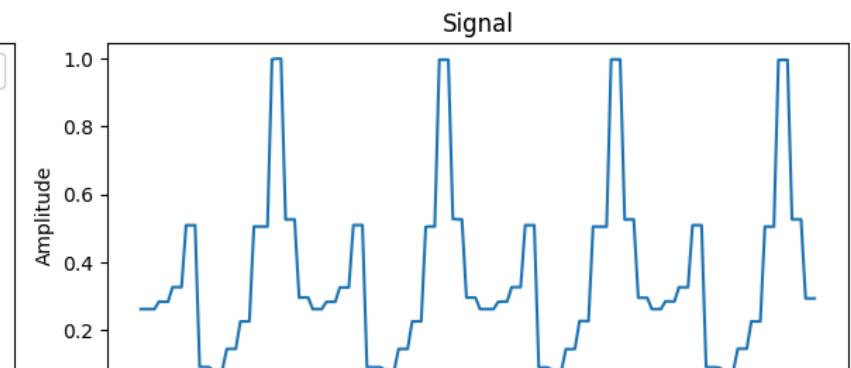
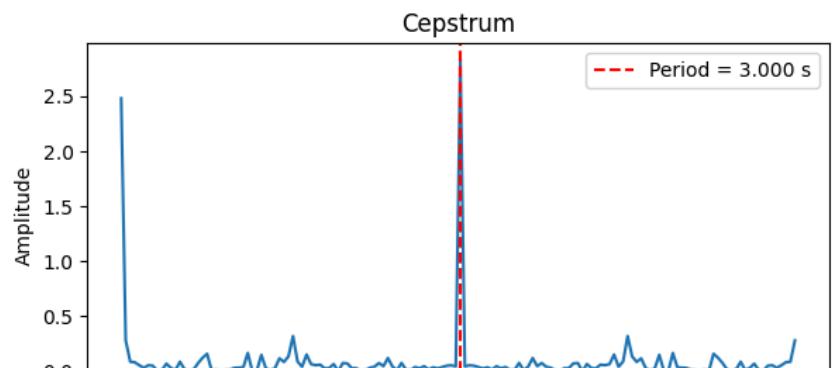
Dominant Frequency: 0.053 , Period: 18.876

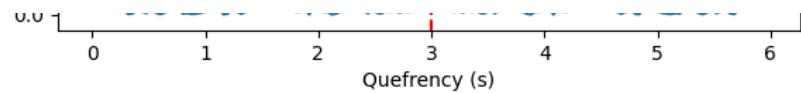
Histogram - Cepstrum



Period: 3.000 seconds      Period: 75.000 frames

PCC - Cepstrum

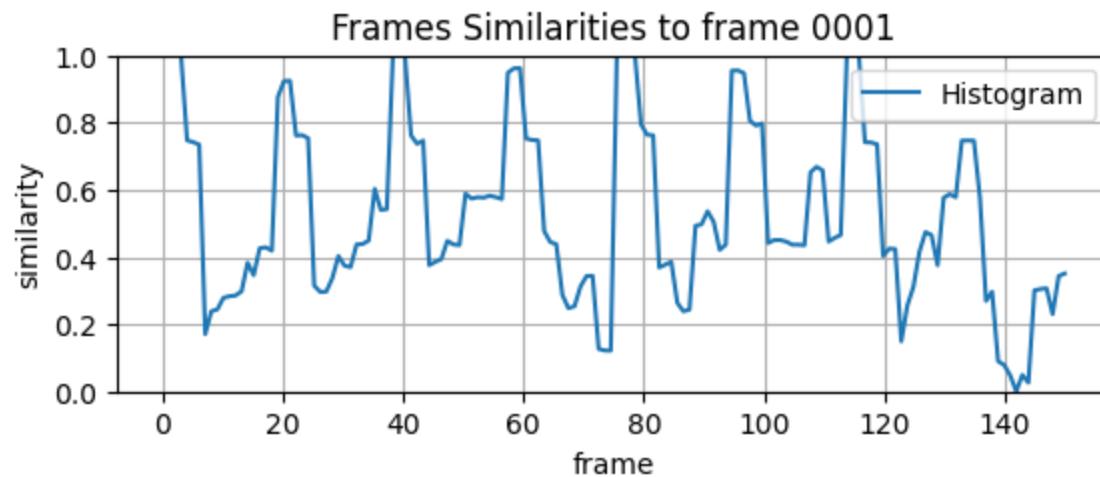




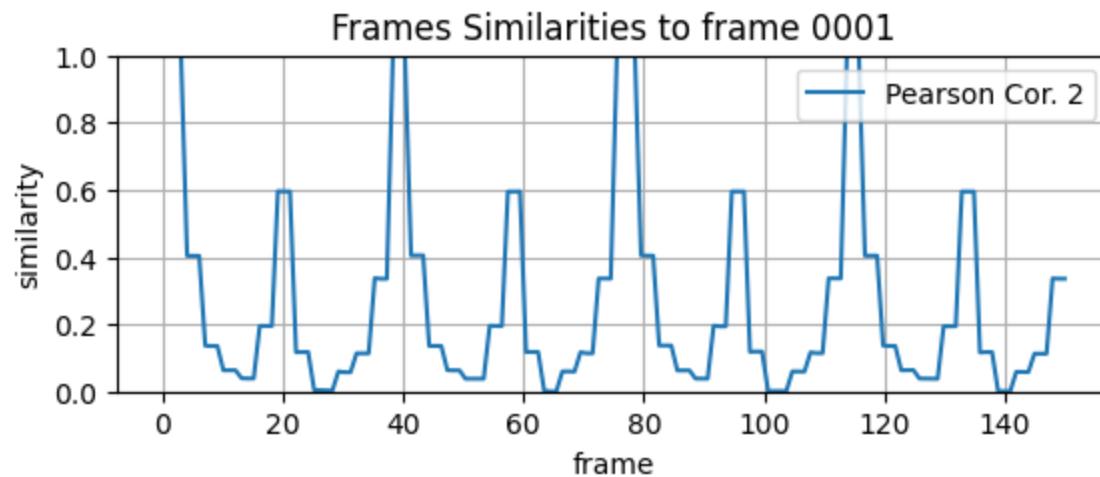
Period: 3.000 seconds      Period: 75.000 frames

\* \* \* \* \* Video: 10 Reference frame at: (50%) 75 \* \* \* \* \*

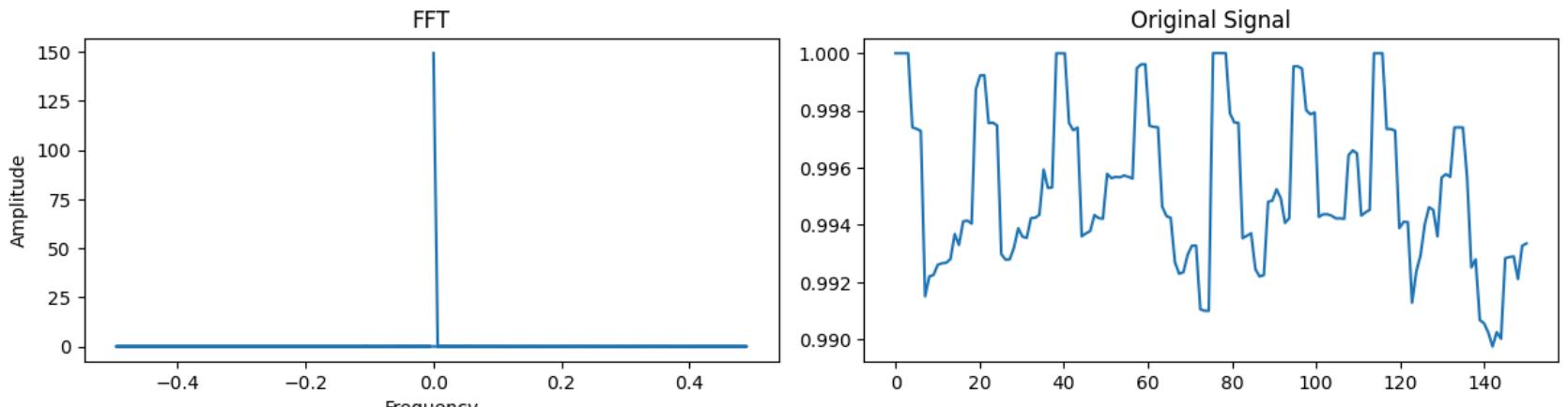
Similarity Signal - Histogram



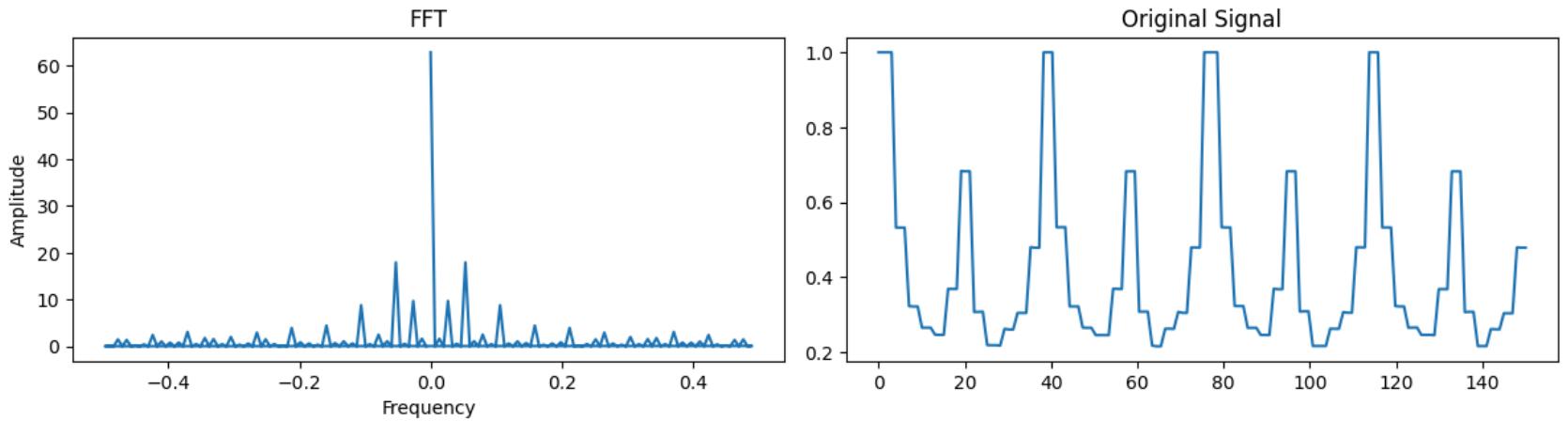
Similarity Signal - Pearson Correlation



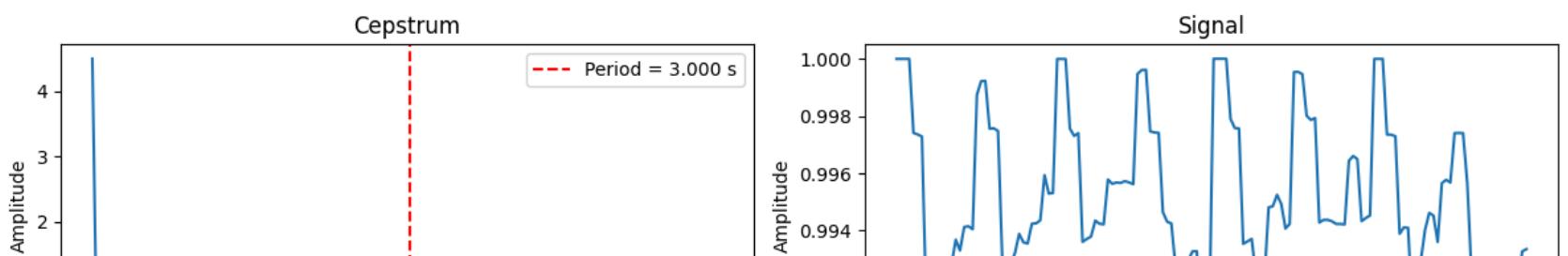
Histogram - FFT

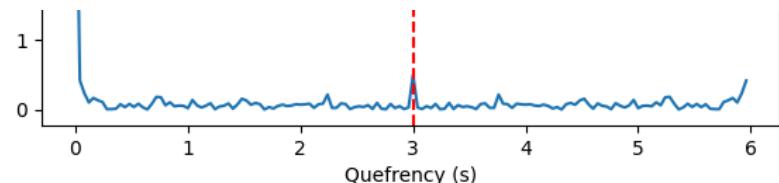


PCC - FFT



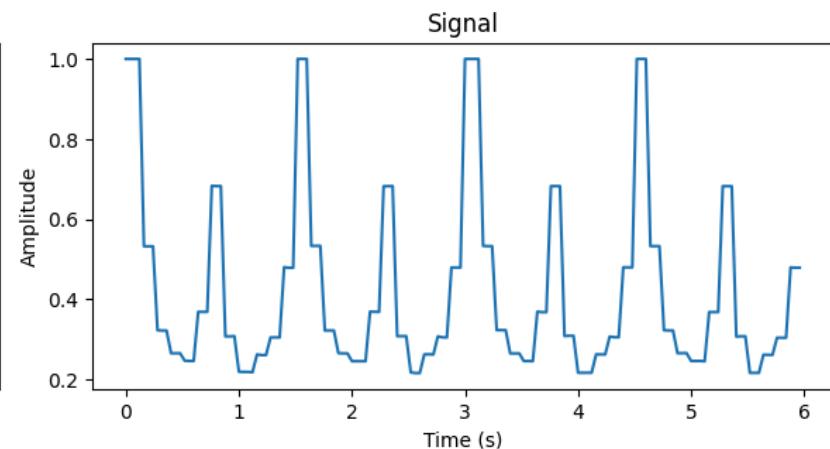
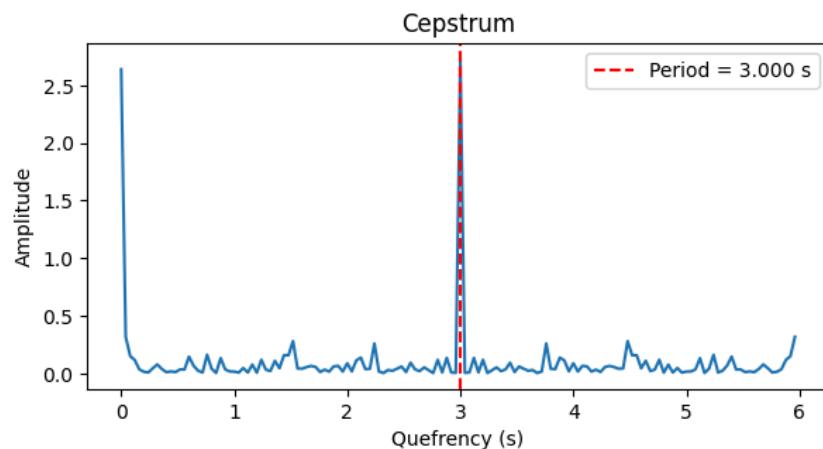
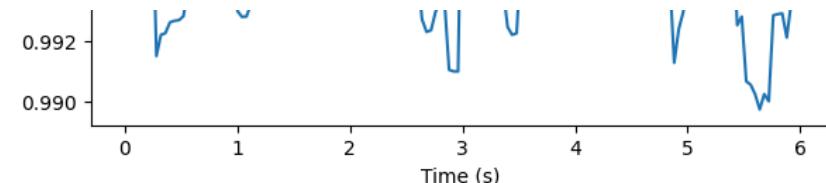
Histogram - Cepstrum





Period: 3.000 seconds      Period: 75.000 frames

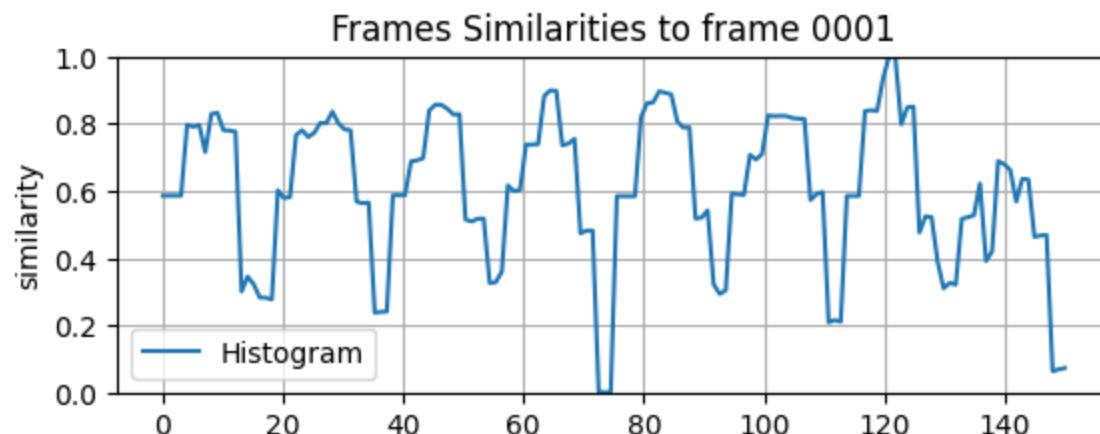
PCC - Cepstrum



Period: 3.000 seconds      Period: 75.000 frames

\* \* \* \* \* Video: 10 Reference frame at: (80%) 120 \* \* \* \* \*

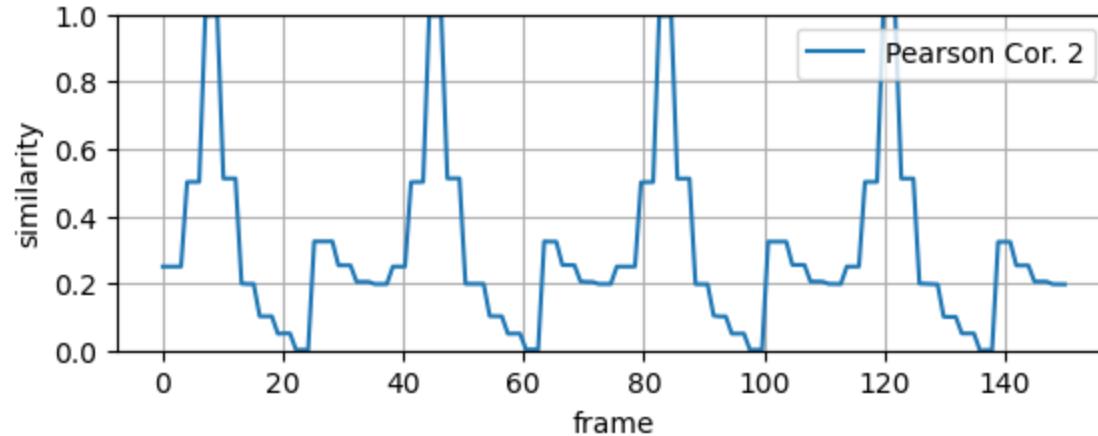
Similarity Signal - Histogram



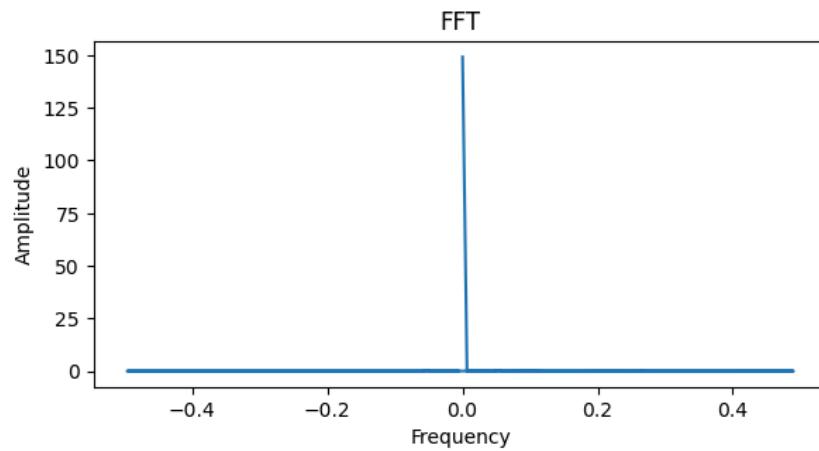
frame

Similarity Signal - Pearson Correlation

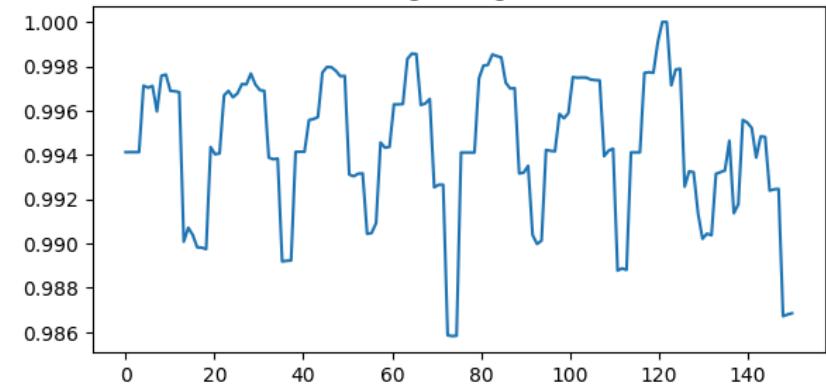
### Frames Similarities to frame 0001



Histogram - FFT



Original Signal



Dominant Frequency: 0.053 , Period: 18.876

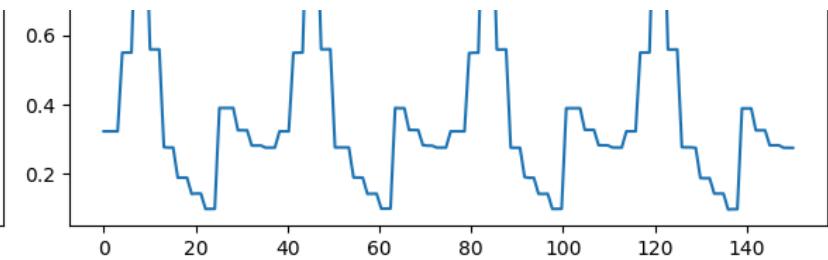
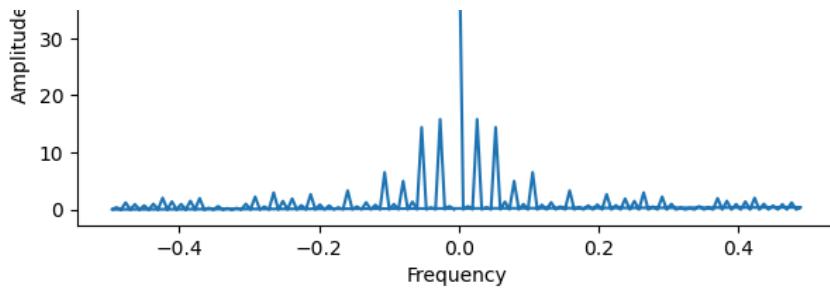
PCC - FFT

FFT



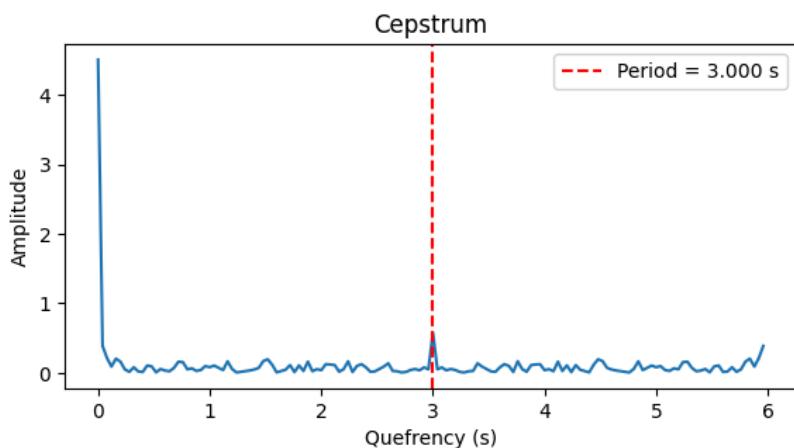
Original Signal



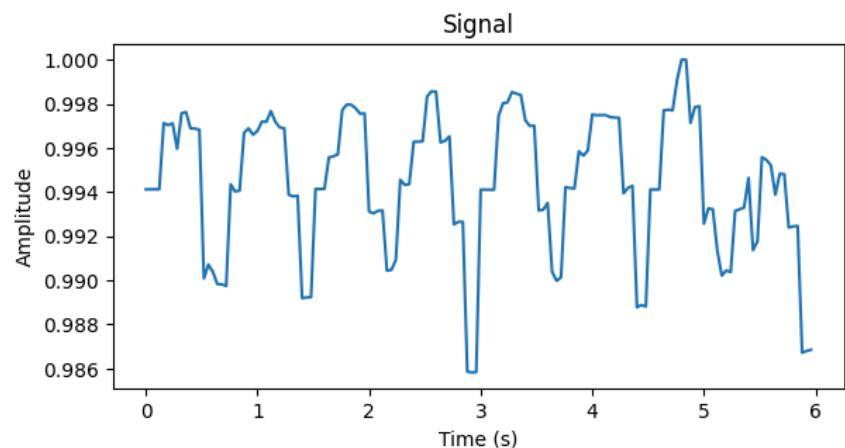


Dominant Frequency: 0.026 , Period: 37.752

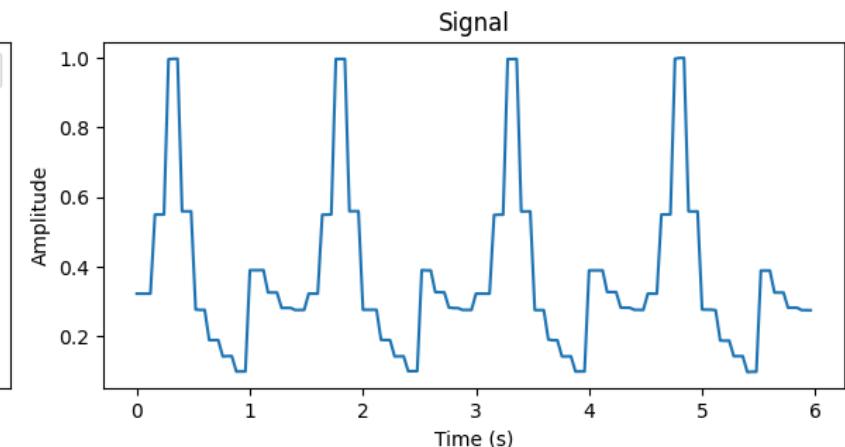
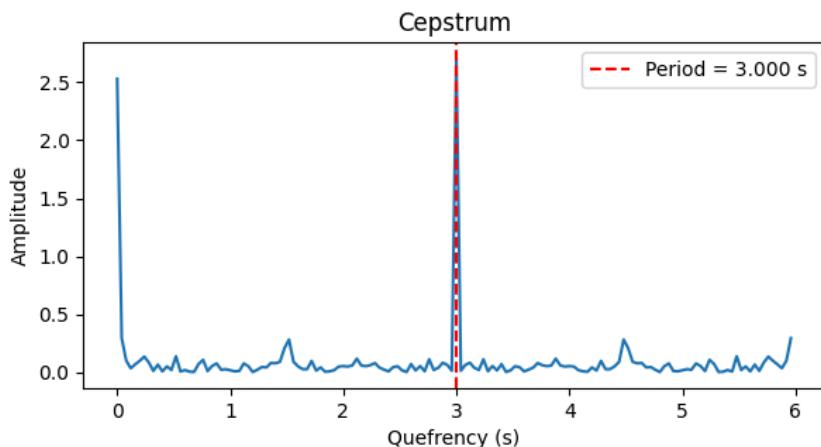
Histogram - Cepstrum



Period: 3.000 seconds      Period: 75.000 frames



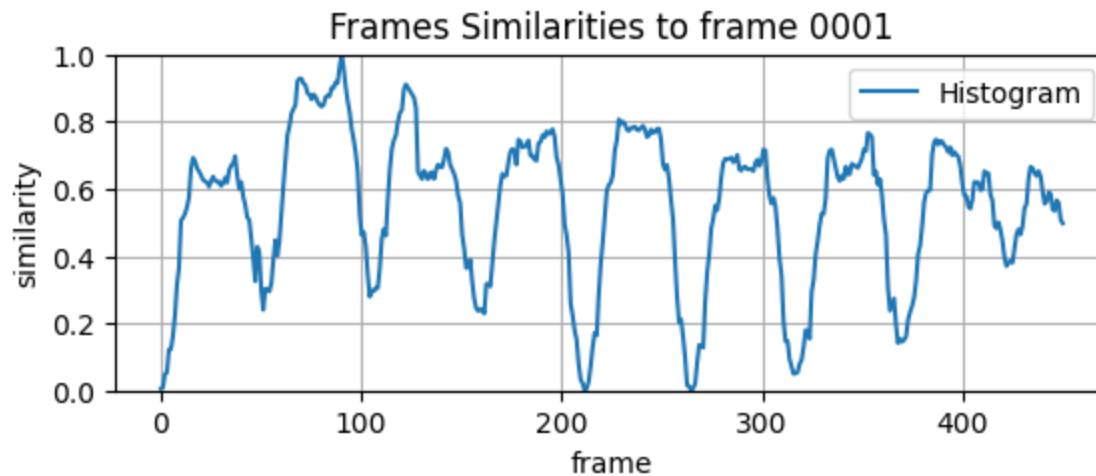
PCC - Cepstrum



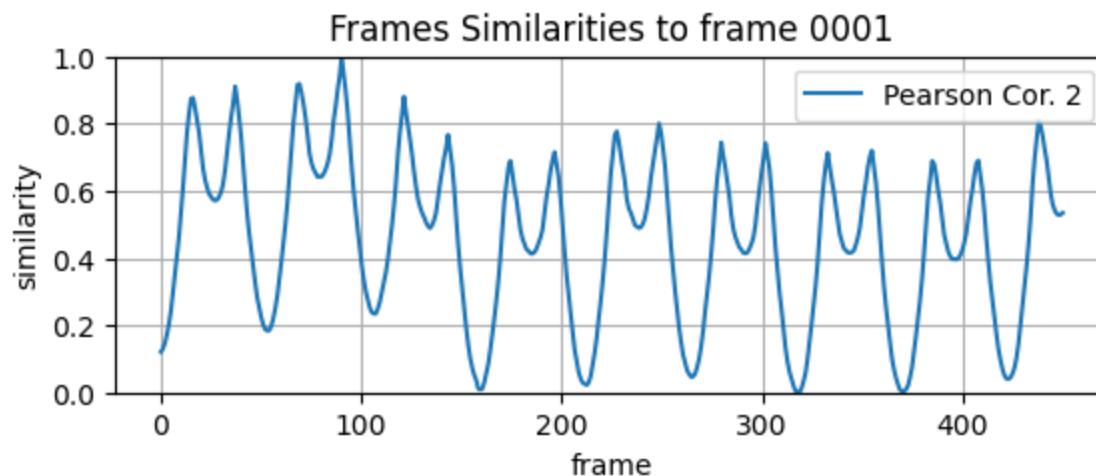
Period: 3.000 seconds Period: 75.000 frames  
\* \* \* \* \* 11.webm Frames:450 FPS:25.0 \* \* \* \* \*

\* \* \* \* \* Video: 11 Reference frame at: (20%) 90 \* \* \* \* \*

Similarity Signal - Histogram



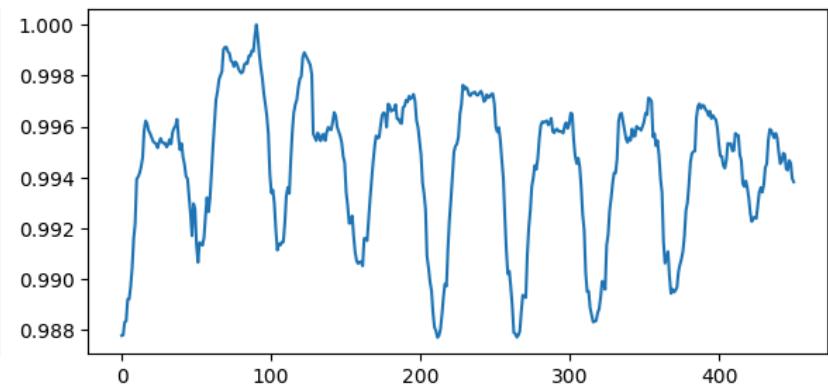
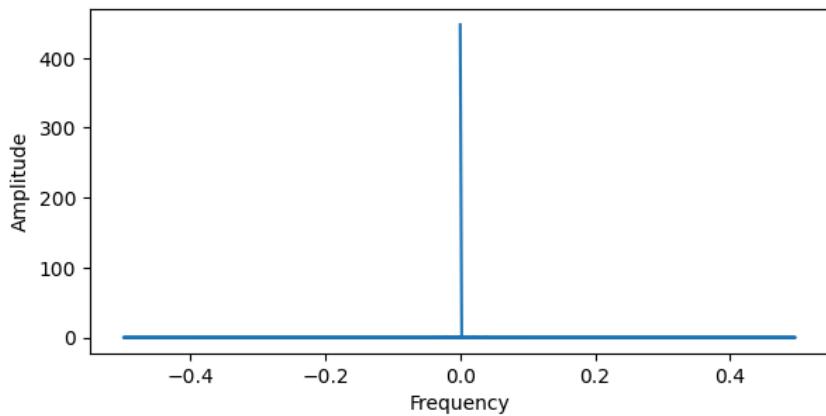
Similarity Signal - Pearson Correlation



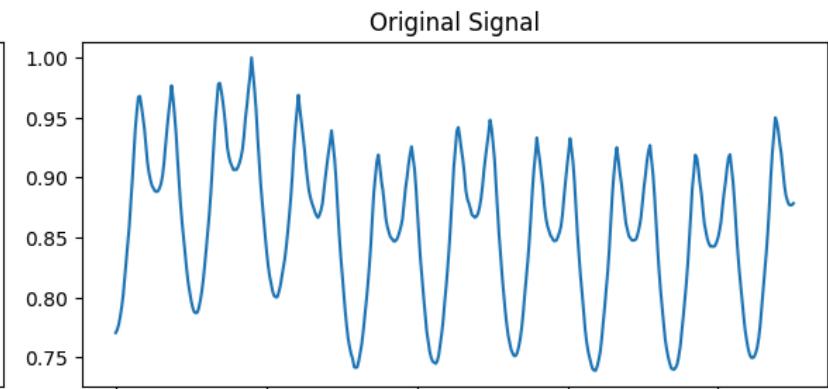
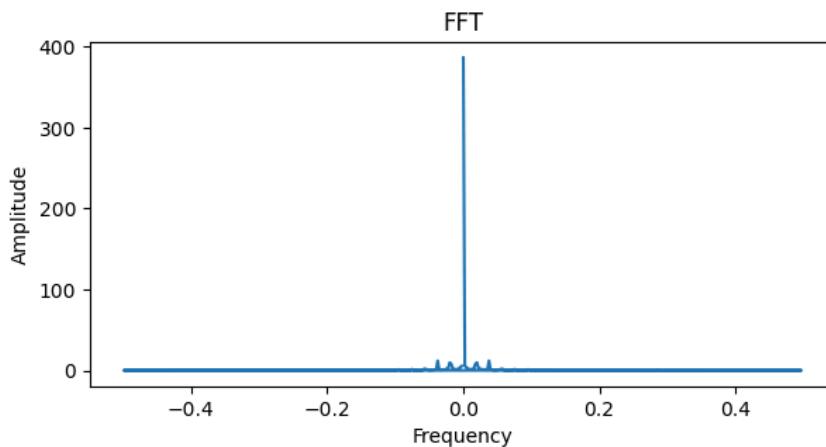
Histogram - FFT

FFT

Original Signal

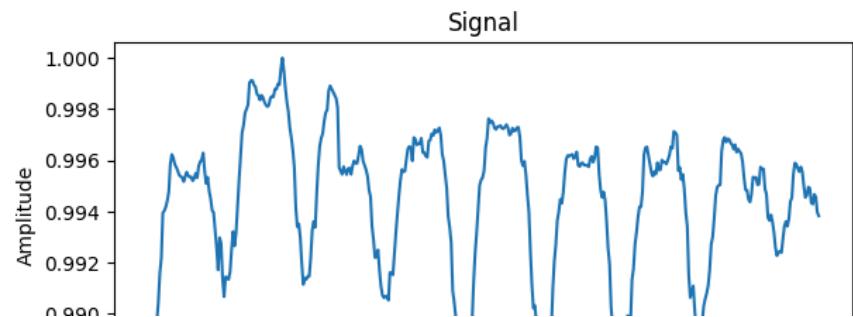
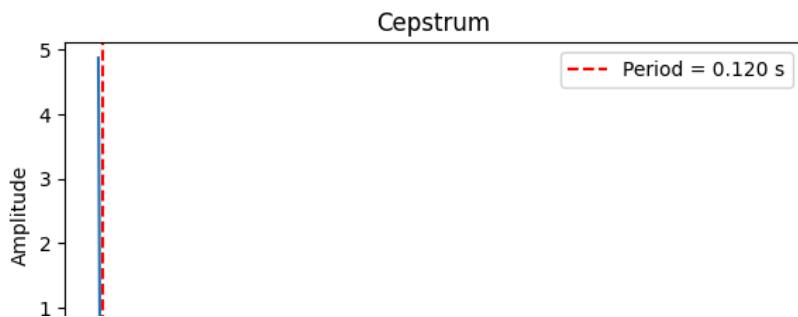


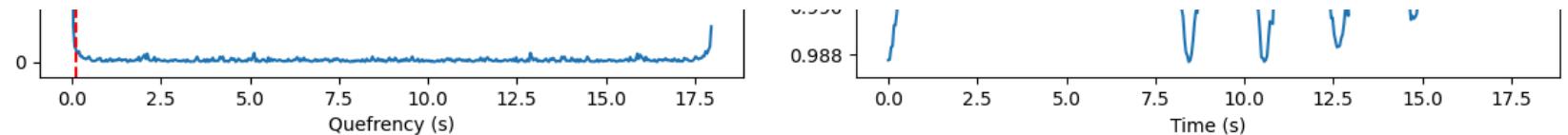
PCC - FFT



Dominant Frequency: 0.038 , Period: 26.530

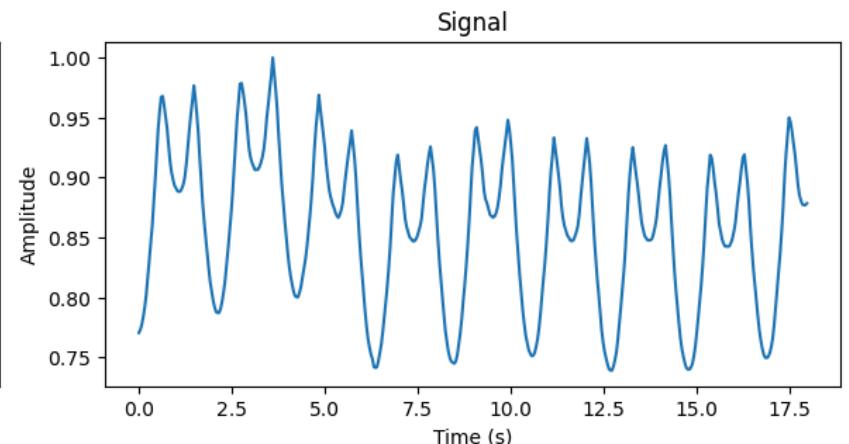
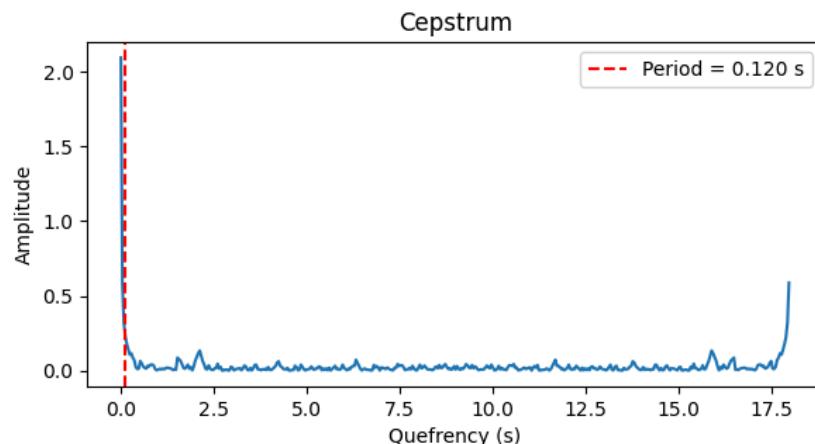
Histogram - Cepstrum





Period: 0.120 seconds      Period: 3.000 frames

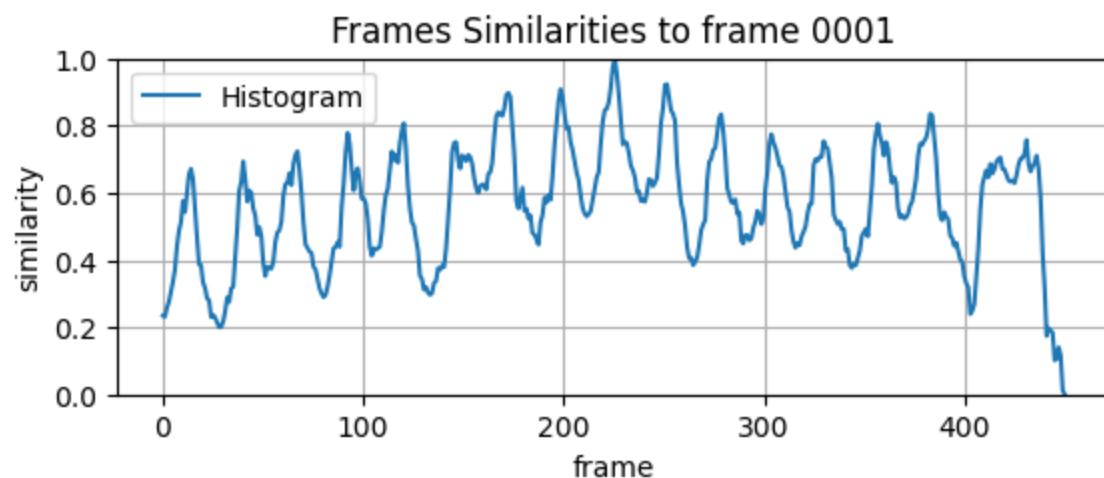
PCC - Cepstrum



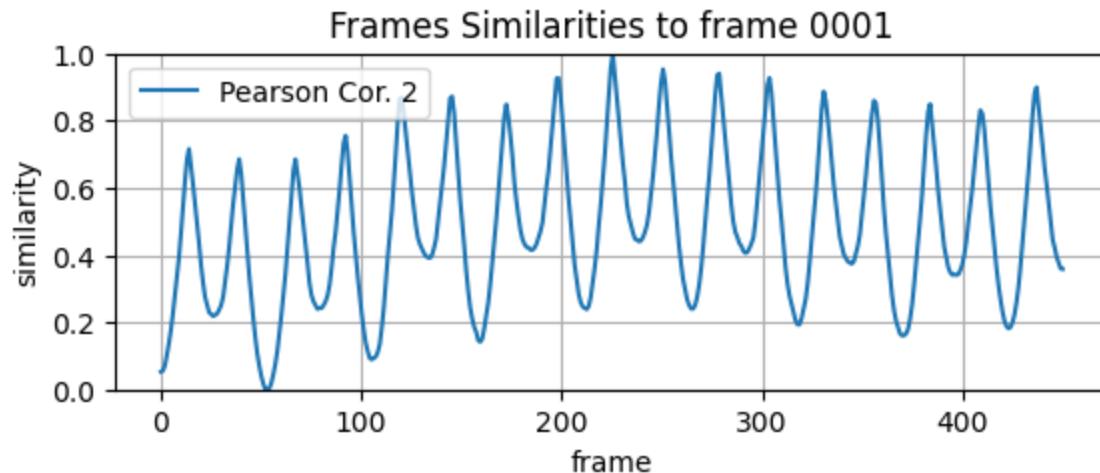
Period: 0.120 seconds      Period: 3.000 frames

\* \* \* \* \* Video: 11 Reference frame at: (50%) 225 \* \* \* \* \*

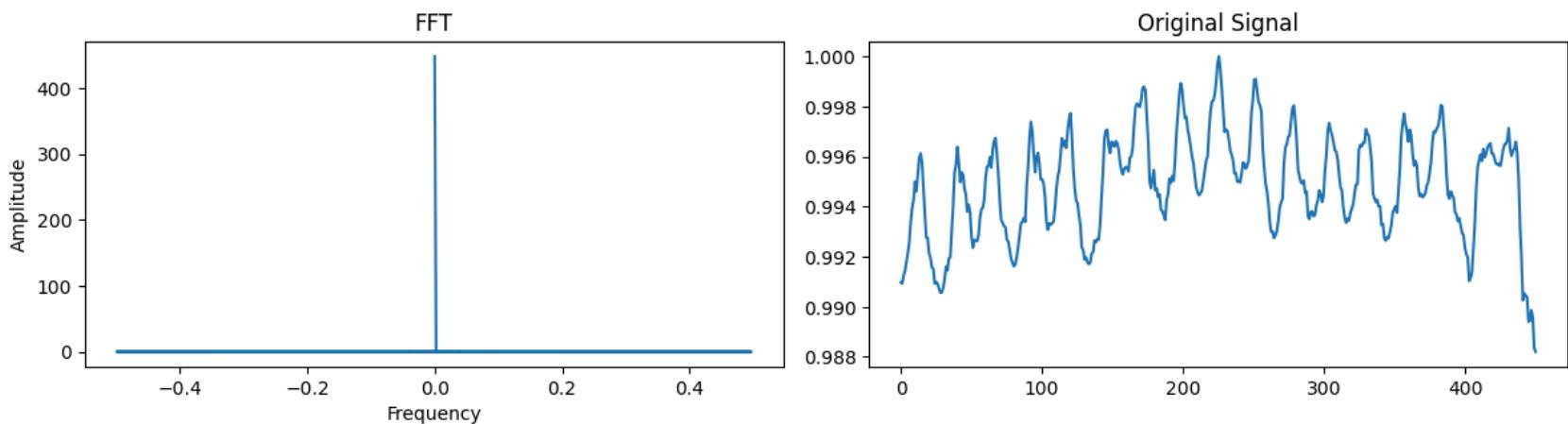
Similarity Signal - Histogram



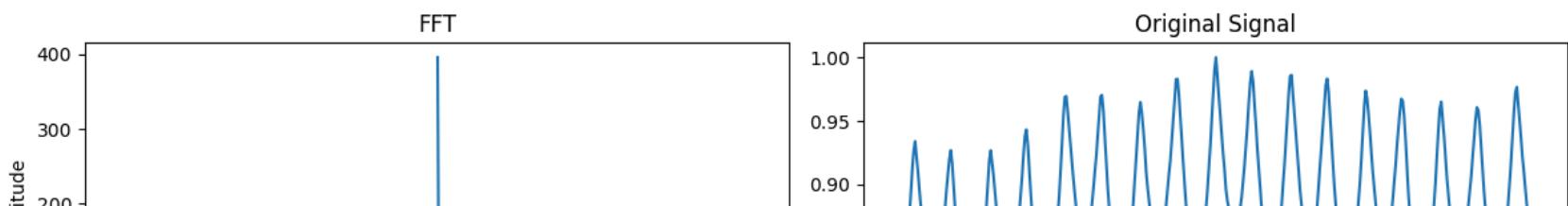
### Similarity Signal - Pearson Correlation

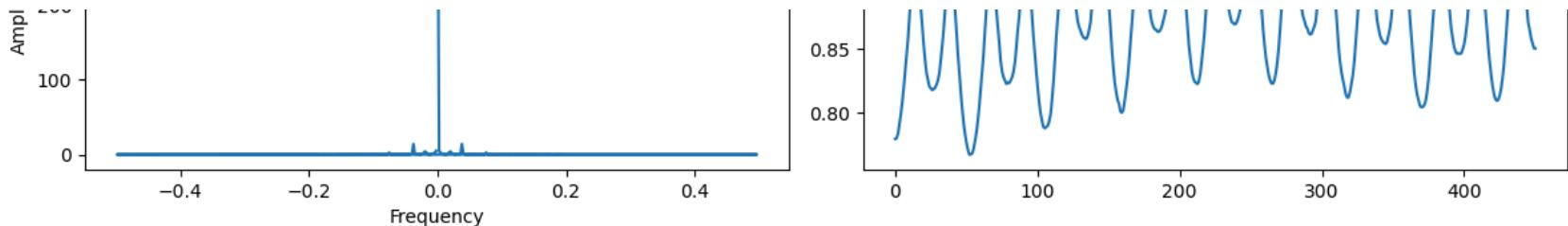


### Histogram - FFT



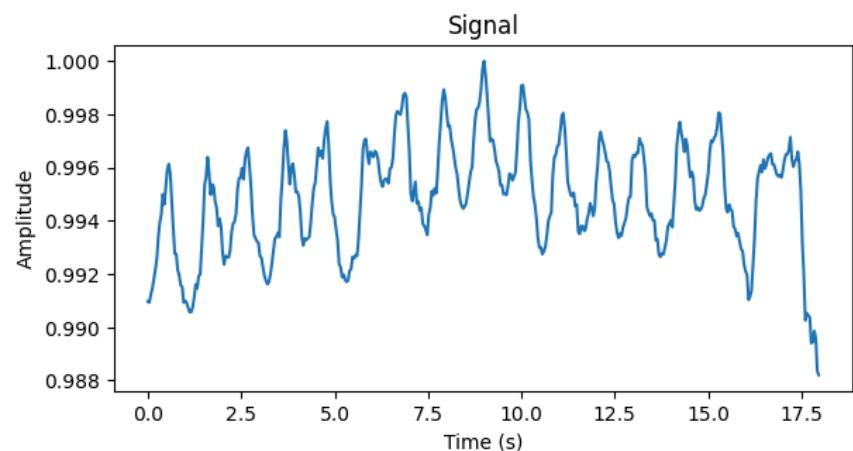
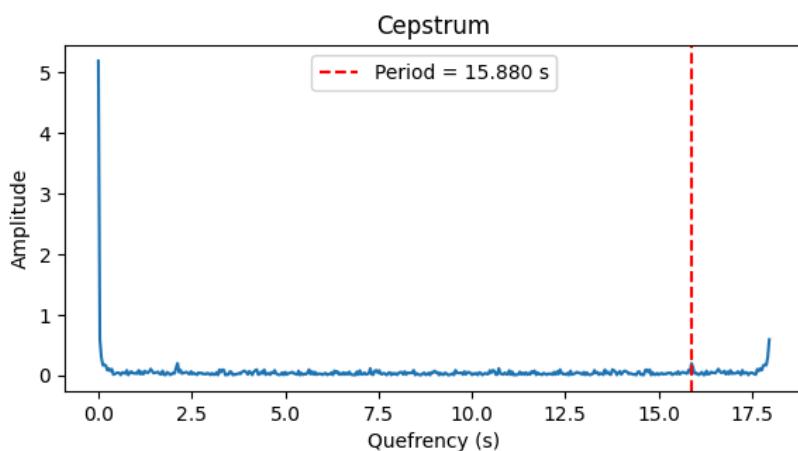
### PCC - FFT





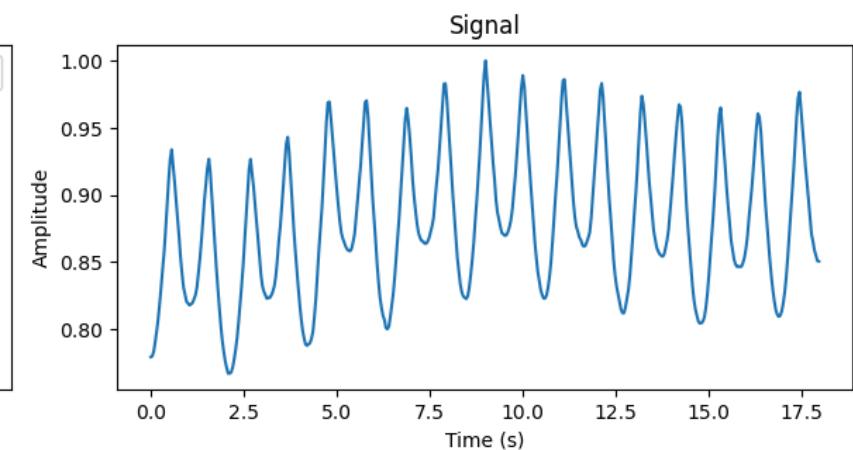
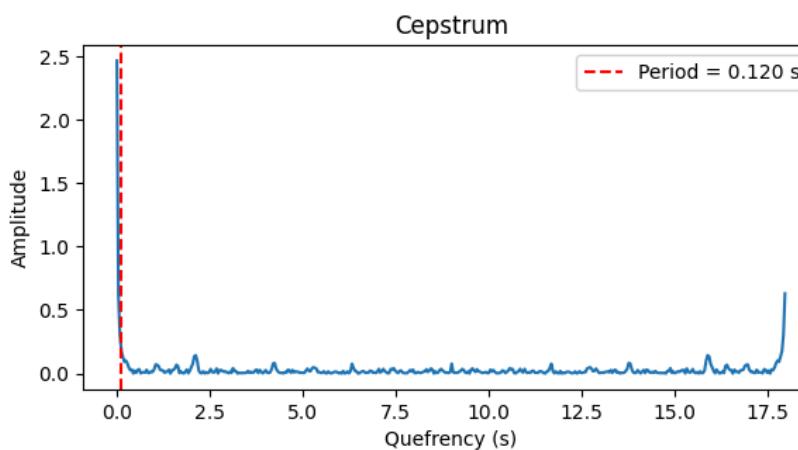
Dominant Frequency: 0.038 , Period: 26.530

#### Histogram - Cepstrum



Period: 15.880 seconds Period: 397.000 frames

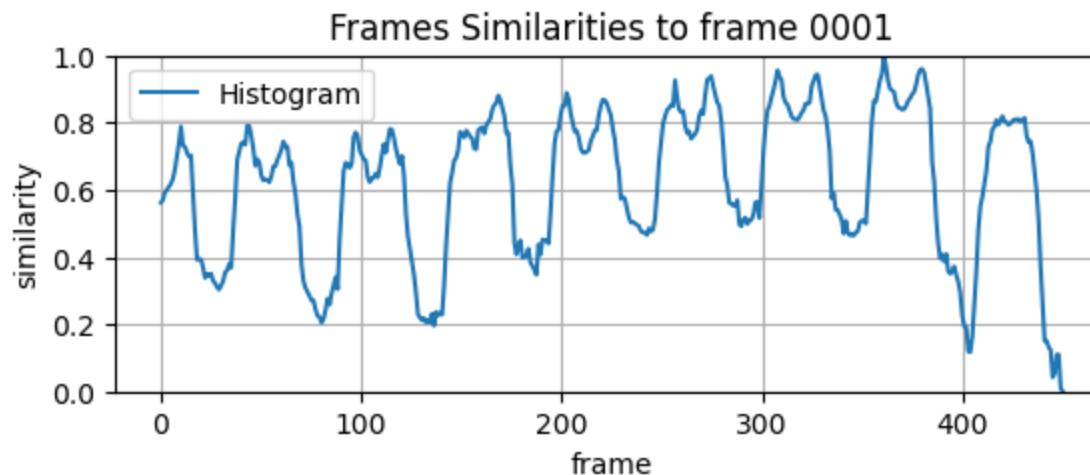
#### PCC - Cepstrum



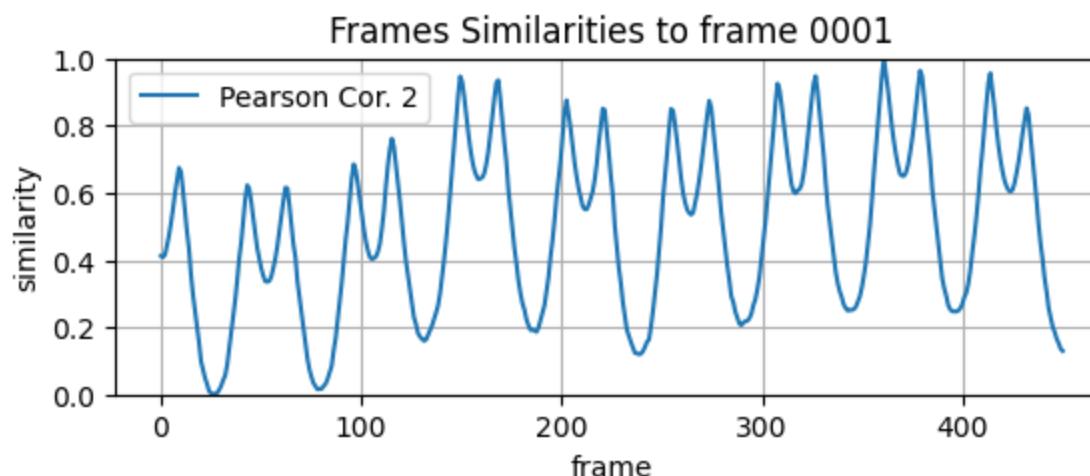
Period: 0.120 seconds Period: 3.000 frames

\* \* \* \* \* Video: 11 Reference frame at: (80%) 360 \* \* \* \* \*

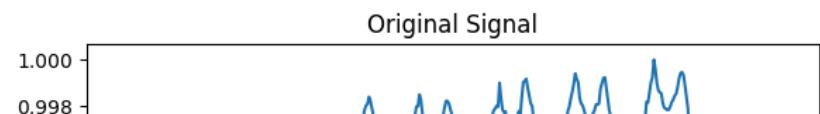
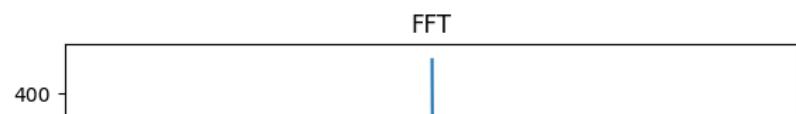
Similarity Signal - Histogram

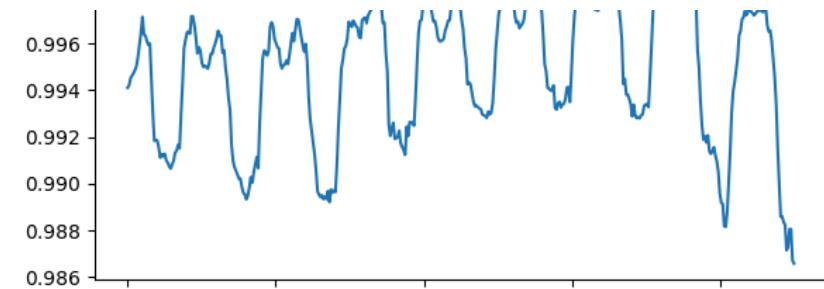
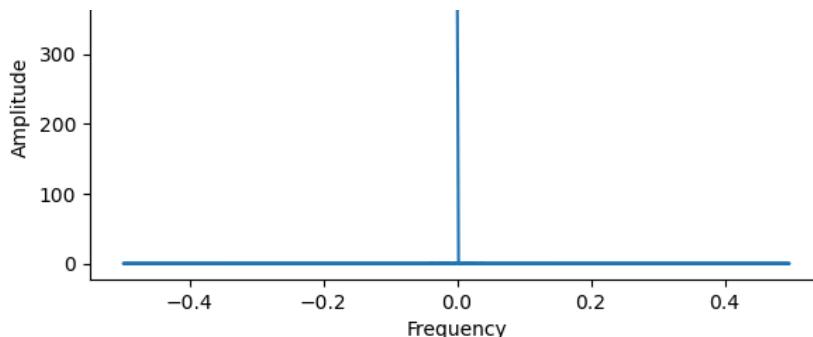


Similarity Signal - Pearson Correlation



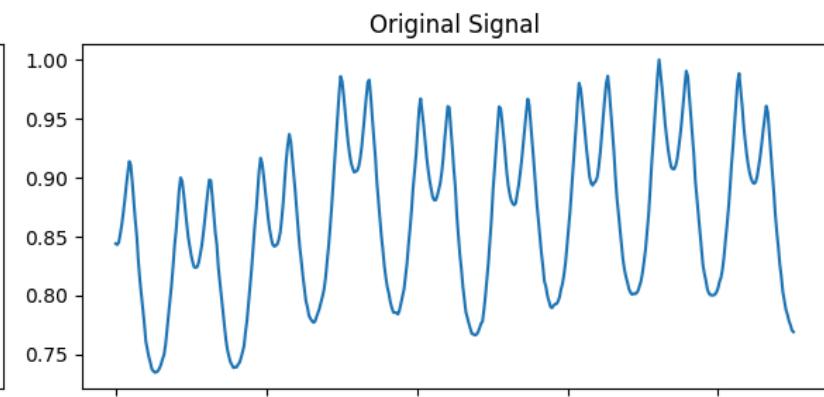
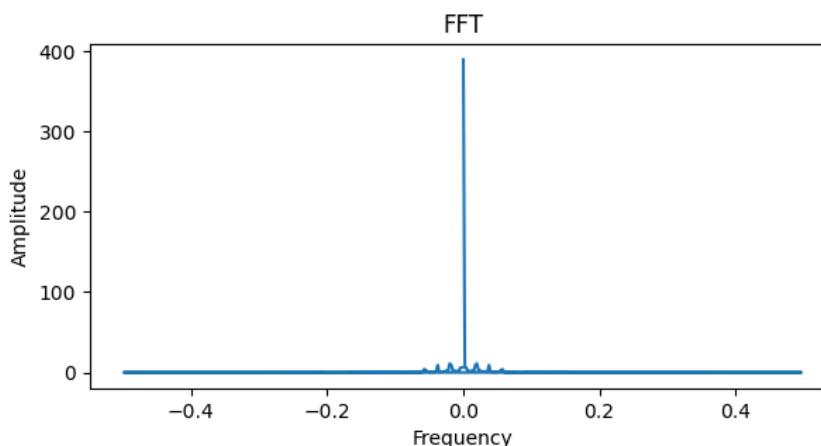
Histogram - FFT





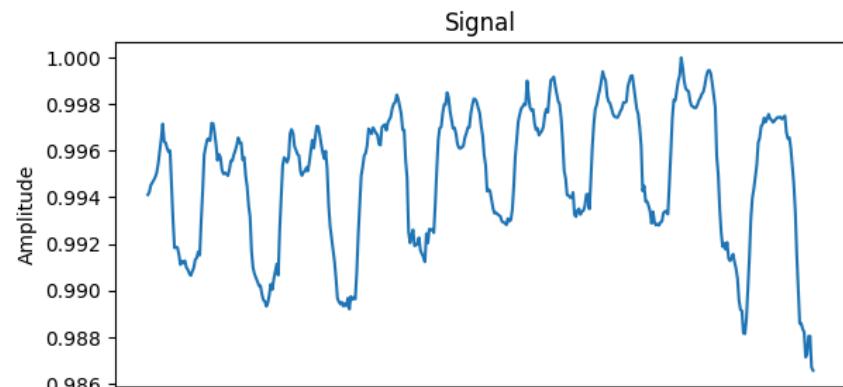
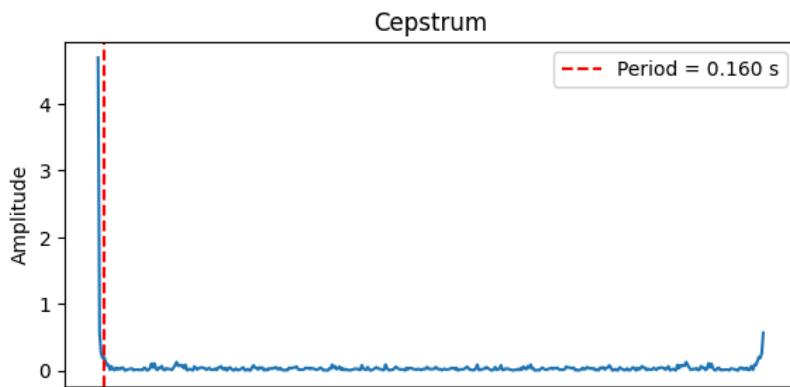
Dominant Frequency: 0.020 , Period: 50.111

PCC - FFT



Dominant Frequency: 0.020 , Period: 50.111

Histogram - Cepstrum

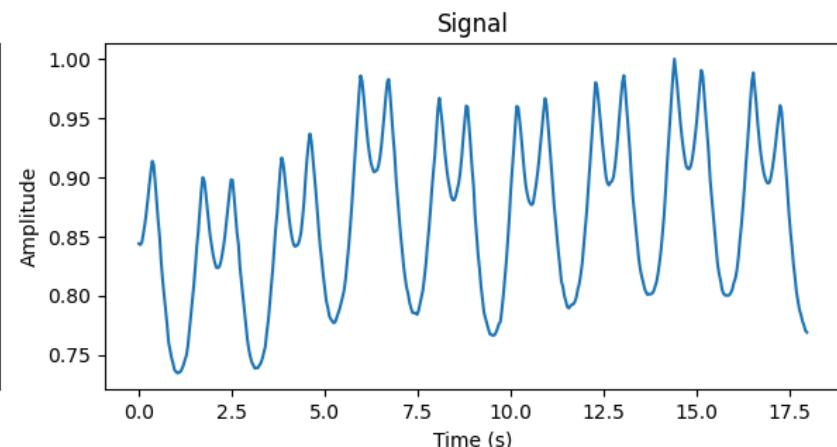
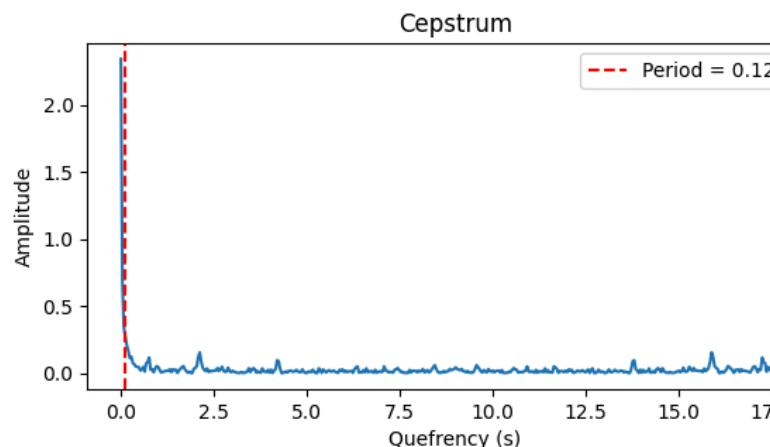


0.0    2.5    5.0    7.5    10.0    12.5    15.0    17.5  
Quefrency (s)

0.0    2.5    5.0    7.5    10.0    12.5    15.0    17.5  
Time (s)

Period: 0.160 seconds    Period: 4.000 frames

PCC - Cepstrum

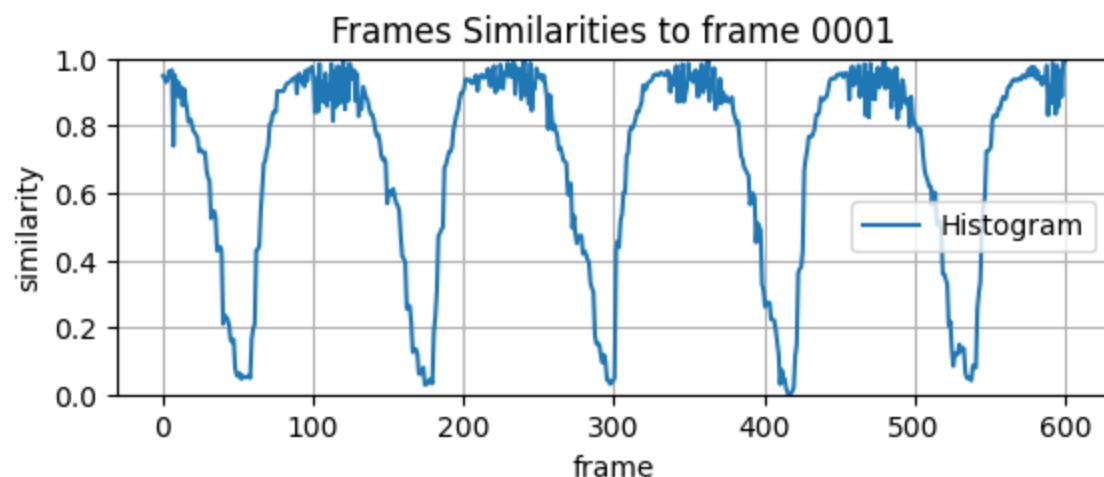


Period: 0.120 seconds    Period: 3.000 frames

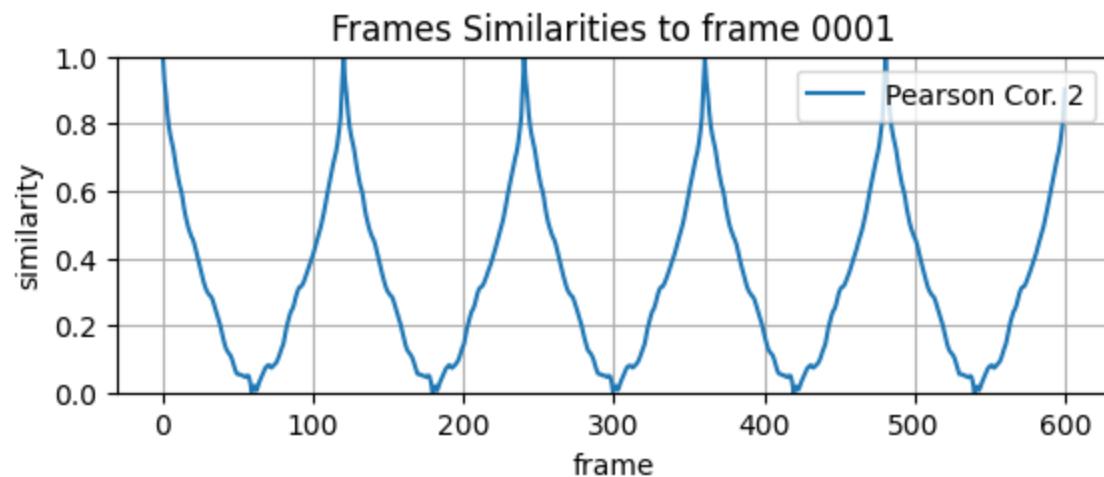
\* \* \* \* \* 12.webm    Frames:600 FPS:25.0 \* \* \* \* \*

\* \* \* \* \* Video: 12 Reference frame at: (20%) 120 \* \* \* \* \*

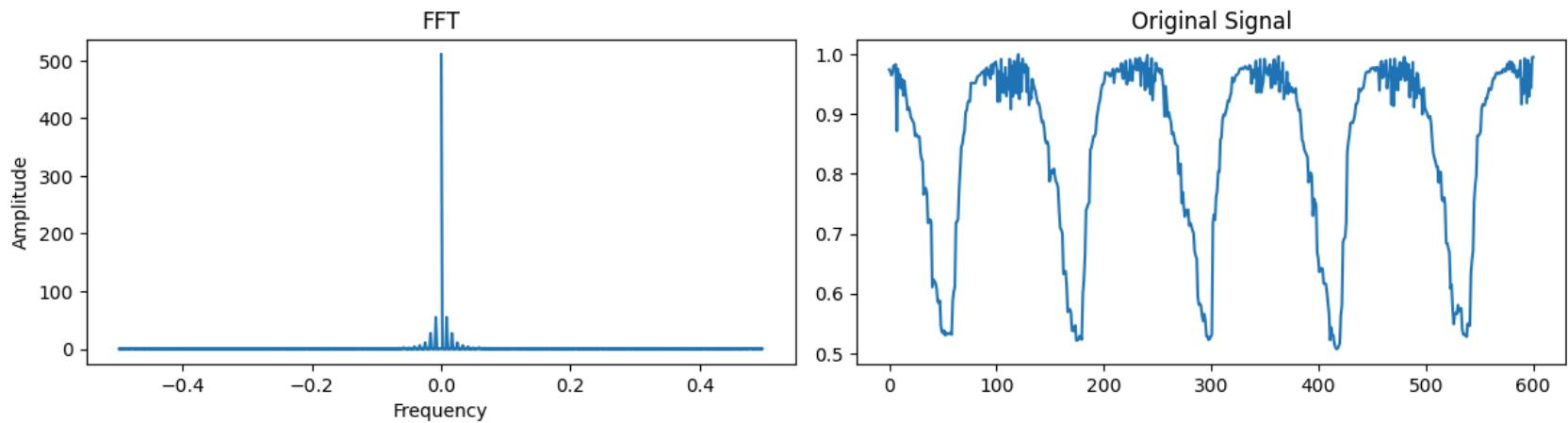
Similarity Signal - Histogram



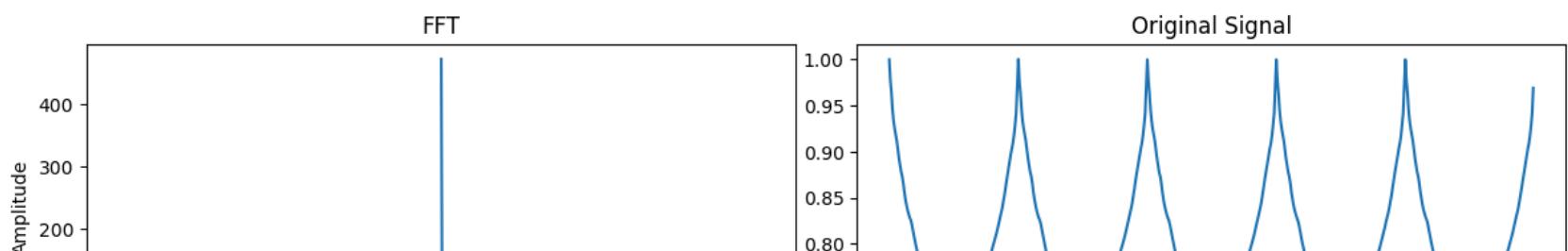
Similarity Signal - Pearson Correlation

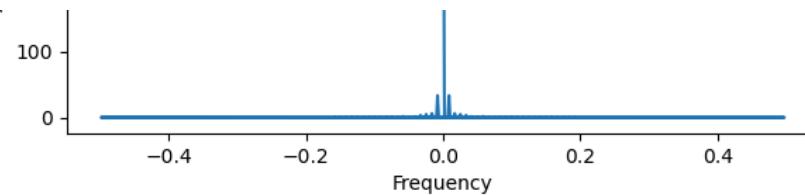


Histogram - FFT



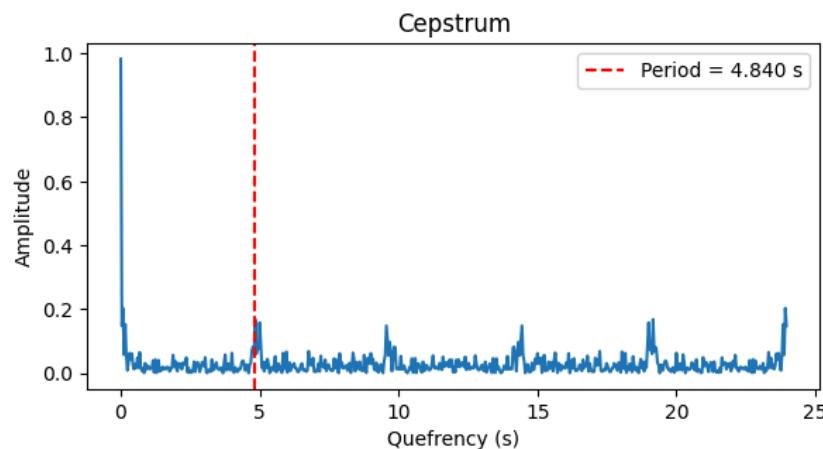
PCC - FFT



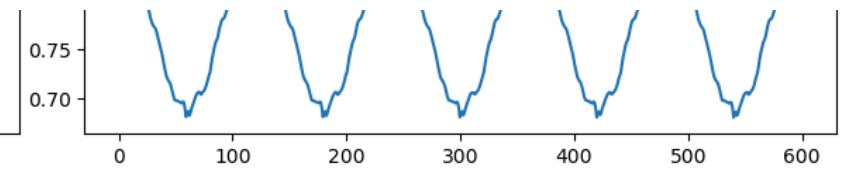


Dominant Frequency: 0.008 , Period: 120.200

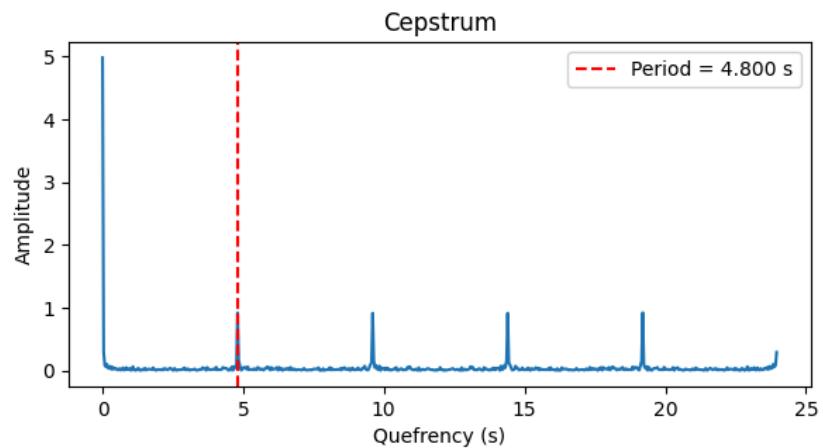
Histogram - Cepstrum



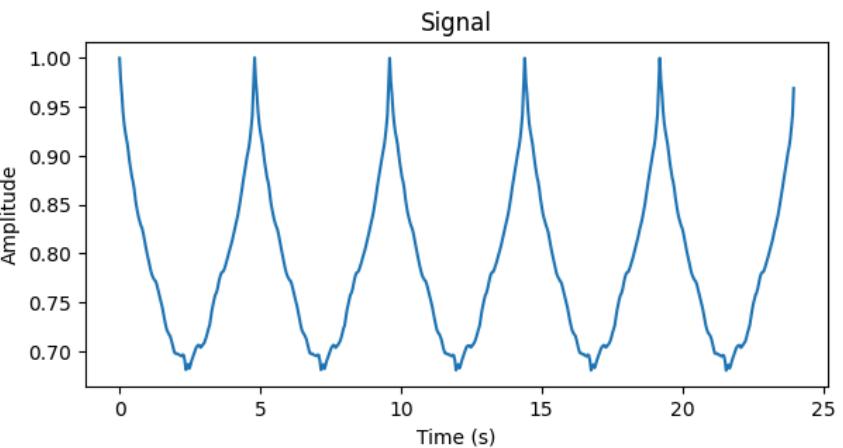
Period: 4.840 seconds      Period: 121.000 frames



PCC - Cepstrum

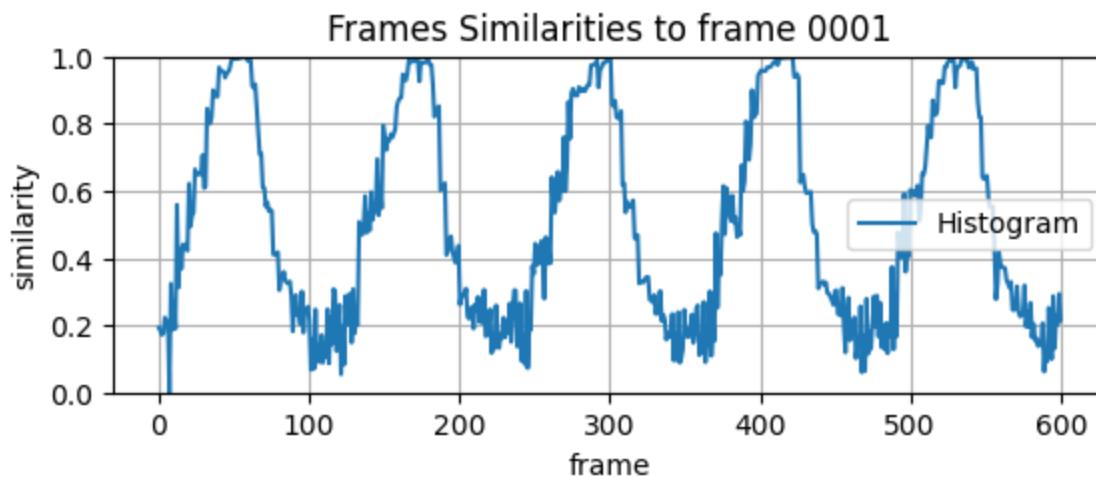


Period: 4.800 seconds      Period: 120.000 frames

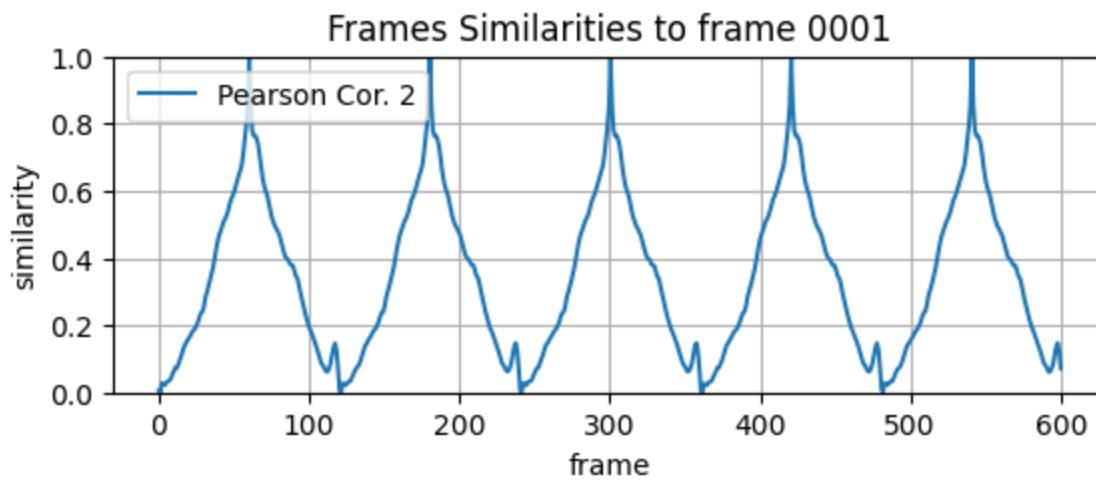


\* \* \* \* \* Video: 12 Reference frame at: (50%) 300 \* \* \* \* \*

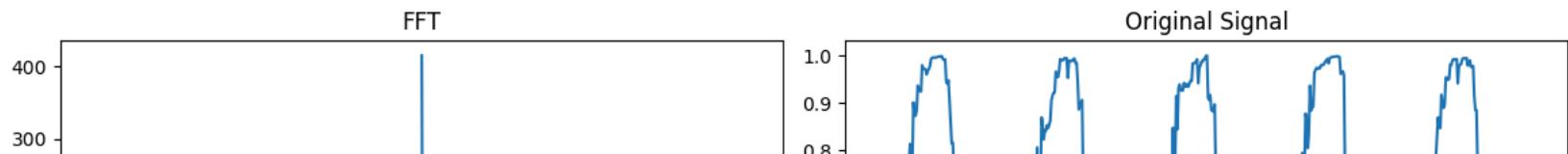
Similarity Signal - Histogram

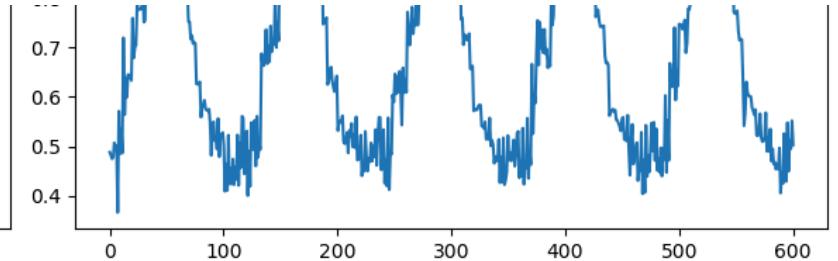
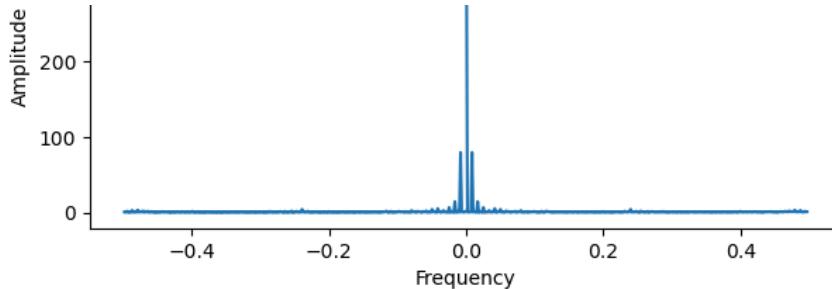


Similarity Signal - Pearson Correlation



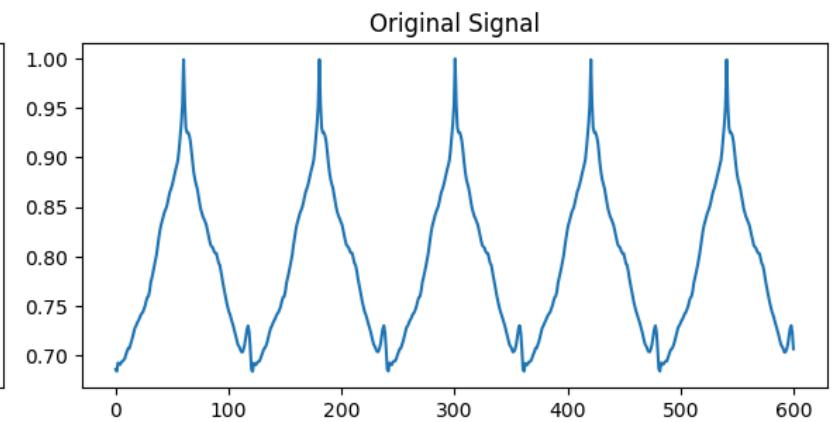
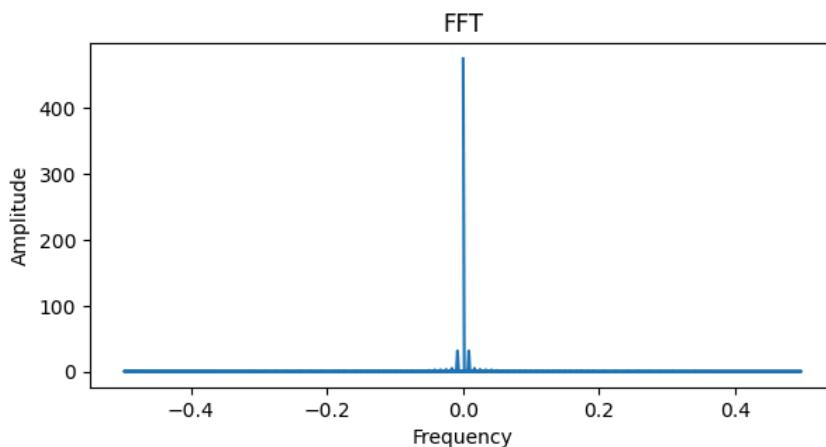
Histogram - FFT





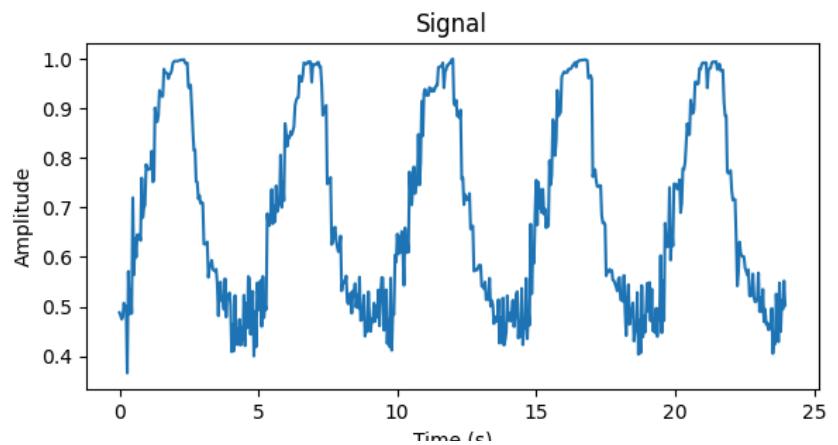
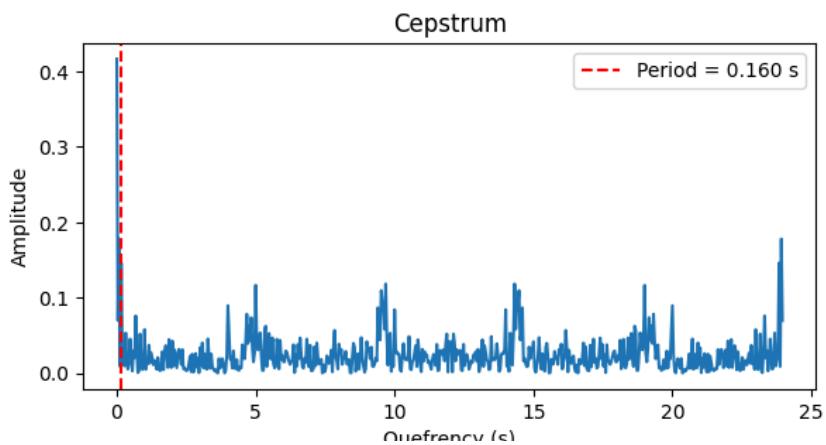
Dominant Frequency: 0.008 , Period: 120.200

PCC - FFT



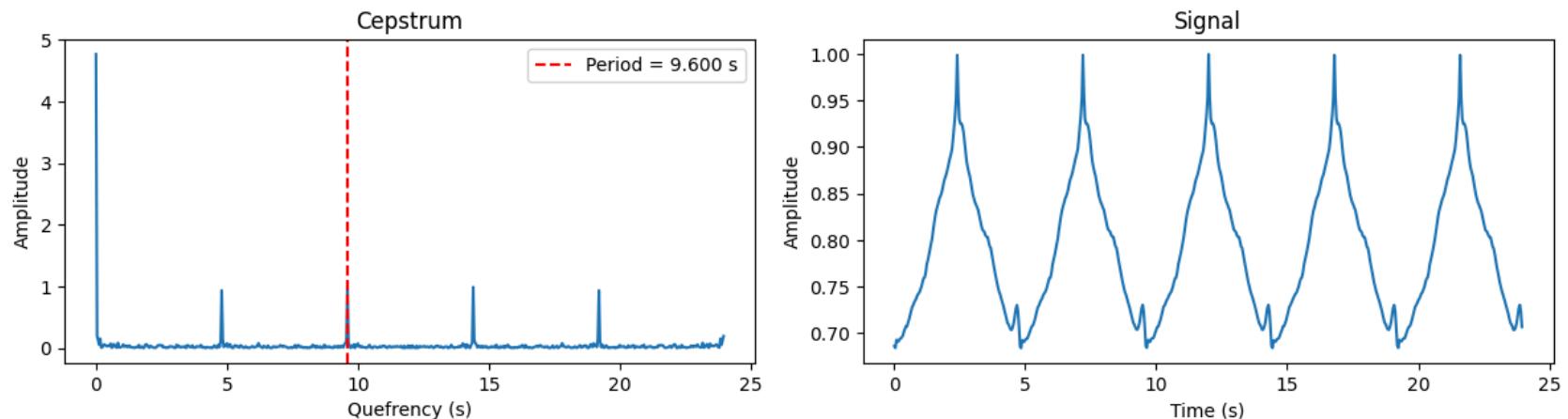
Dominant Frequency: 0.008 , Period: 120.200

Histogram - Cepstrum



Period: 0.160 seconds      Period: 4.000 frames

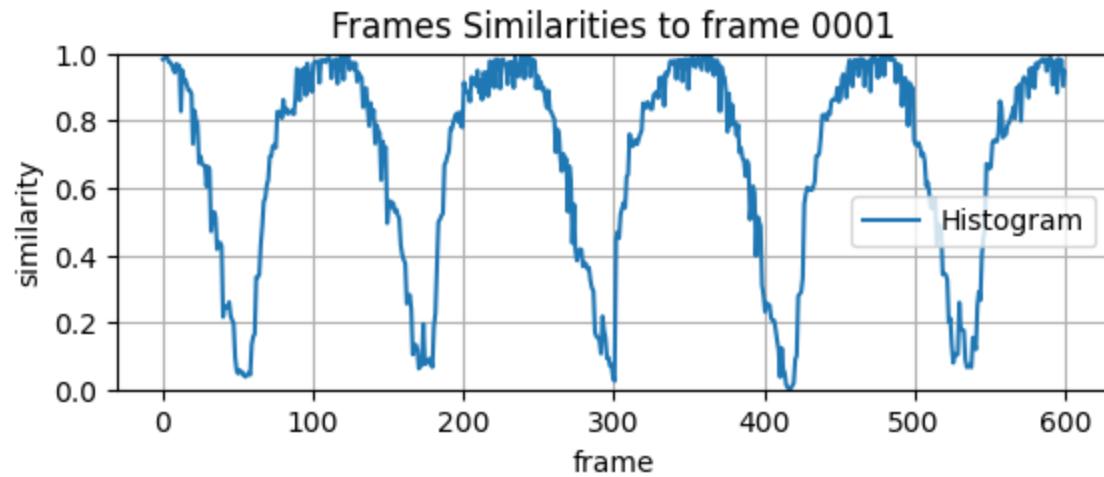
PCC - Cepstrum



Period: 9.600 seconds      Period: 240.000 frames

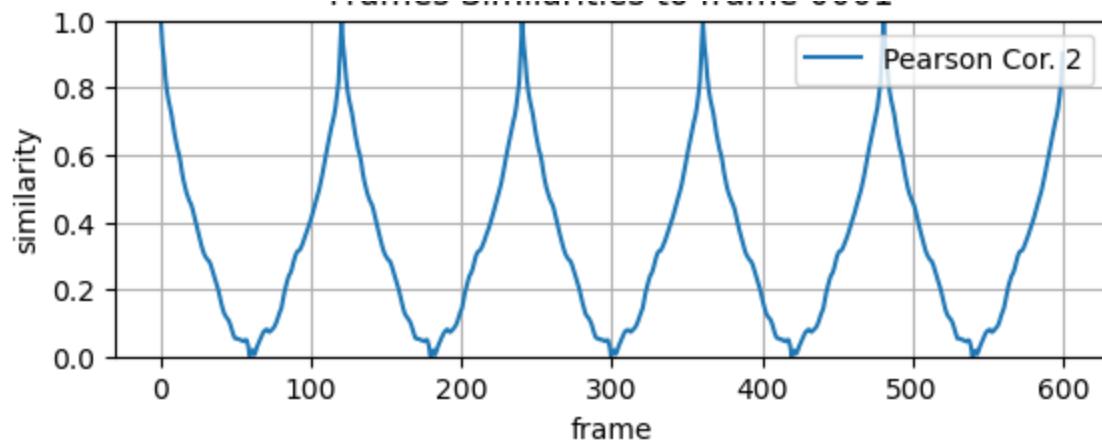
\* \* \* \* \* Video: 12 Reference frame at: (80%) 480 \* \* \* \* \*

Similarity Signal - Histogram

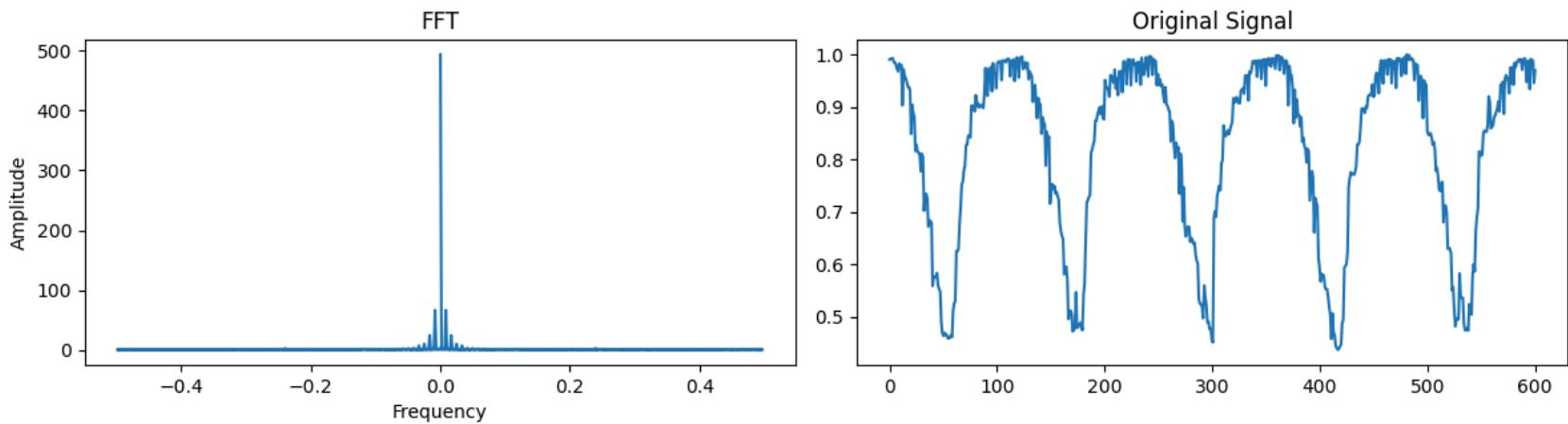


Similarity Signal - Pearson Correlation

Frames Similarities to frame 0001

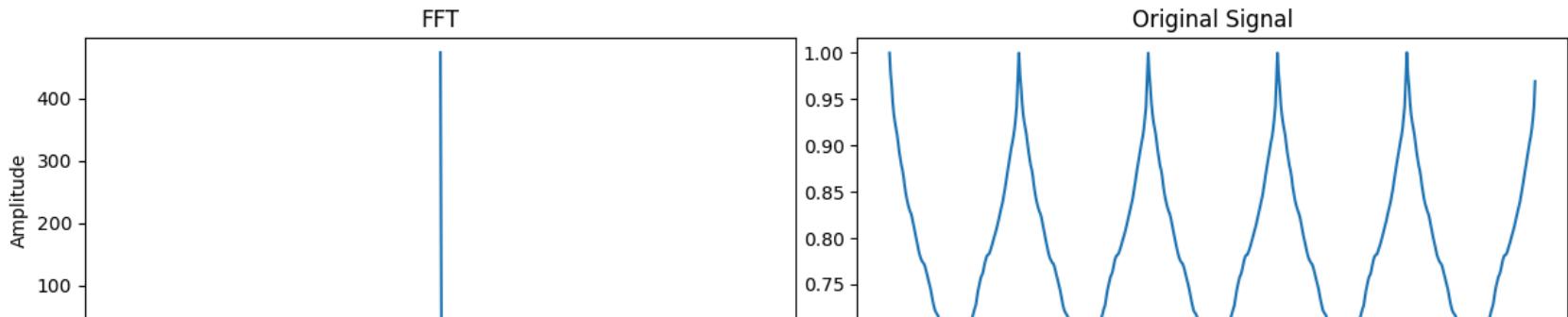


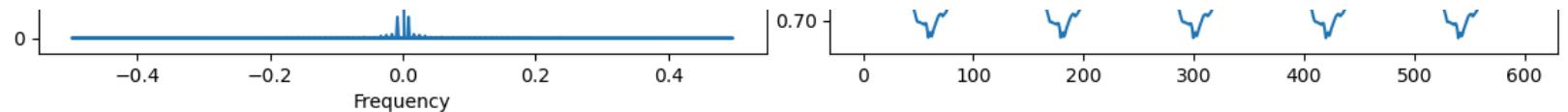
Histogram - FFT



Dominant Frequency: 0.008 , Period: 120.200

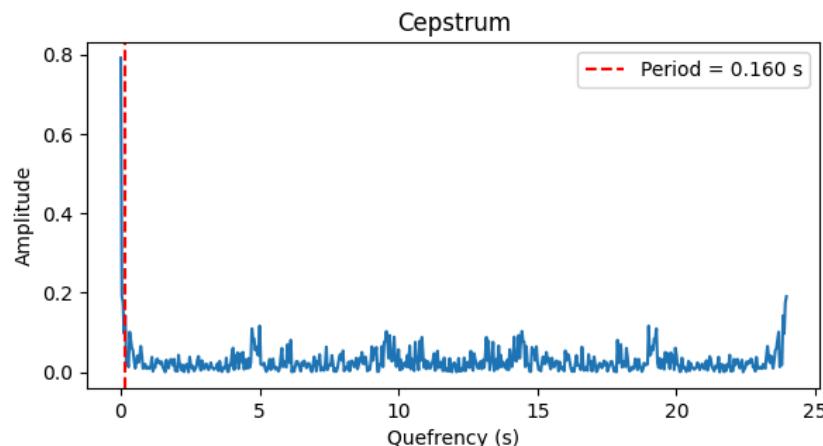
PCC - FFT



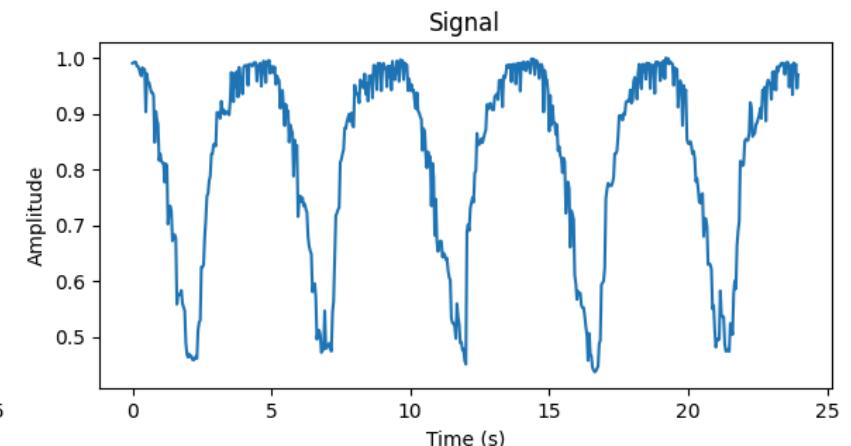


Dominant Frequency: 0.008 , Period: 120.200

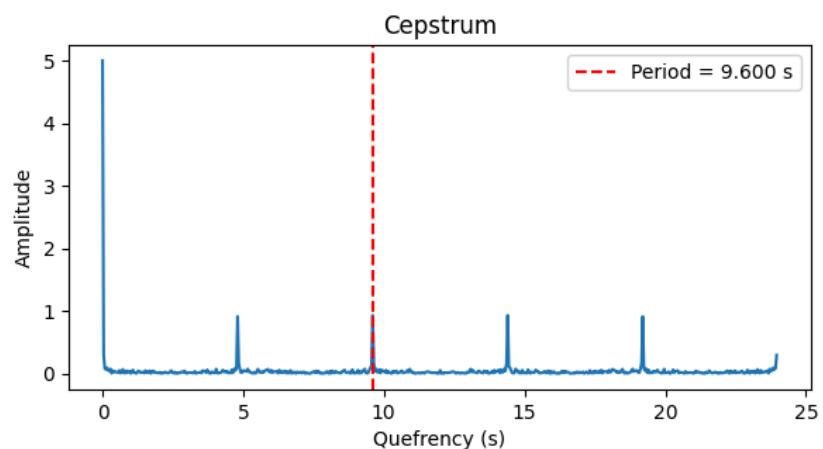
#### Histogram - Cepstrum



Period: 0.160 seconds      Period: 4.000 frames

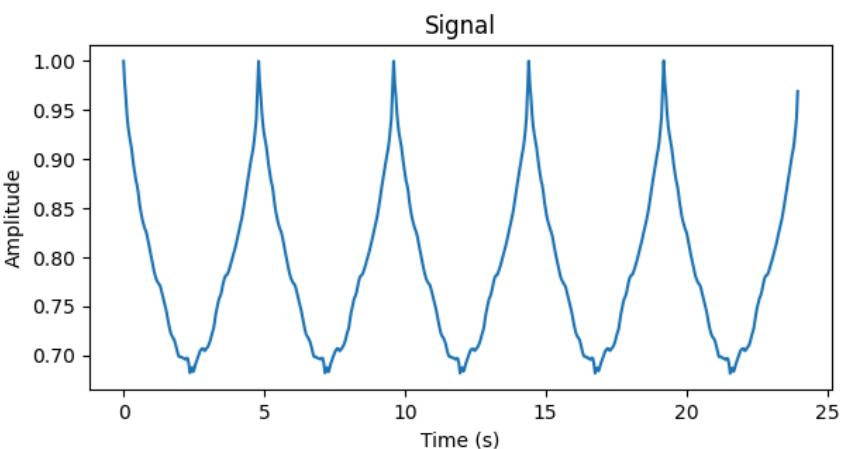


#### PCC - Cepstrum



Period: 9.600 seconds      Period: 240.000 frames

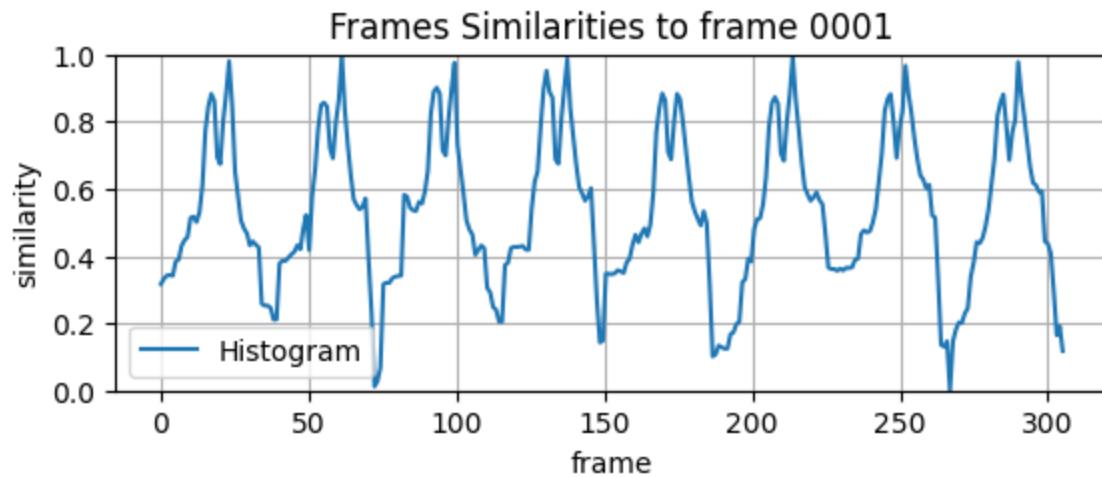
\* \* \* \* \* 13.mp4   Frames:305 FPS:25.0 \* \* \* \* \*



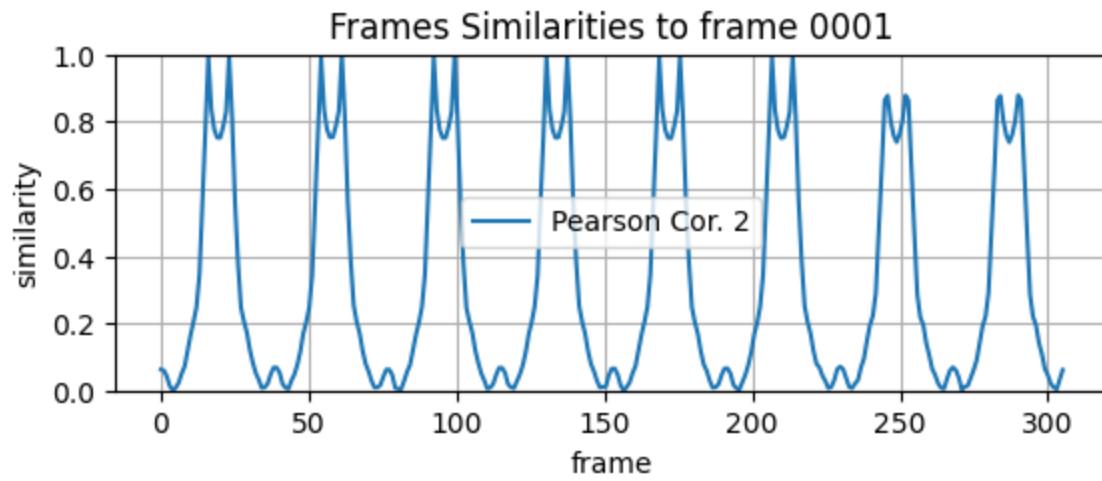
\* \* \* \* \* Video: 13 Reference frame at: (20%) 61 \* \* \* \* \*

VIDEO: 15 REFERENCE FRAME AT. (20%) 01

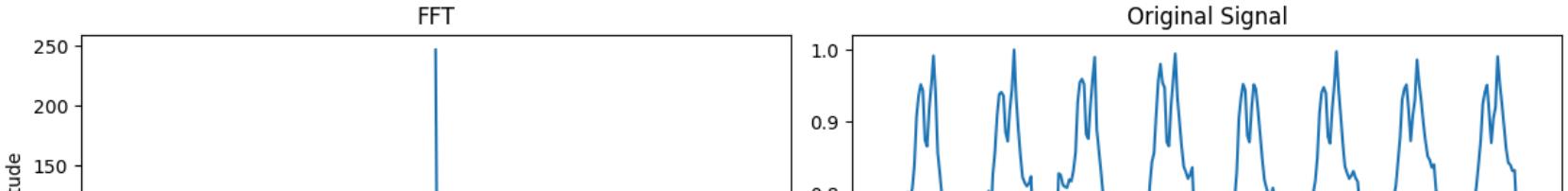
Similarity Signal - Histogram

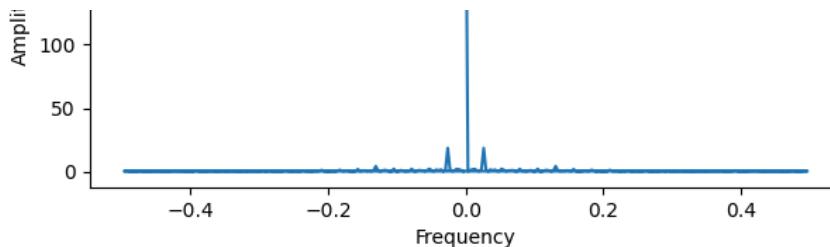


Similarity Signal - Pearson Correlation



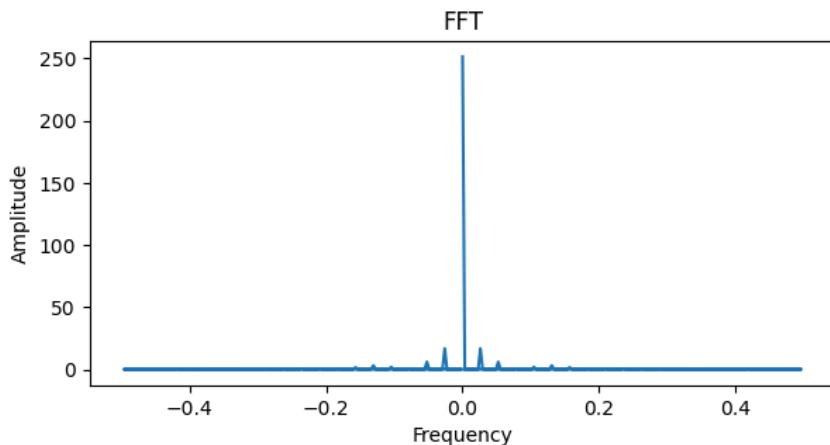
Histogram - FFT



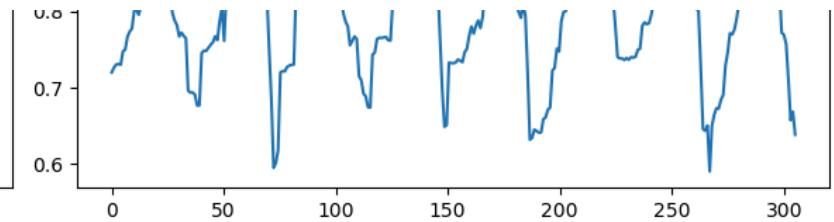


Dominant Frequency: 0.026 , Period: 38.250

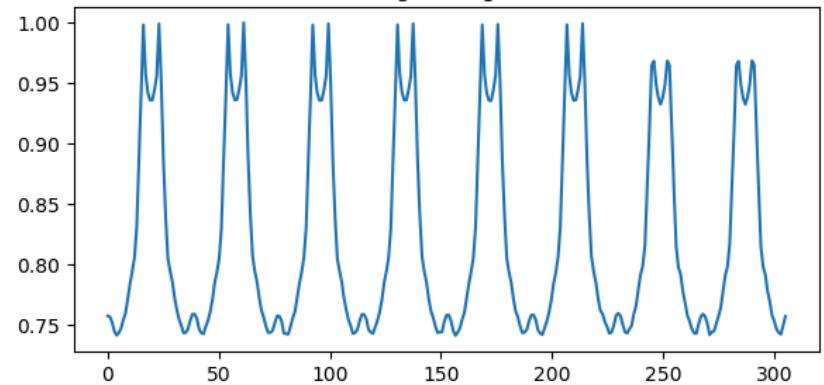
PCC - FFT



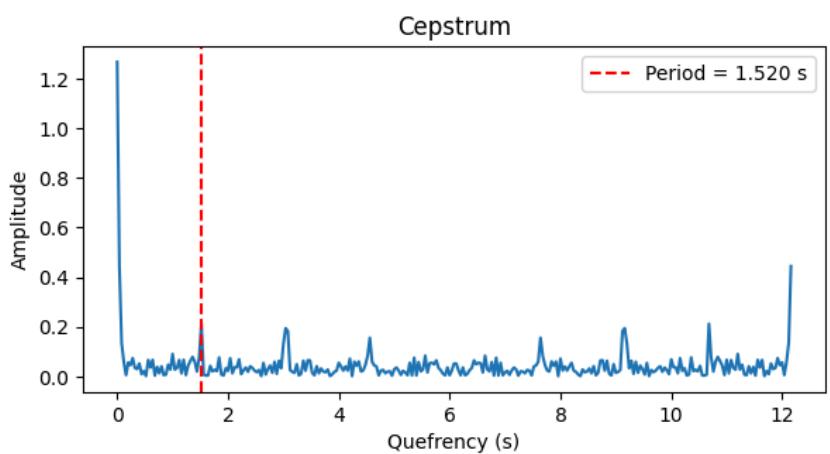
Dominant Frequency: 0.026 , Period: 38.250



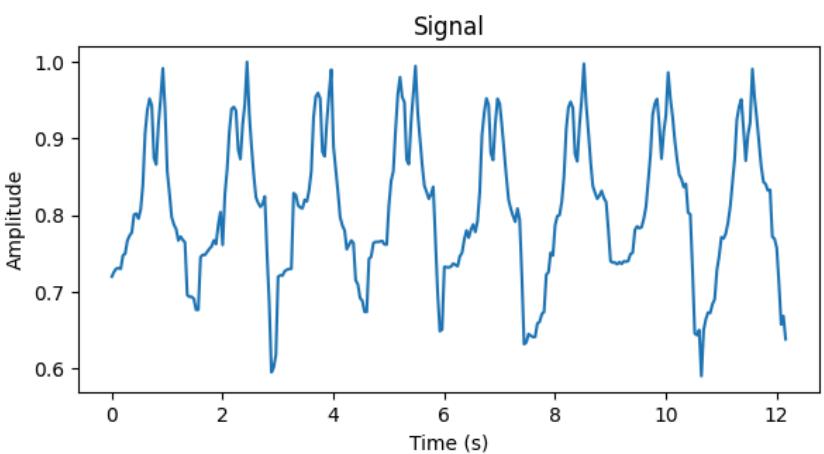
Original Signal



Histogram - Cepstrum



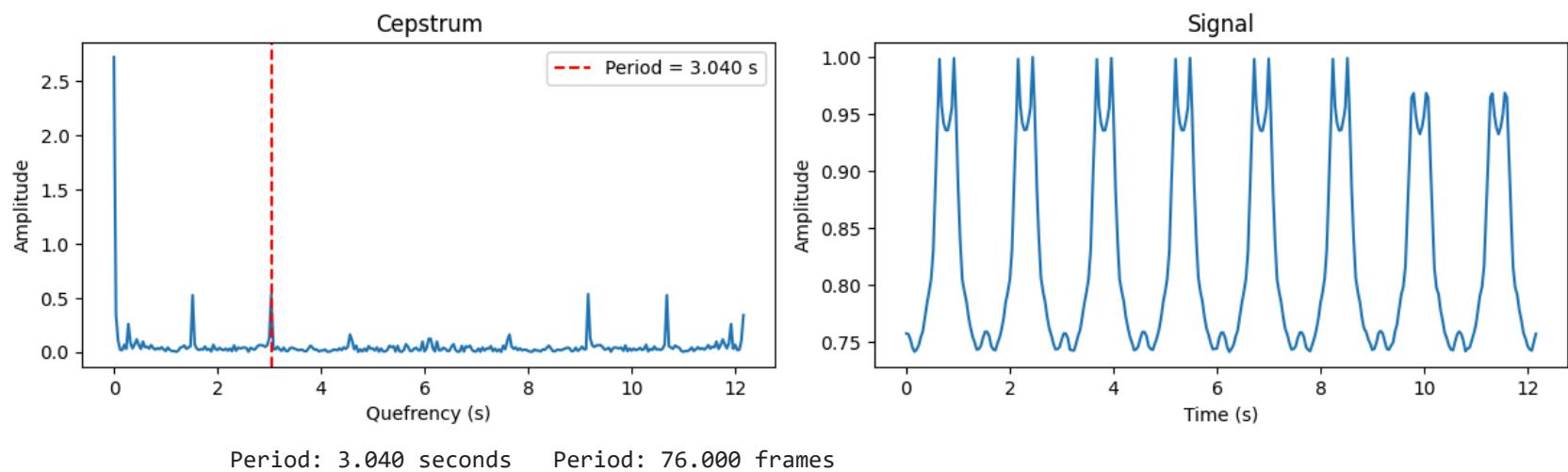
Period: 1.520 seconds



Period: 38.250 frames

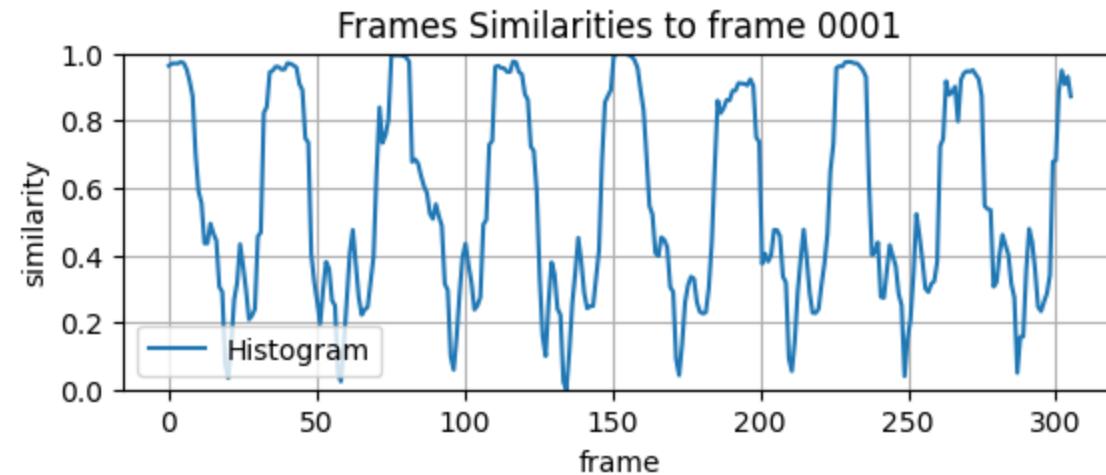
PERIOD: 1.920 SECONDS PERIOD: 50.000 FRAMES

### PCC - Cepstrum



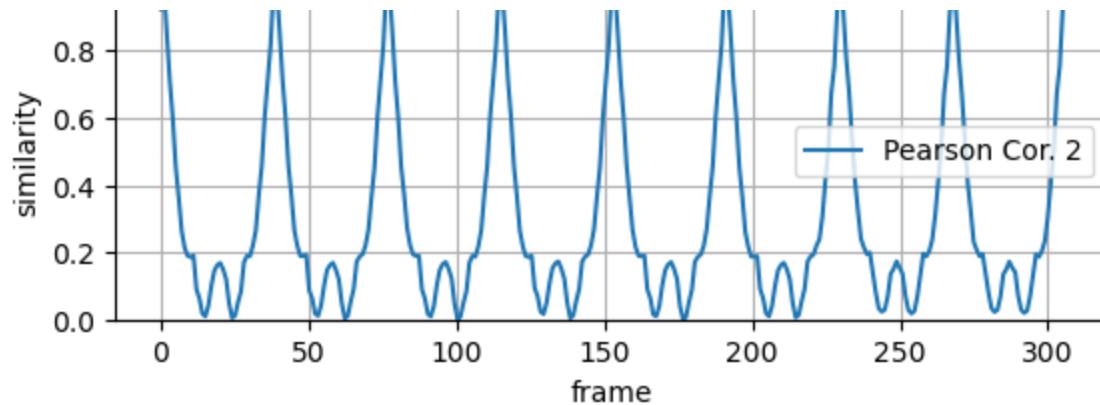
\* \* \* \* \* Video: 13 Reference frame at: (50%) 152 \* \* \* \* \*

### Similarity Signal - Histogram

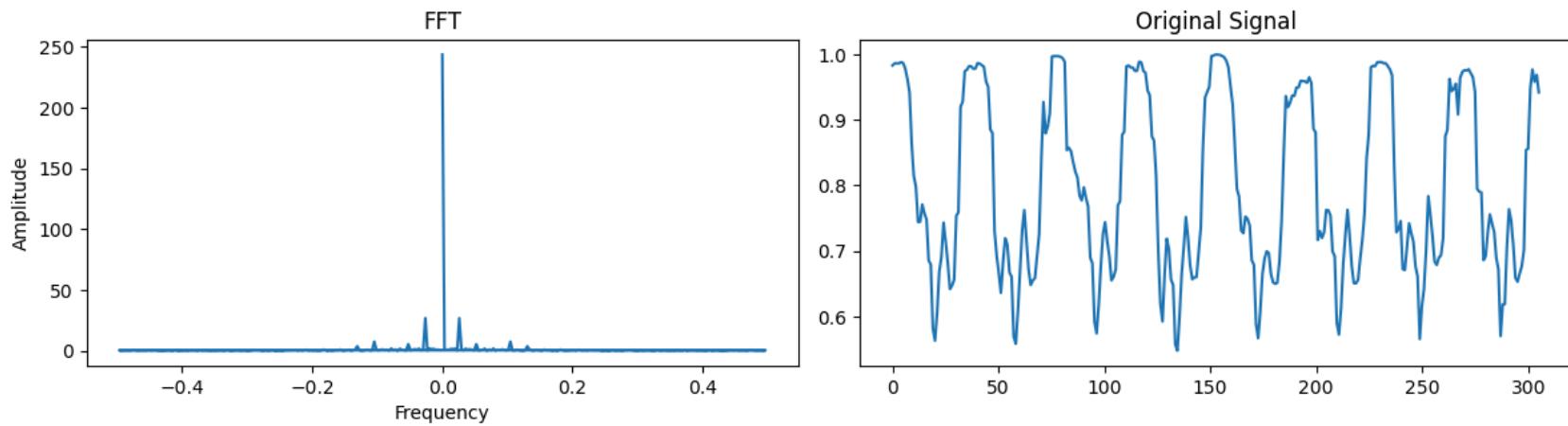


### Similarity Signal - Pearson Correlation

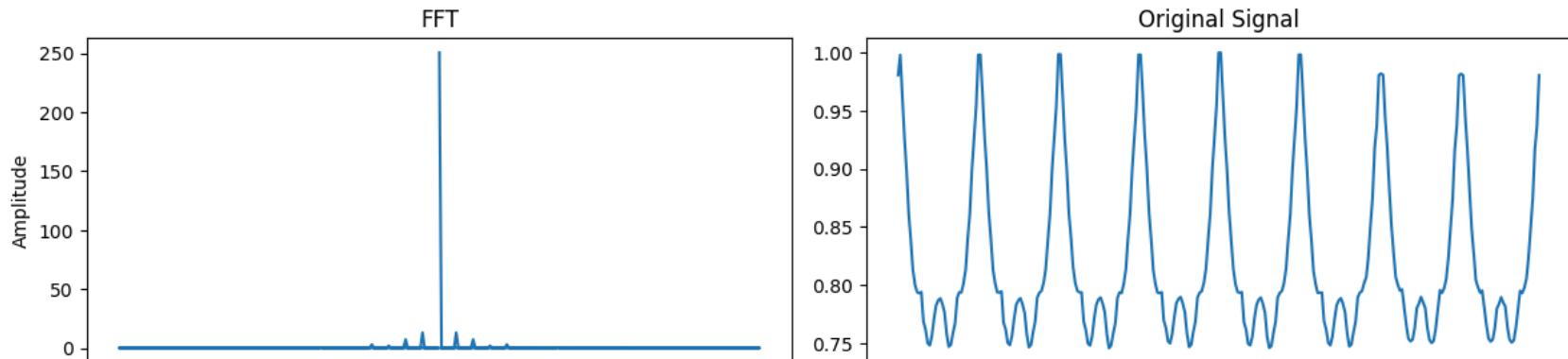


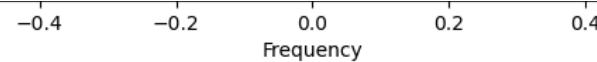


Histogram - FFT



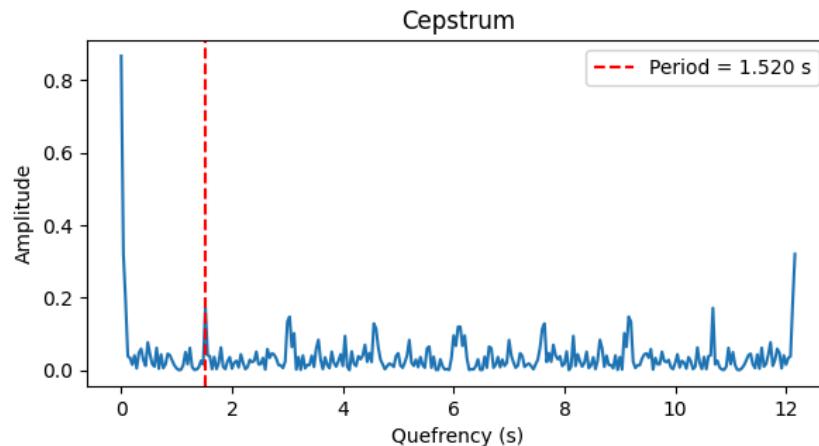
PCC - FFT



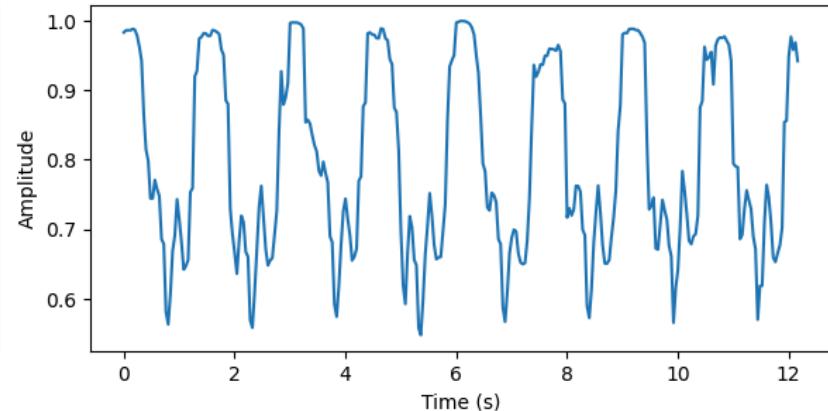


Dominant Frequency: 0.026 , Period: 38.250

#### Histogram - Cepstrum

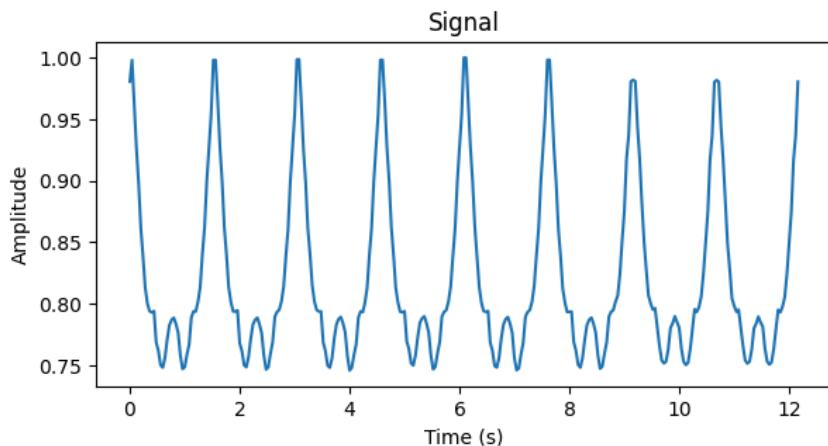
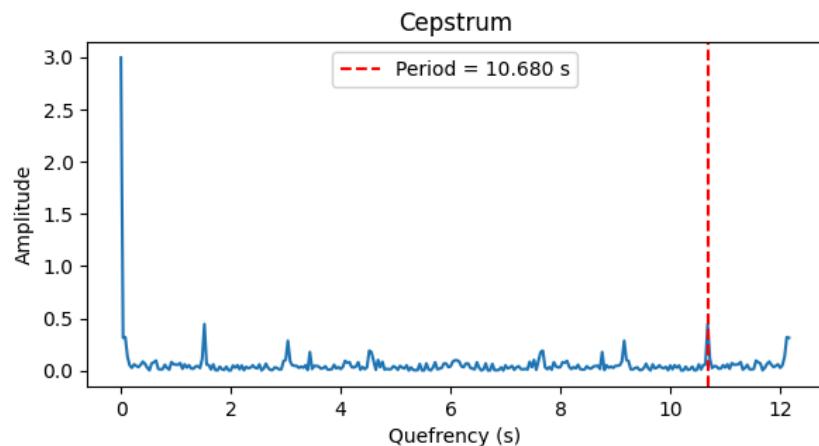


#### Signal



Period: 1.520 seconds      Period: 38.000 frames

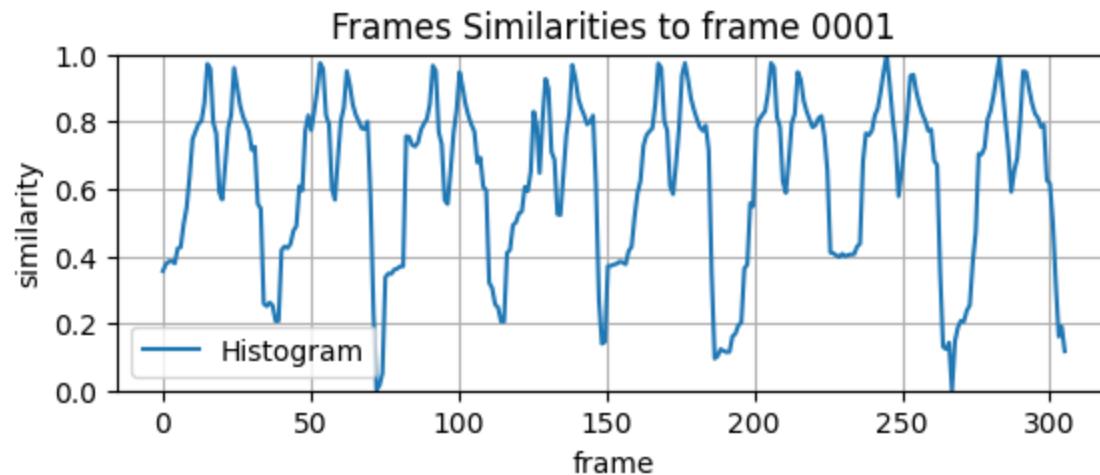
#### PCC - Cepstrum



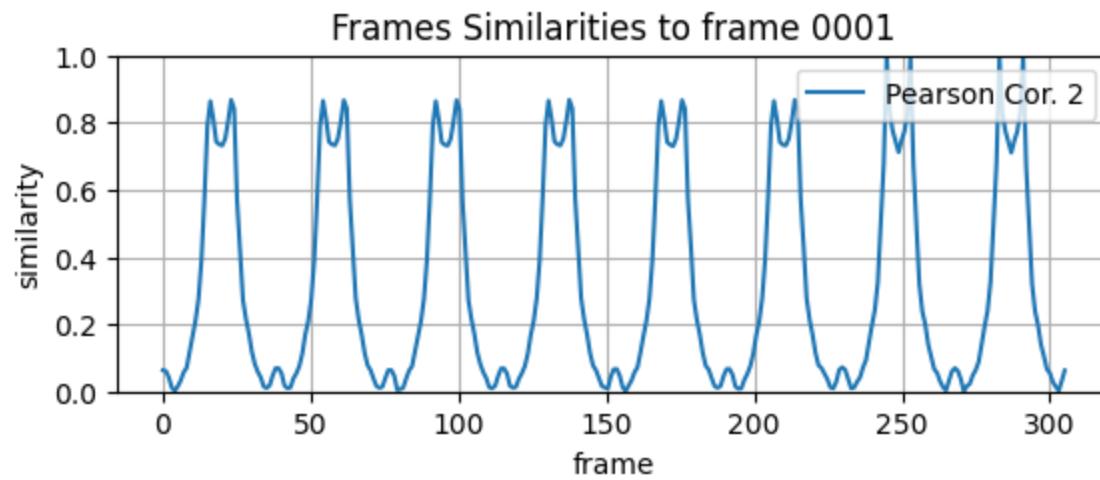
Period: 10.680 seconds      Period: 267.000 frames

\* \* \* \* \* Video: 13 Reference frame at: (80%) 244 \* \* \* \* \*

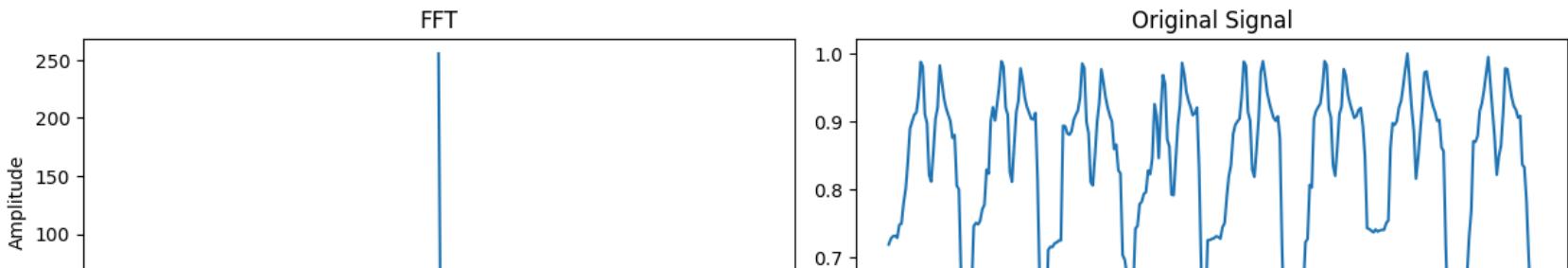
#### Similarity Signal - Histogram

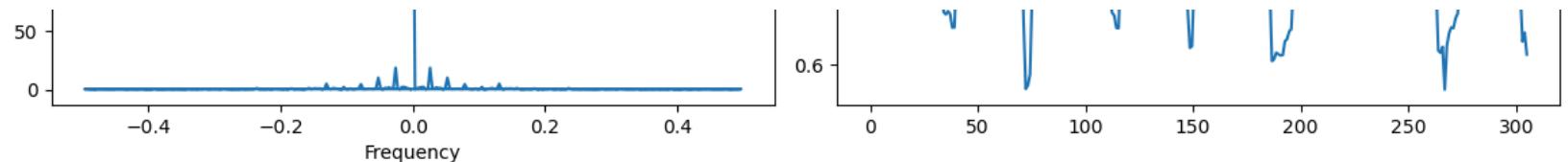


Similarity Signal - Pearson Correlation

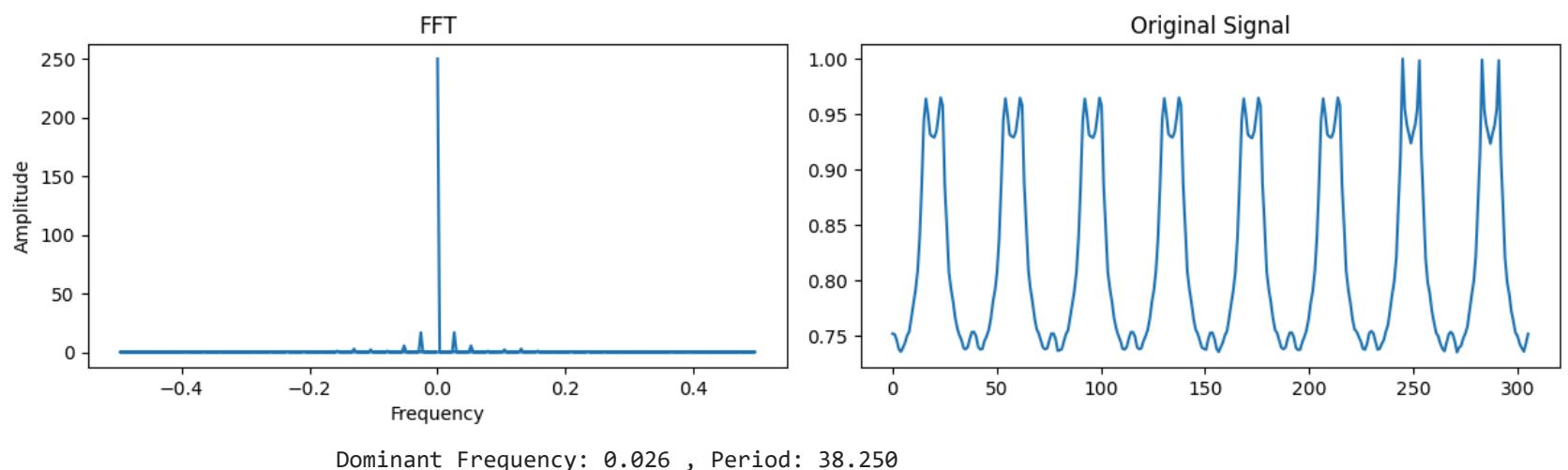


Histogram - FFT

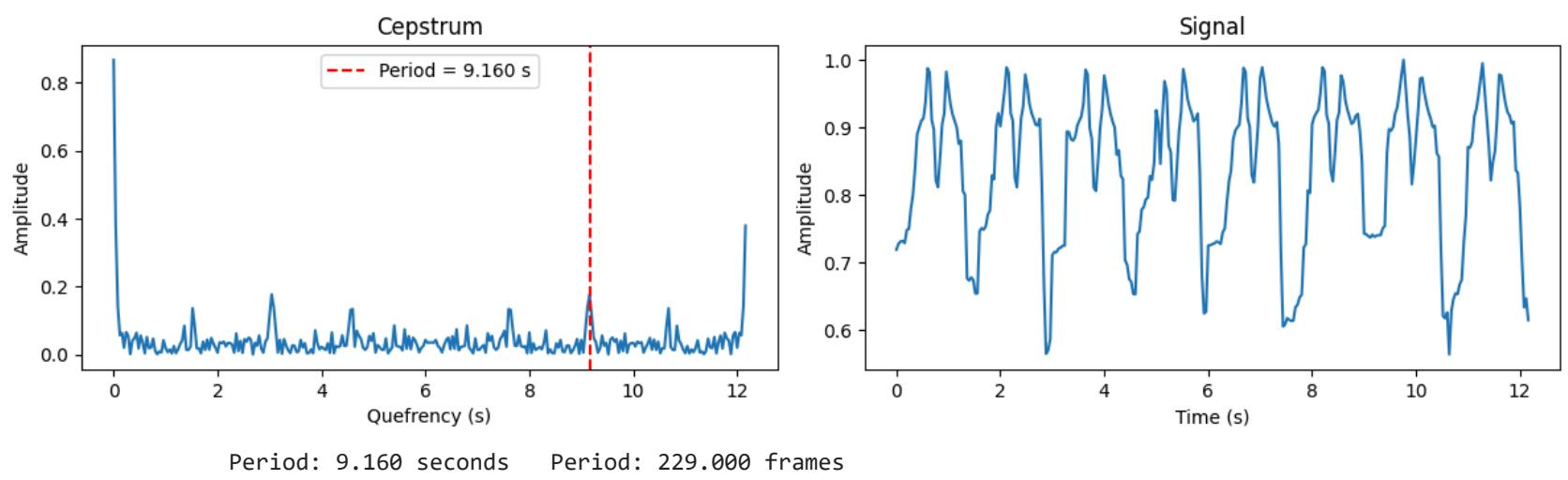




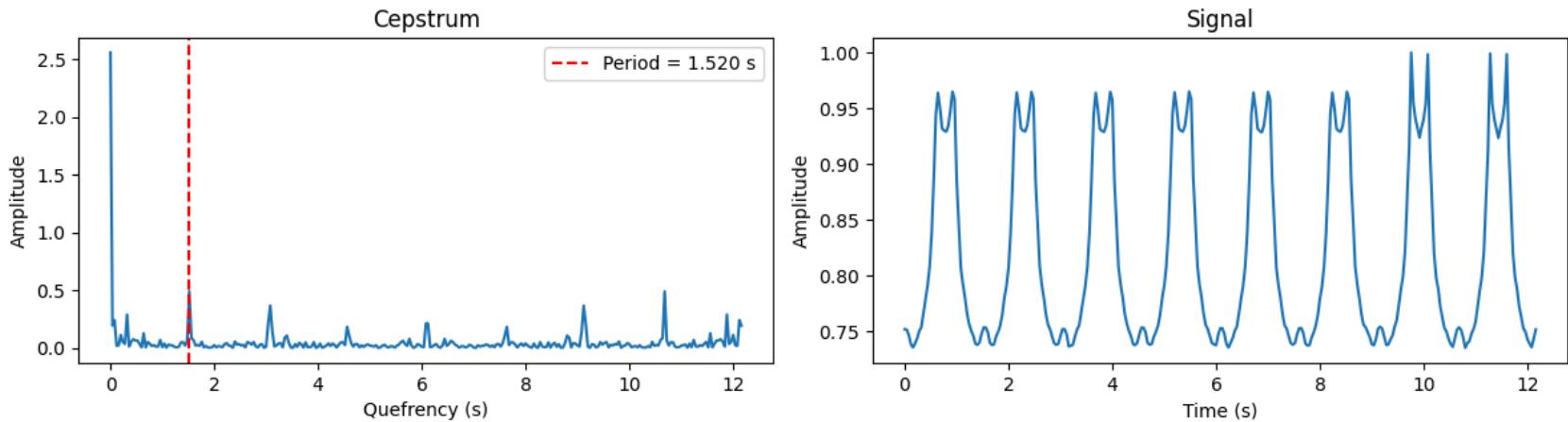
PCC - FFT



Histogram - Cepstrum



PCC - Cepstrum



```
Period: 1.520 seconds    Period: 38.000 frames
* * * * * 14.webm  Frames:393 FPS:24.0 * * * * *
```

```
* * * * * Video: 14 Reference frame at: (20%) 78 * * * * *
```

---

-----

**ValueError** Traceback (most recent call last)

```
Cell In[26], line 28
  24 totalFrames, frame_rate = video_frames_fps(video_name+video_ext)
  25 print(5*' ' + video_name + video_ext + f'  Frames:{totalFrames} FPS:{frame_rate}' + 5*' ')
--> 28 reference_frame_analysis(video_name)

Cell In[24], line 8, in reference_frame_analysis(video_name)
  5 print('\n')
  6 print(5*' ' + 'Video: ' + video_name + ' ' + 'Reference frame at: (' + str(round(100*ref_frame_num/totalFrames)) + '%' + str(ref_frame_num) + 5*' ')
--> 8 write_signal_file('Signals/Video_' + video_name + '_ref_' + str(ref_frame_num) + '.txt', ref_frame_num)
  9 data_into_list = read_signal_file('Signals/Video_' + video_name + '_ref_' + str(ref_frame_num) + '.txt')
 11 ls_Histogram = ast.literal_eval(data_into_list[0])

Cell In[15], line 4, in write_signal_file(file_name, reference_frame_number)
  1 def write_signal_file(file_name, reference_frame_number):
  2     with open(file_name, 'w') as output:
--> 4         signal = similarity_Signal('histogram', reference_frame_number)
  5         output.write(str(signal))
  7         signal = similarity_Signal('cor3', reference_frame_number)

Cell In[7], line 8, in similarity_Signal(func, reference_frame_number)
  5 for i in range(totalFrames):
  6     image_path = 'Frames/Video ' + video_name + '/frame ' + f'{i:04}' + '.jpg'
```

```
----> 8     simSig.append(compare_images(func,image_path1, image_path2))
  10 return simSig

Cell In[6], line 8, in compare_images(func, image_path1, image_path2)
    6 # Check if images were loaded correctly
    7 if image1 is None or image2 is None:
----> 8     raise ValueError("One or both image paths are invalid or the images cannot be read.")
  10 # Resize images to the same dimensions, if necessary
  11 if image1.shape != image2.shape:
```

ValueError: One or both image paths are invalid or the images cannot be read.

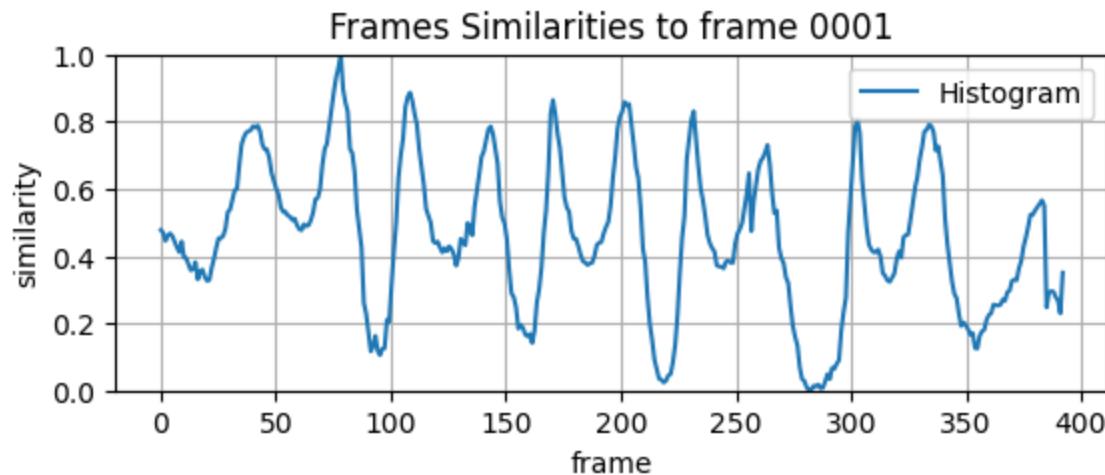
```
In [18]: for pair in [#('1','.mp4'),
                   #('2','.mp4'),
                   #('3','.mp4'),
                   #('4','.mp4'),
                   #('5','.mp4'),
                   #('6','.webm'),
                   #('7','.webm'),
                   #('8','.webm'),
                   #('9','.webm'),
                   #('10','.webm'),
                   #('11','.webm'),
                   #('12','.webm'),
                   #('13','.mp4'),
                   ('14','.webm'),
                   #('15','.webm'),
                   #('16','.webm'),
                   #('17','.webm'),
                   #('18','.webm'),
                   #('19','.mp4'),
                   #('20','.mp4'),
                   ]:
    video_name = pair[0]
    video_ext = pair[1]
    totalFrames, frame_rate = video_frames_fps(video_name+video_ext)
    totalFrames = 392
    print(5**' * ' + video_name + video_ext + f'  Frames:{totalFrames} FPS:{frame_rate}' + 5*' *')

    reference_frame_analysis(video_name)
```

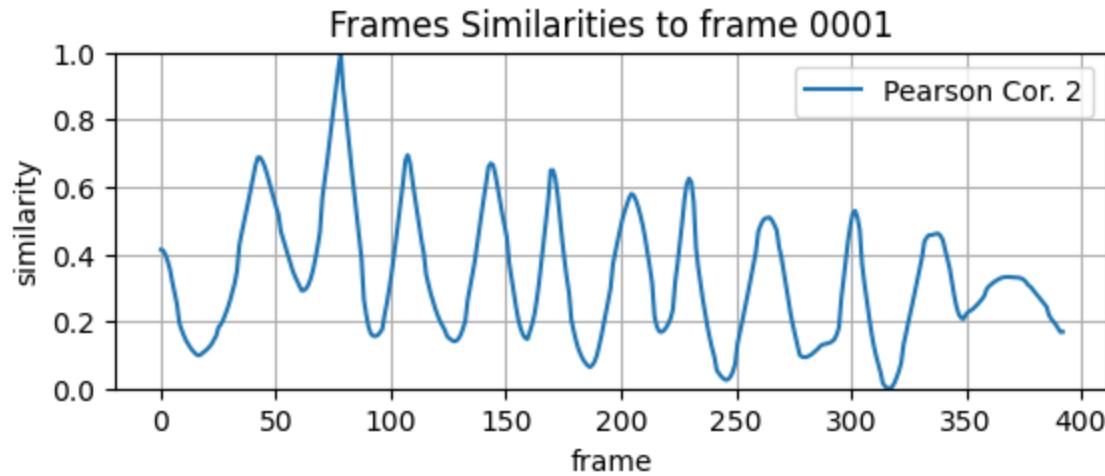
\* \* \* \* \* 14.webm Frames:392 FPS:24.0 \* \* \* \* \*

\* \* \* \* \* Video: 14 Reference frame at: (20%) 78 \* \* \* \* \*

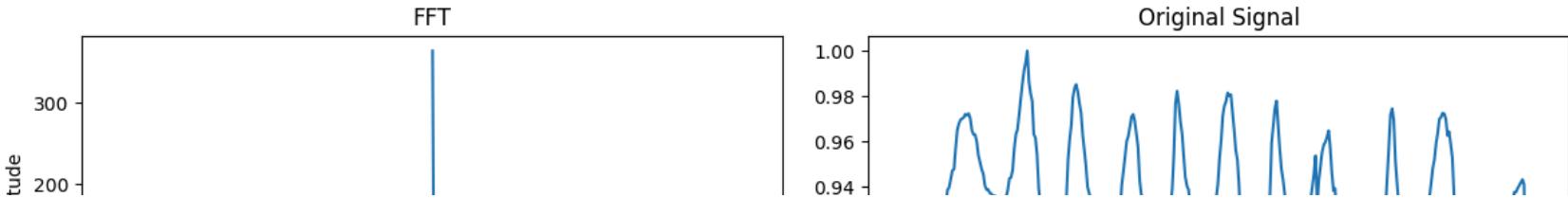
Similarity Signal - Histogram

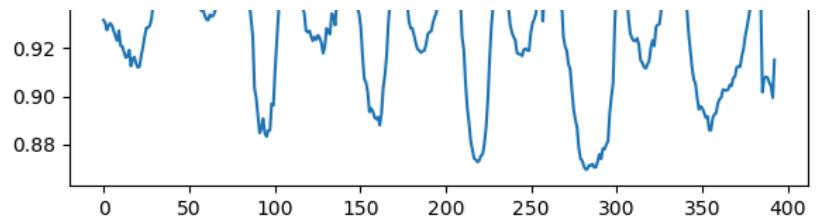
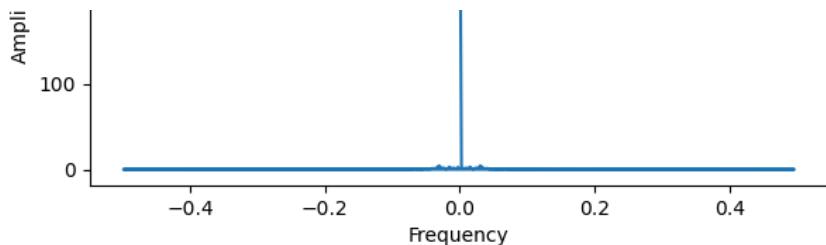


Similarity Signal - Pearson Correlation

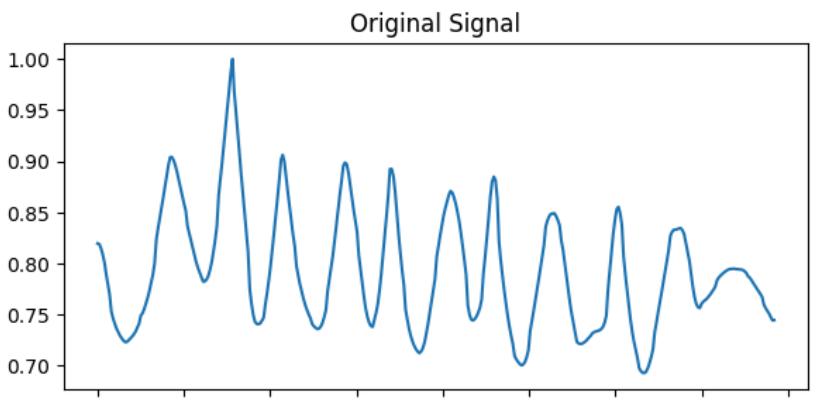
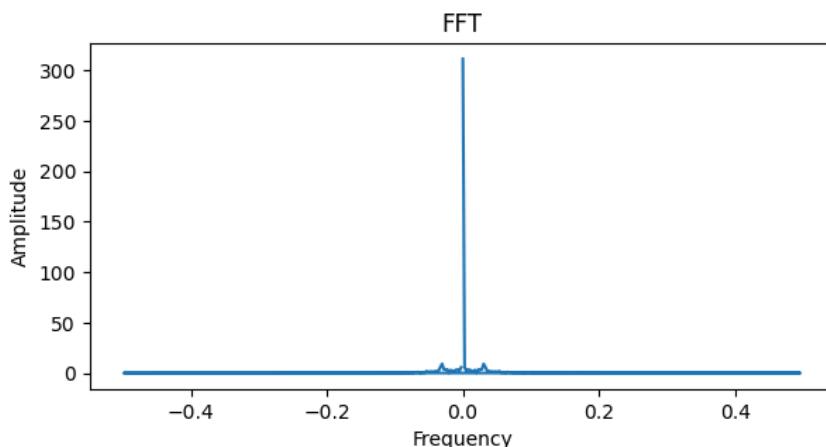


Histogram - FFT

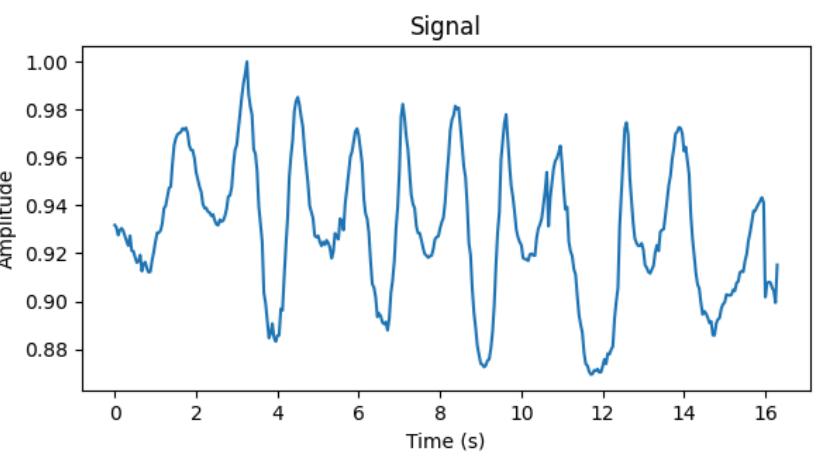
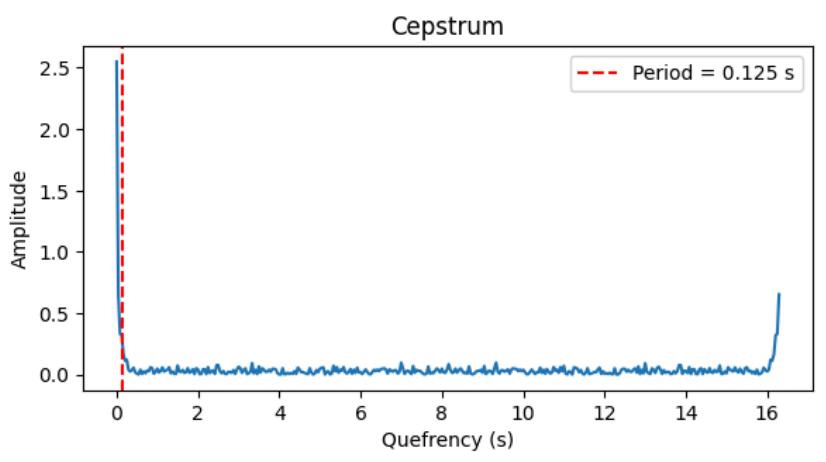




PCC - FFT

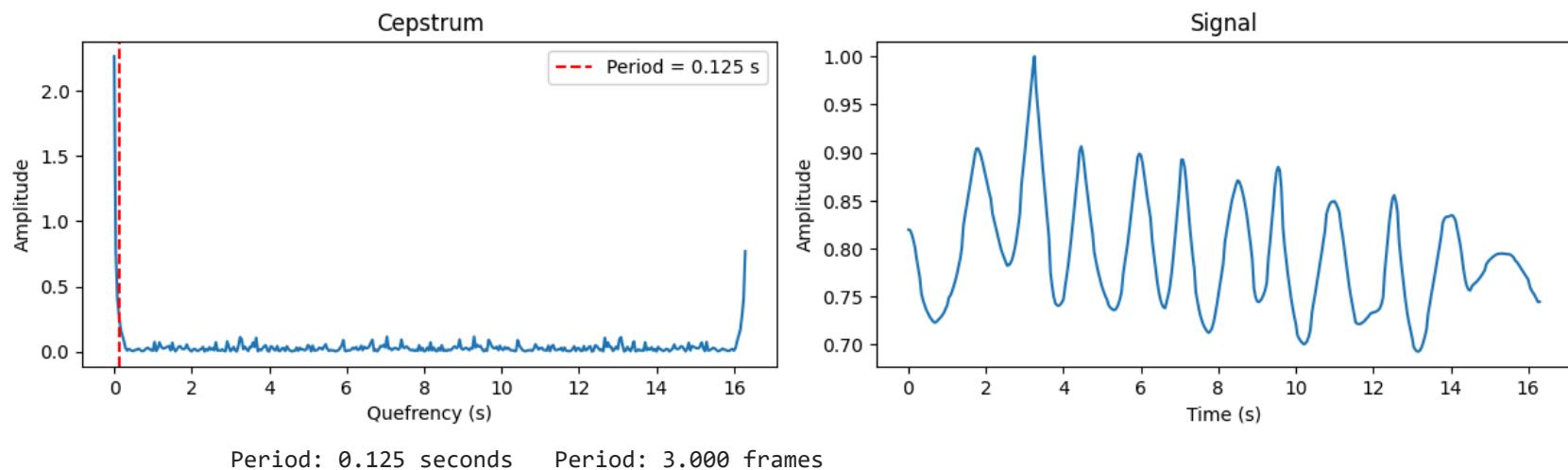


Histogram - Cepstrum



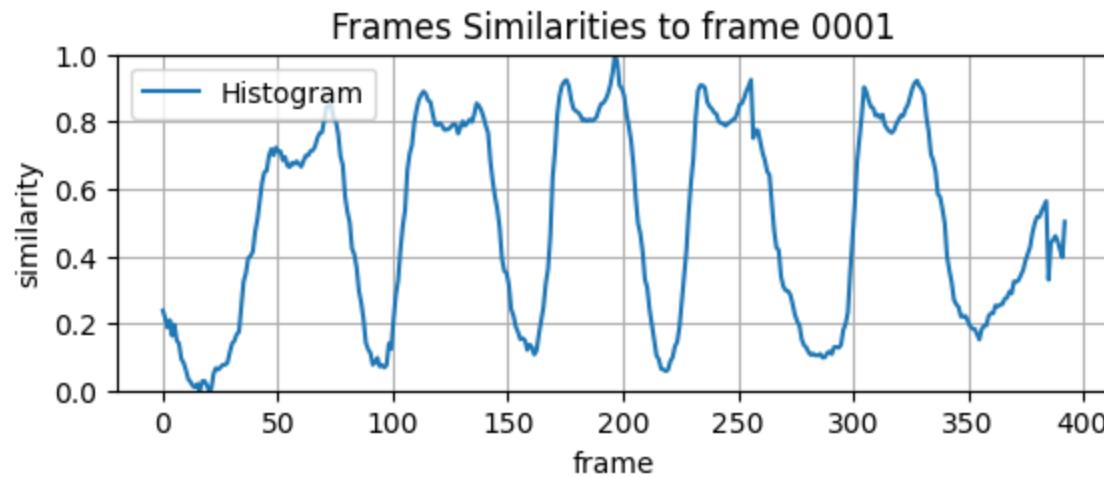
PERIOD: 0.125 seconds PERIOD: 3.000 frames

### PCC - Cepstrum



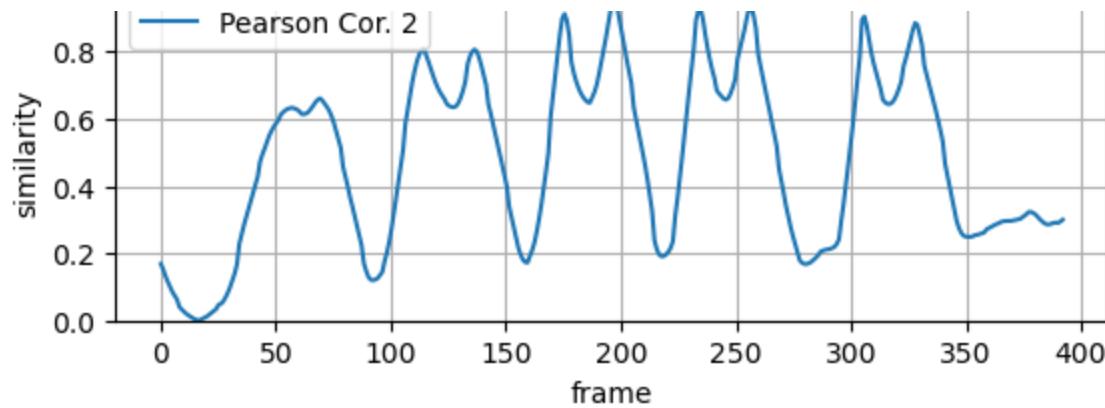
\* \* \* \* \* Video: 14 Reference frame at: (50%) 196 \* \* \* \* \*

### Similarity Signal - Histogram

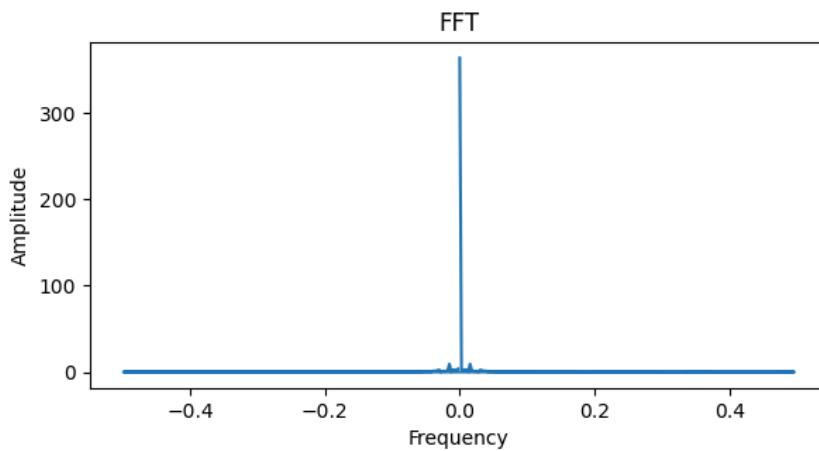


### Similarity Signal - Pearson Correlation

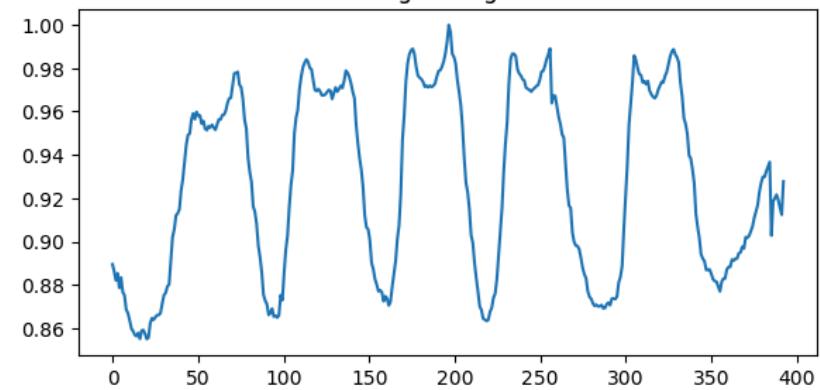




Histogram - FFT

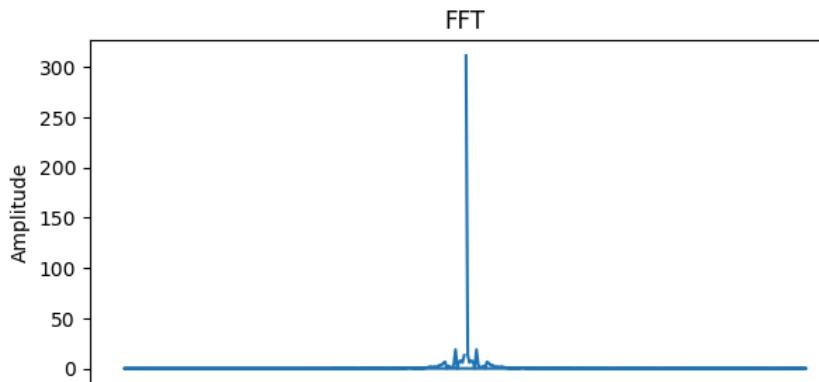


Original Signal

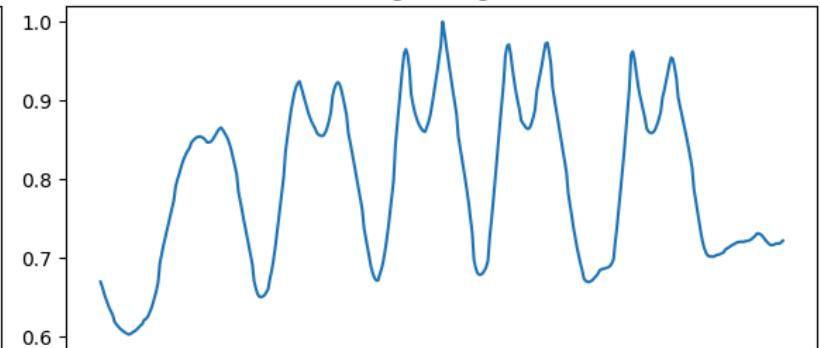


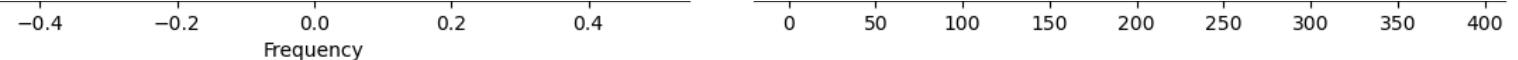
Dominant Frequency: 0.015 , Period: 65.500

PCC - FFT



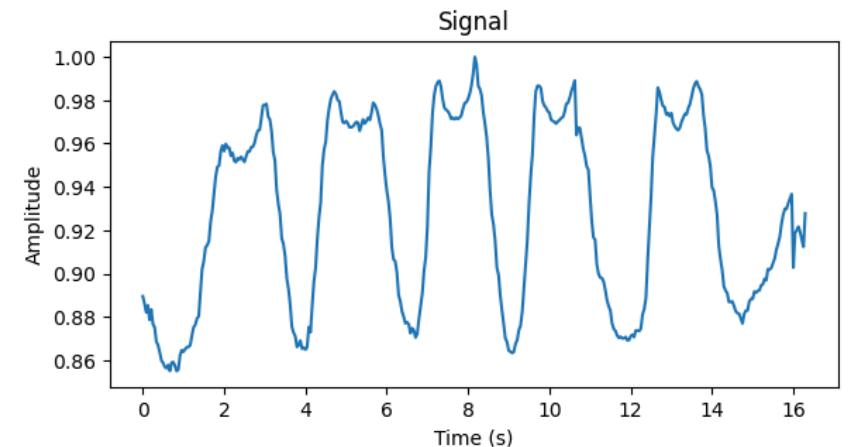
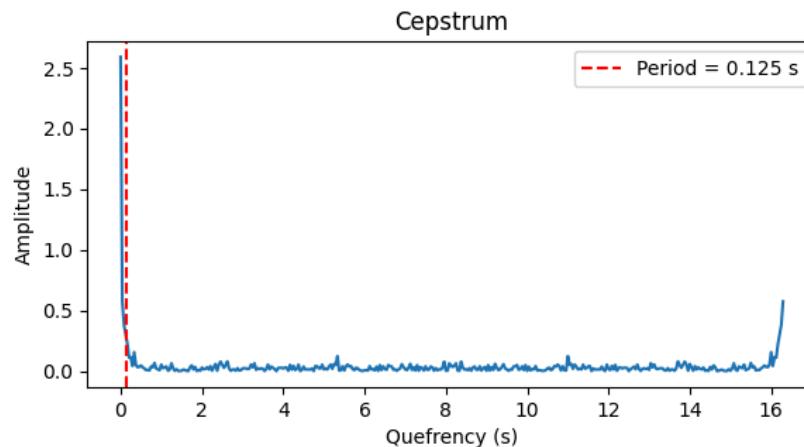
Original Signal





Dominant Frequency: 0.015 , Period: 65.500

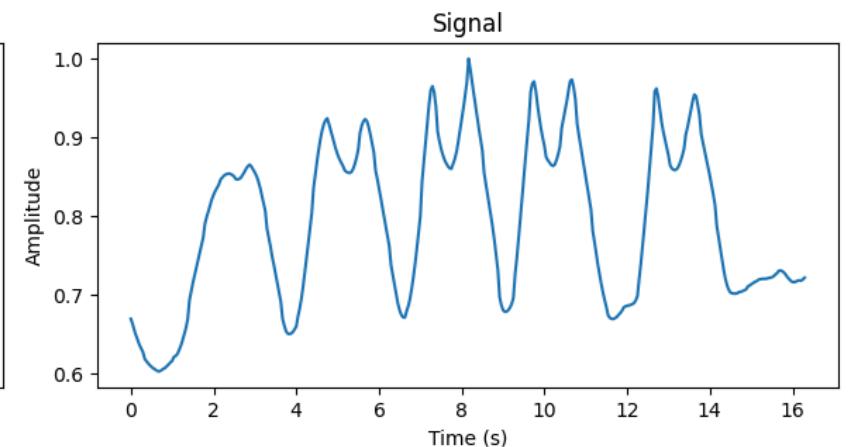
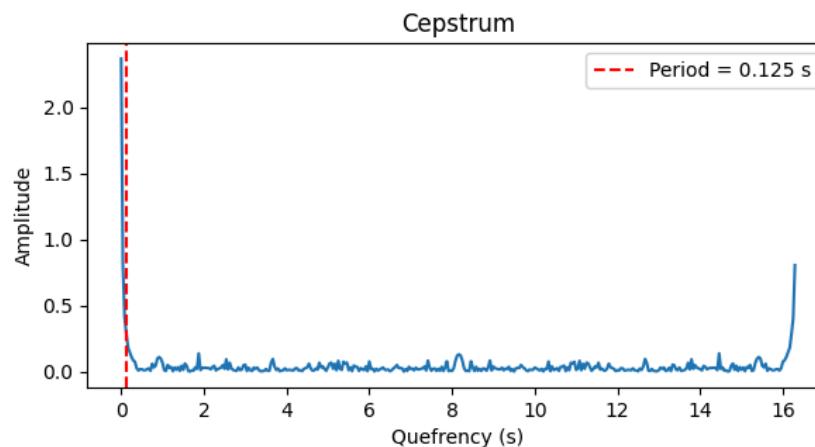
Histogram - Cepstrum



Period: 0.125 seconds

Period: 3.000 frames

PCC - Cepstrum

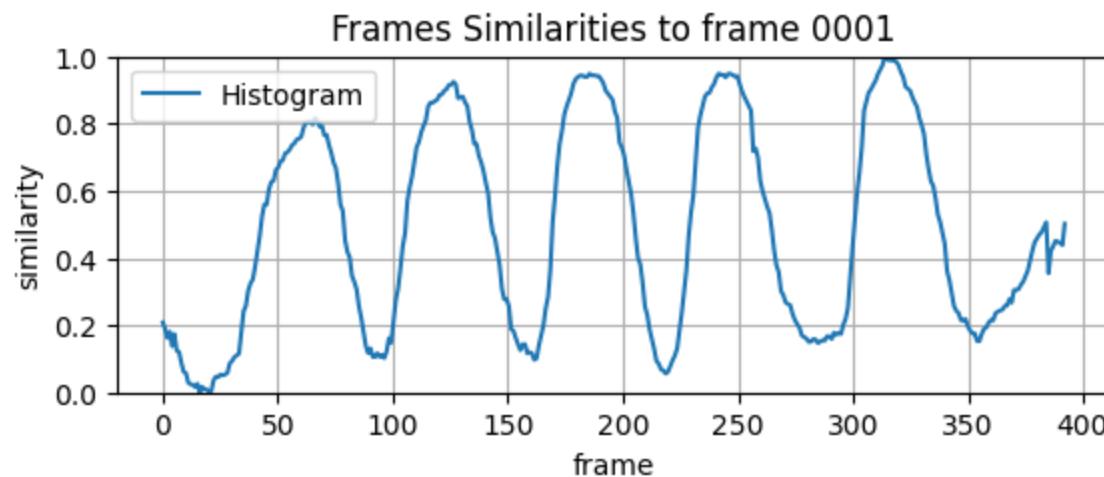


Period: 0.125 seconds

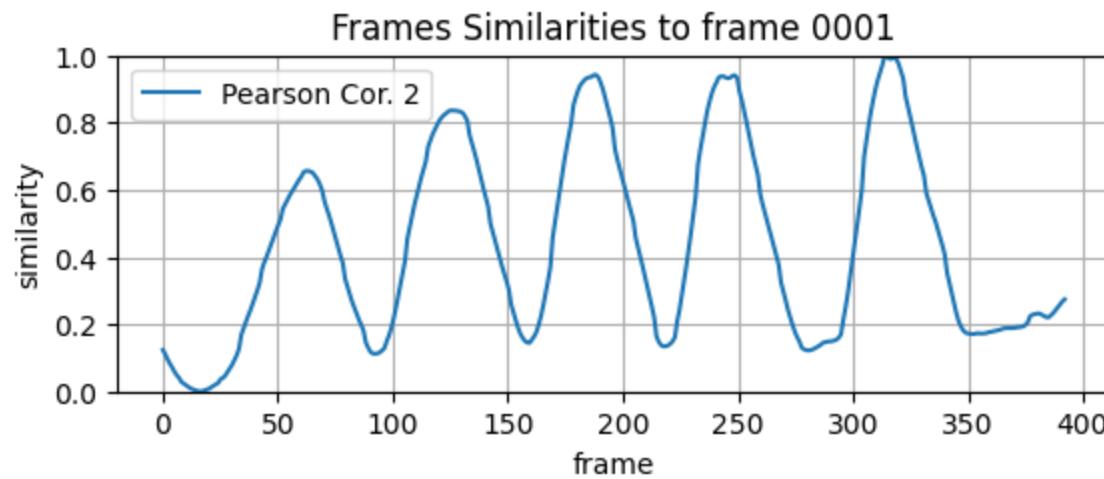
Period: 3.000 frames

\* \* \* \* \* Video: 14 Reference frame at: (80%) 313 \* \* \* \*

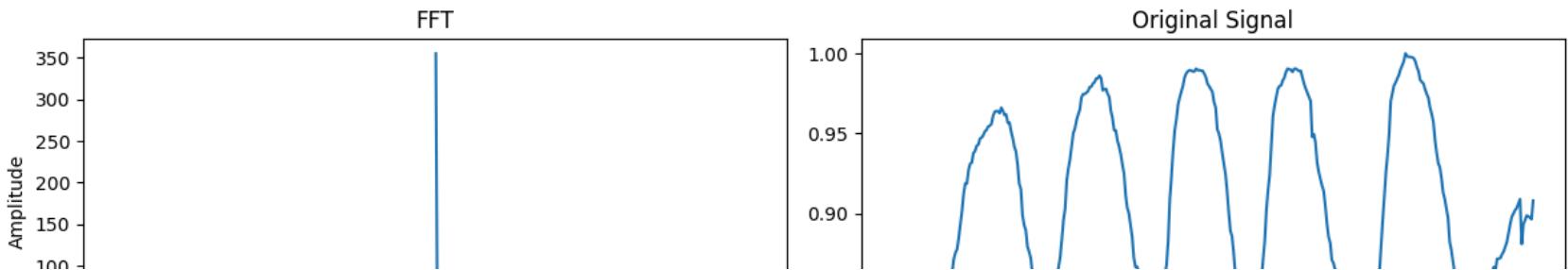
Similarity Signal - Histogram

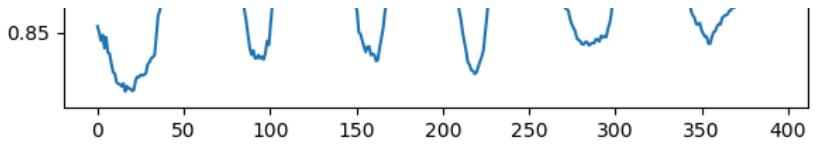
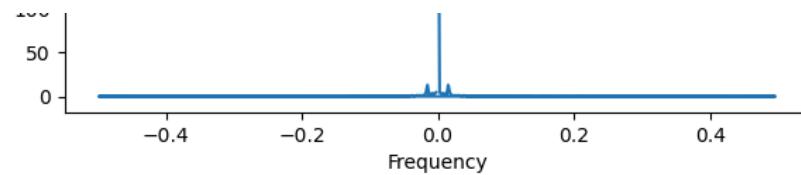


Similarity Signal - Pearson Correlation



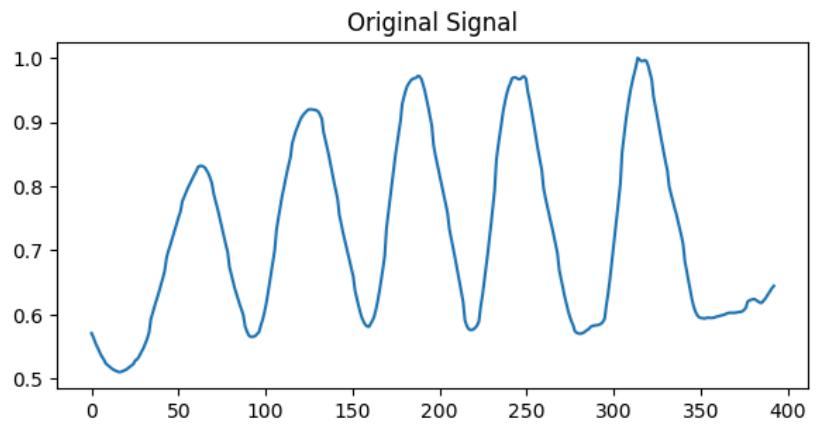
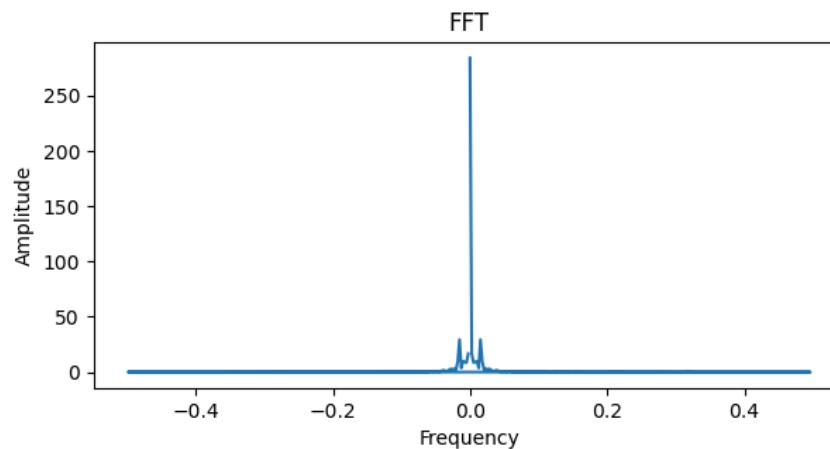
Histogram - FFT





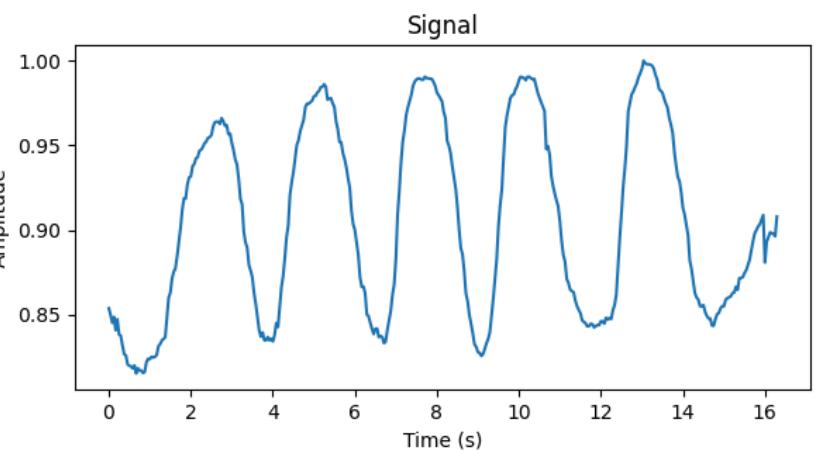
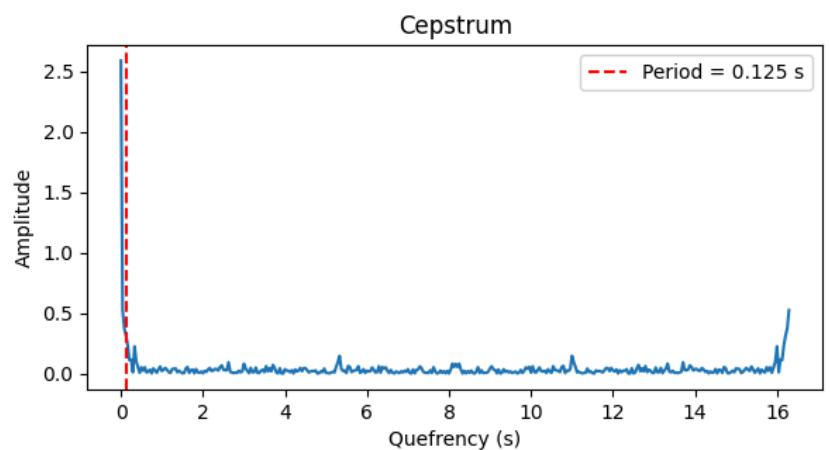
Dominant Frequency: 0.015 , Period: 65.500

PCC - FFT



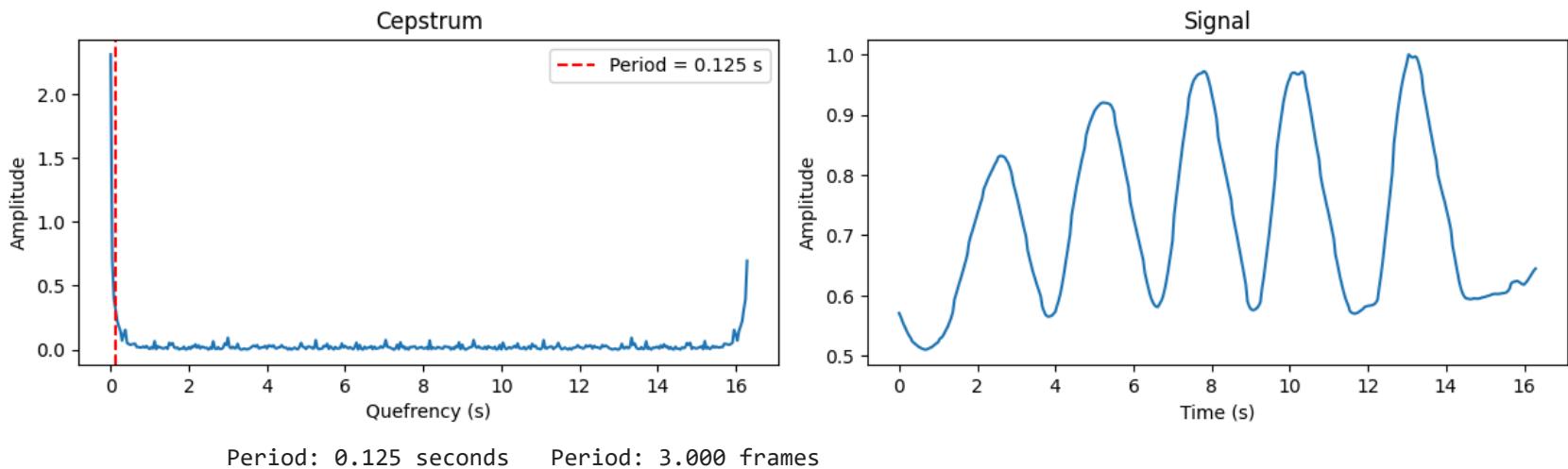
Dominant Frequency: 0.015 , Period: 65.500

Histogram - Cepstrum



Period: 0.125 seconds      Period: 3.000 frames

PCC - Cepstrum



In [27]:

```

for pair in [#('1', '.mp4'),
             #('2', '.mp4'),
             #('3', '.mp4'),
             #('4', '.mp4'),
             #('5', '.mp4'),
             #('6', '.webm'),
             #('7', '.webm'),
             #('8', '.webm'),
             #('9', '.webm'),
             #('10', '.webm'),
             #('11', '.webm'),
             #('12', '.webm'),
             #('13', '.mp4'),
             #('14', '.webm'),
             ('15', '.webm'),
             ('16', '.webm'),
             ('17', '.webm'),
             ('18', '.webm'),
             ('19', '.mp4'),
             ('20', '.mp4'),
             ]:
    video_name = pair[0]
    video_ext = pair[1]
    totalFrames, frame_rate = video_frames_fps(video_name+video_ext)

    print(5**' * ' + video_name + video_ext + f'  Frames:{totalFrames} FPS:{frame_rate}' + 5*' *')

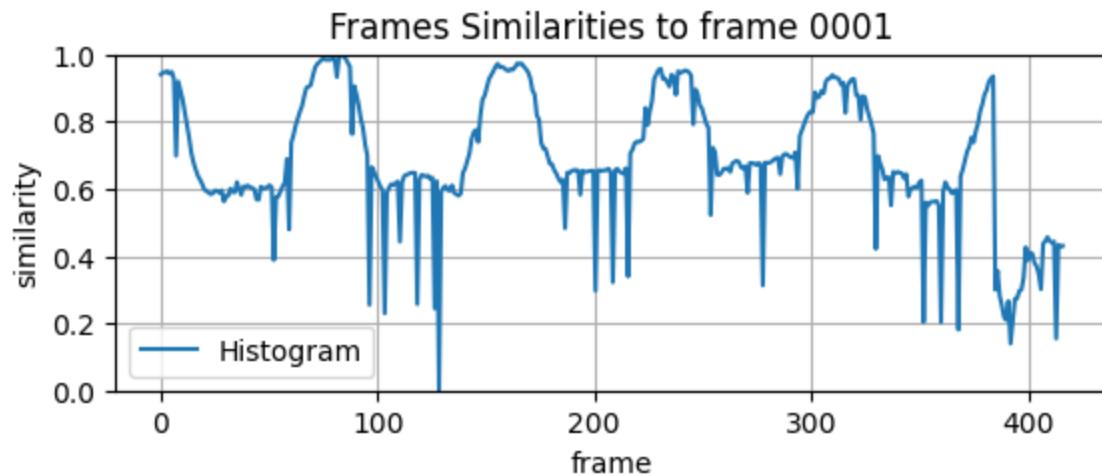
```

REFERENCE\_FRAME\_ANALYSIS(video\_name)

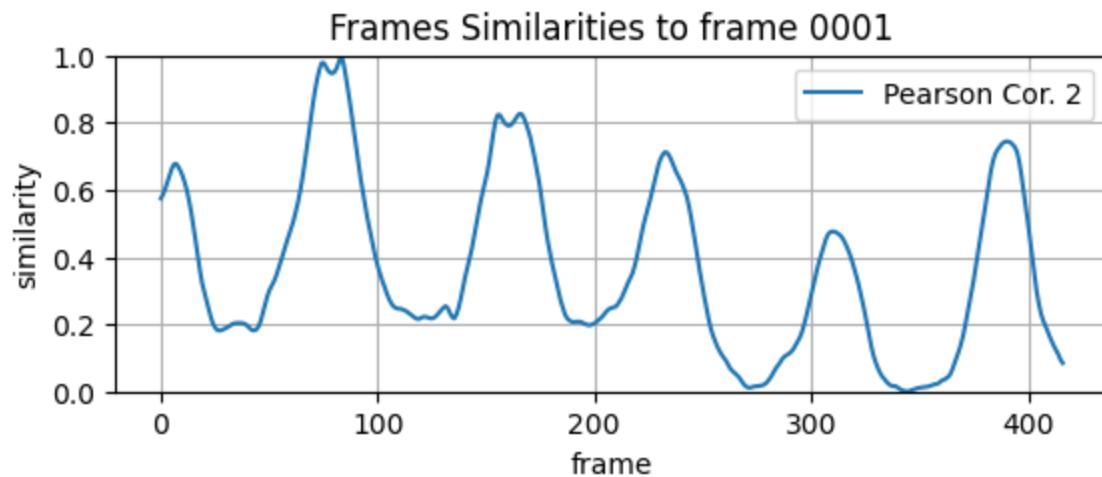
\* \* \* \* \* 15.webm Frames:416 FPS:25.0 \* \* \* \* \*

\* \* \* \* \* Video: 15 Reference frame at: (20%) 83 \* \* \* \* \*

Similarity Signal - Histogram



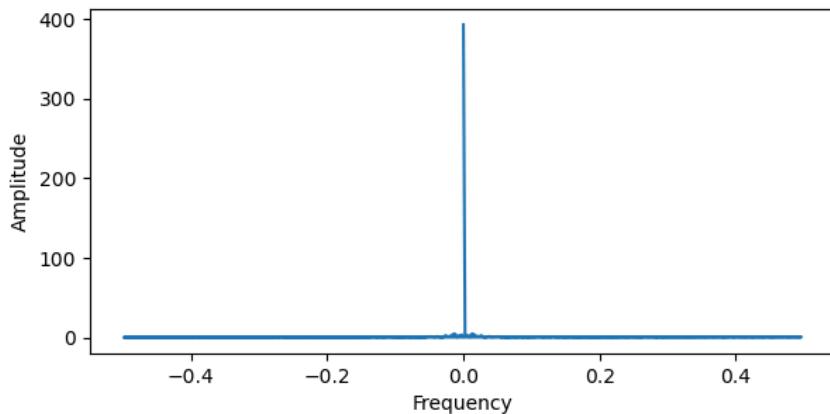
Similarity Signal - Pearson Correlation



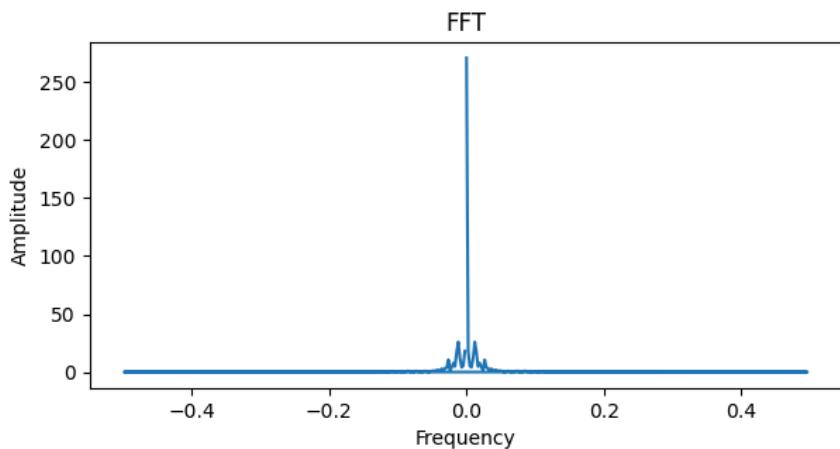
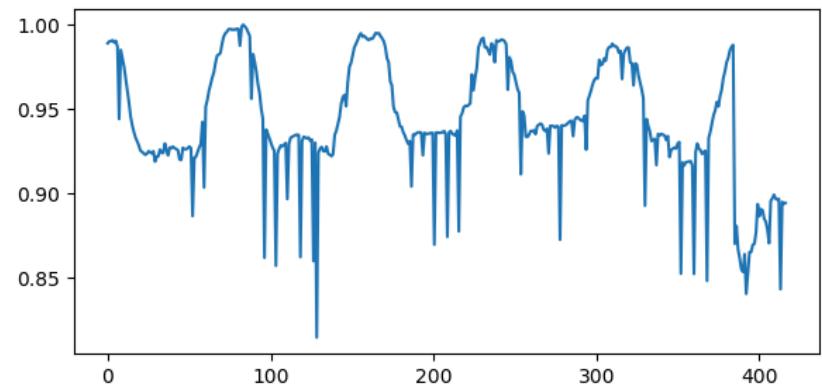
Histogram - FFT

FFT

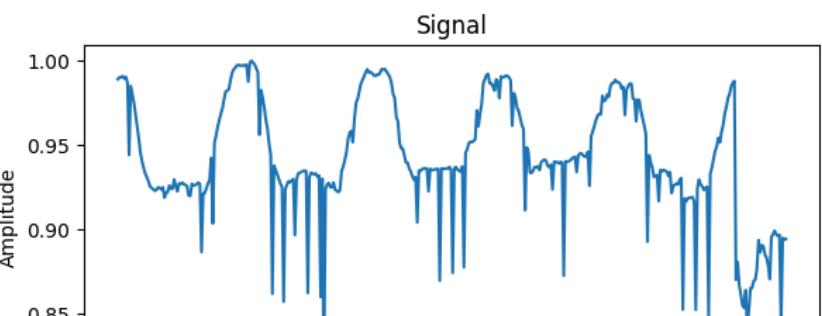
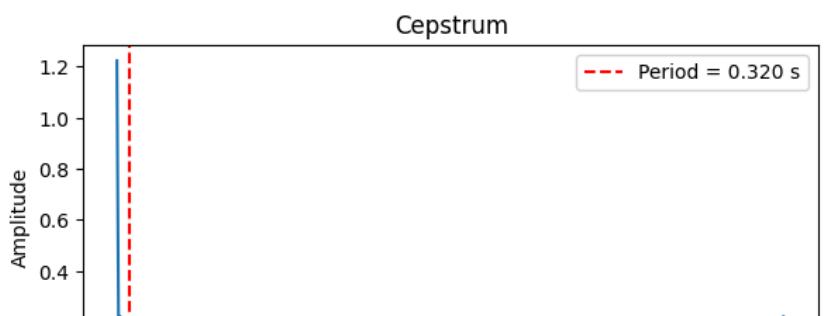
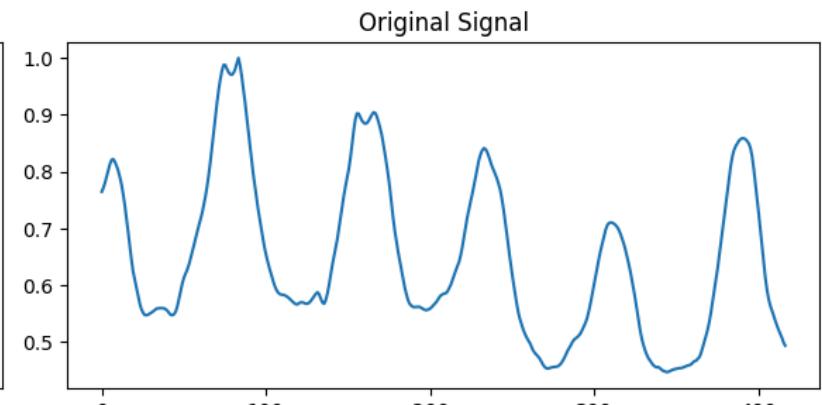
Original Signal

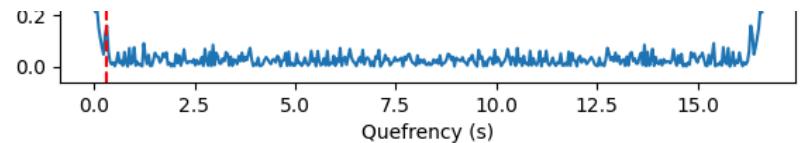


PCC - FFT



Histogram - Cepstrum

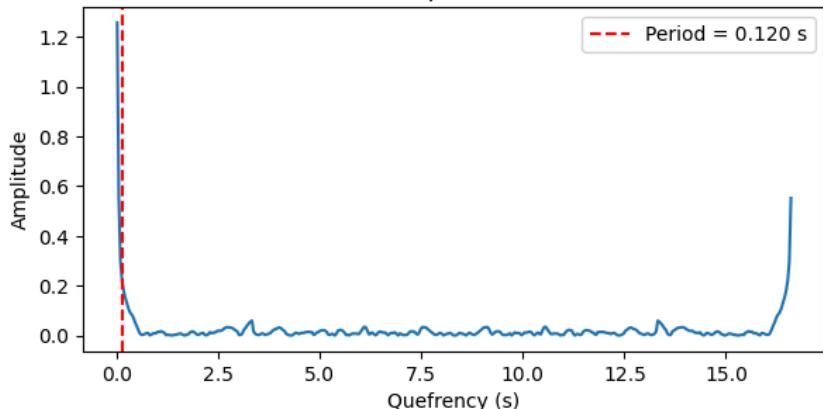




Period: 0.320 seconds      Period: 8.000 frames

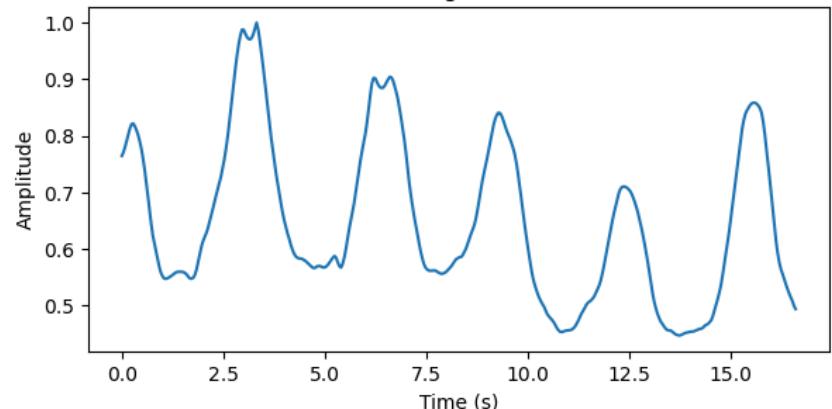
PCC - Cepstrum

Cepstrum



Period: 0.120 seconds      Period: 3.000 frames

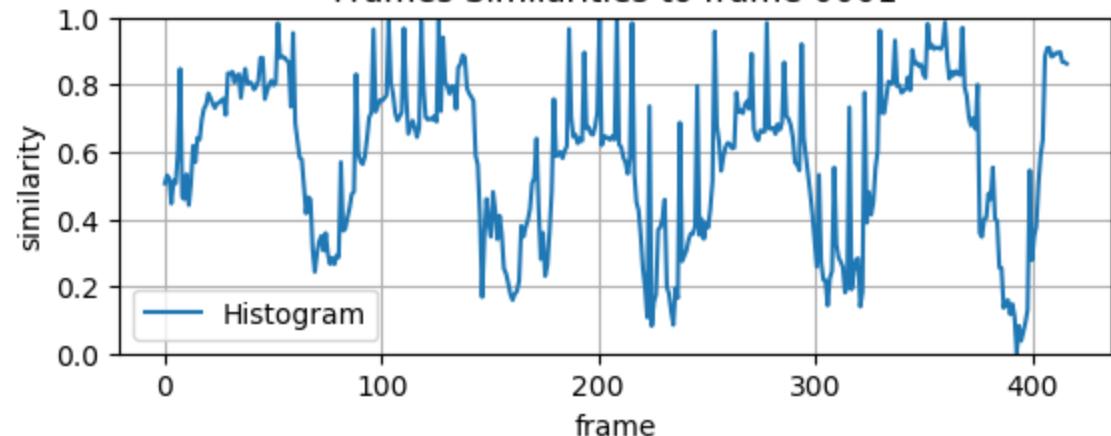
Signal



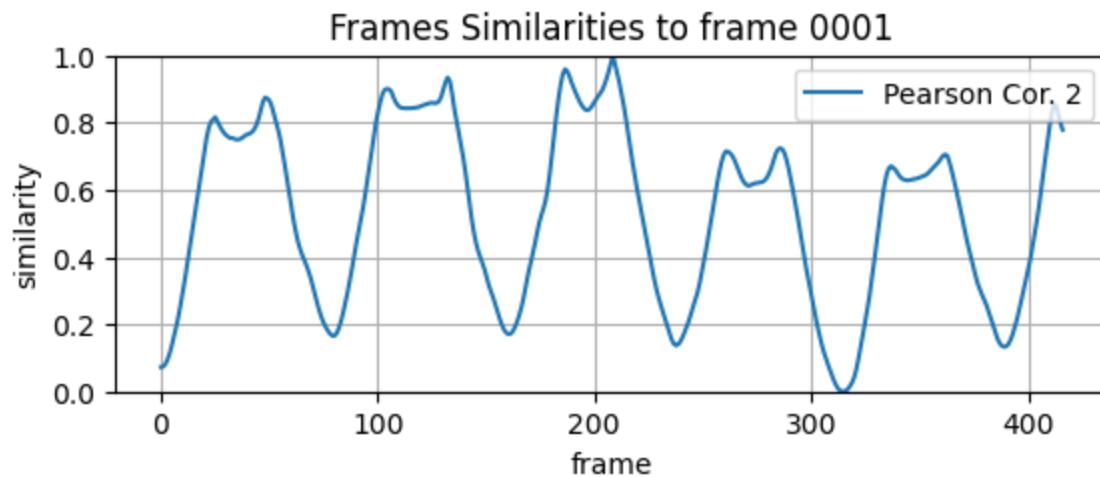
\* \* \* \* \* Video: 15 Reference frame at: (50%) 208 \* \* \* \* \*

Similarity Signal - Histogram

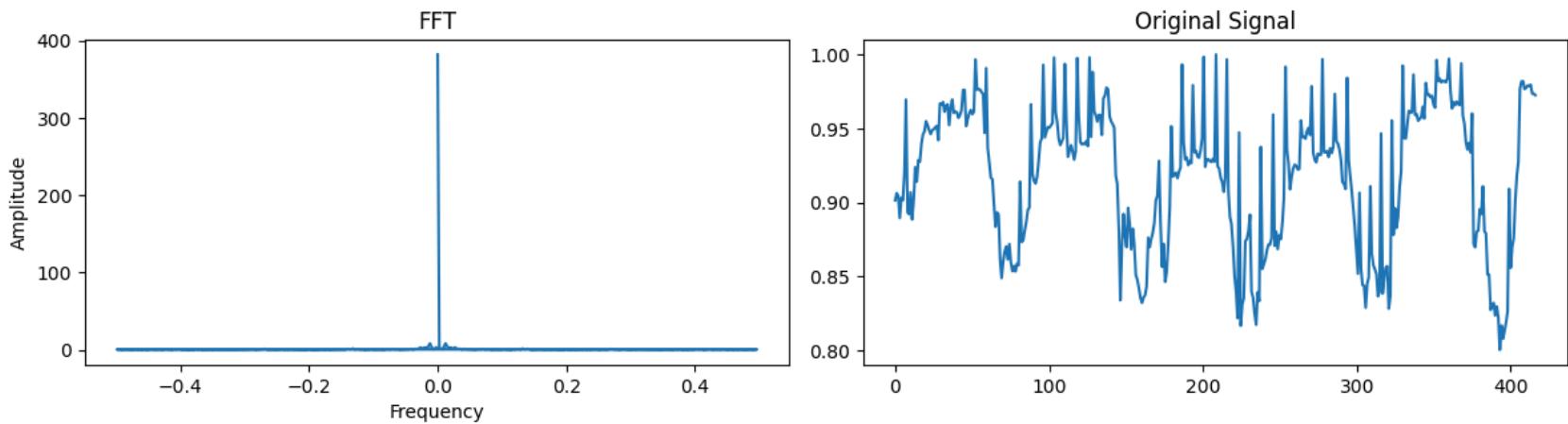
Frames Similarities to frame 0001



### Similarity Signal - Pearson Correlation

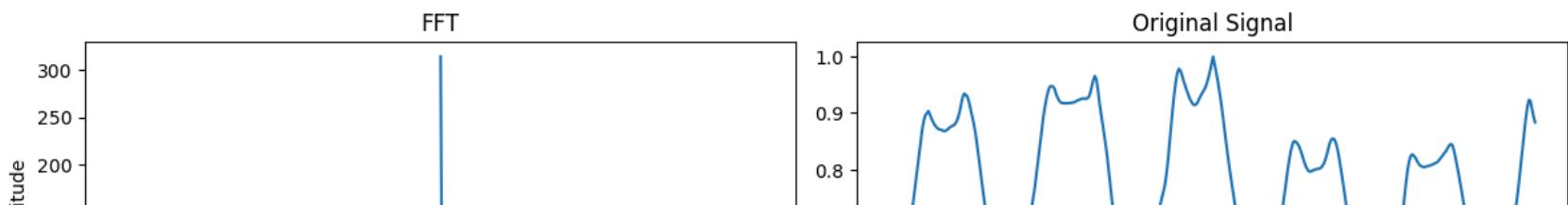


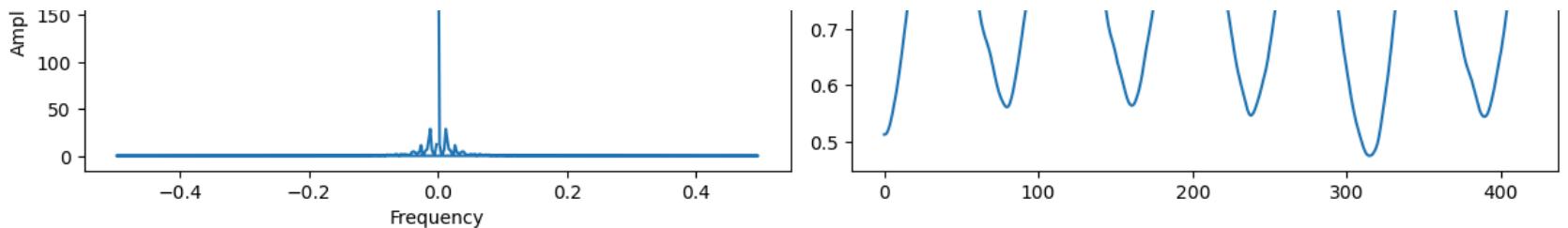
### Histogram - FFT



Dominant Frequency: 0.012 , Period: 83.400

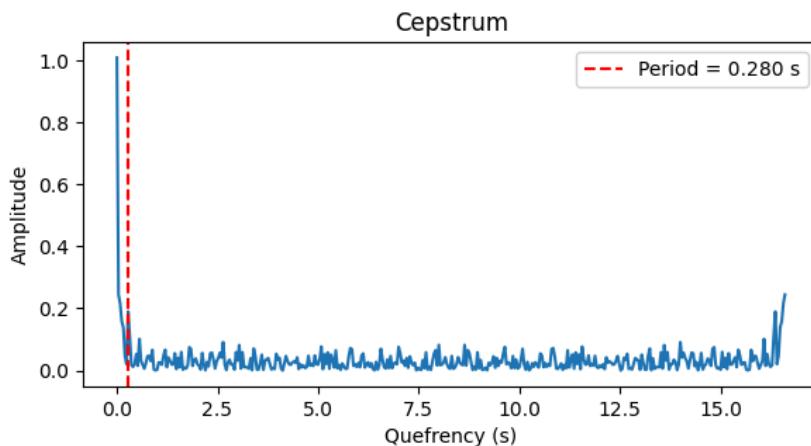
### PCC - FFT



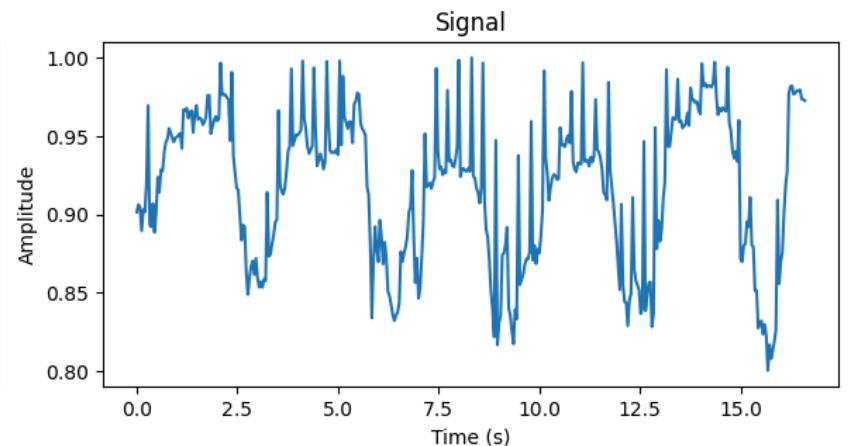


Dominant Frequency: 0.012 , Period: 83.400

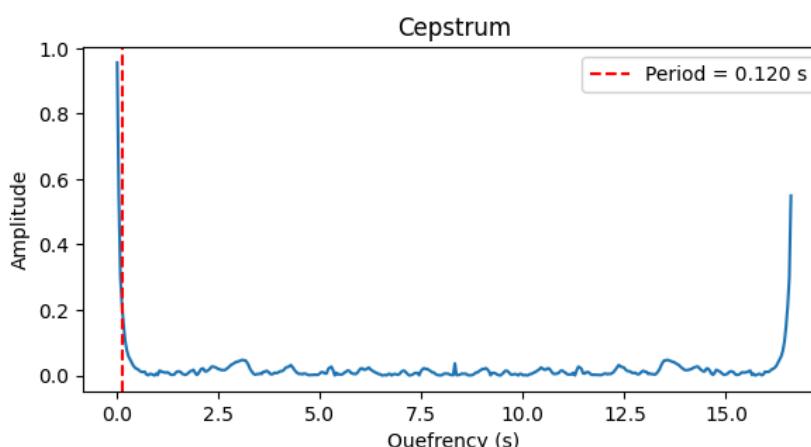
#### Histogram - Cepstrum



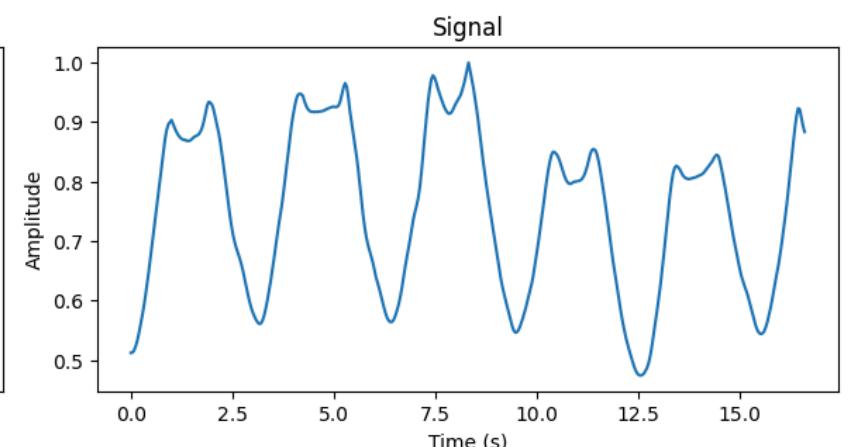
Period: 0.280 seconds      Period: 7.000 frames



#### PCC - Cepstrum

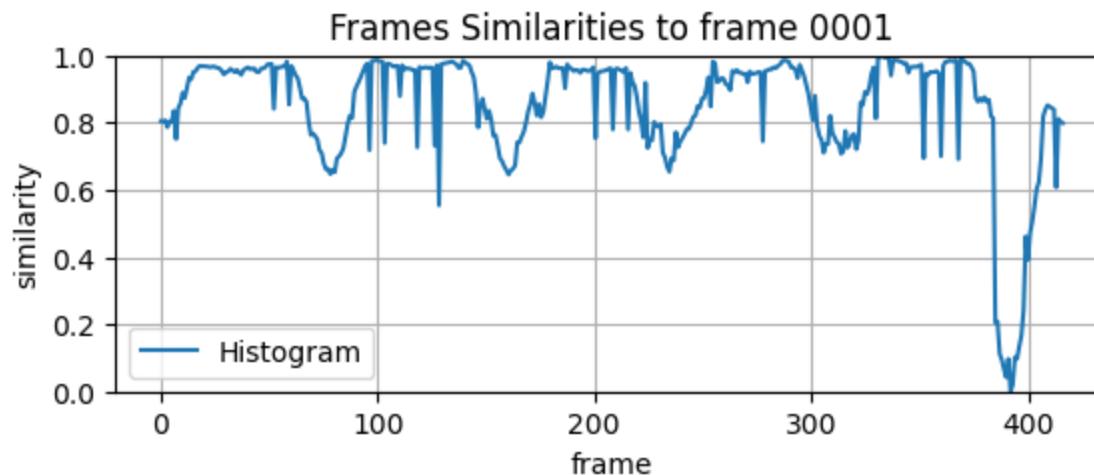


Period: 0.120 seconds      Period: 3.000 frames

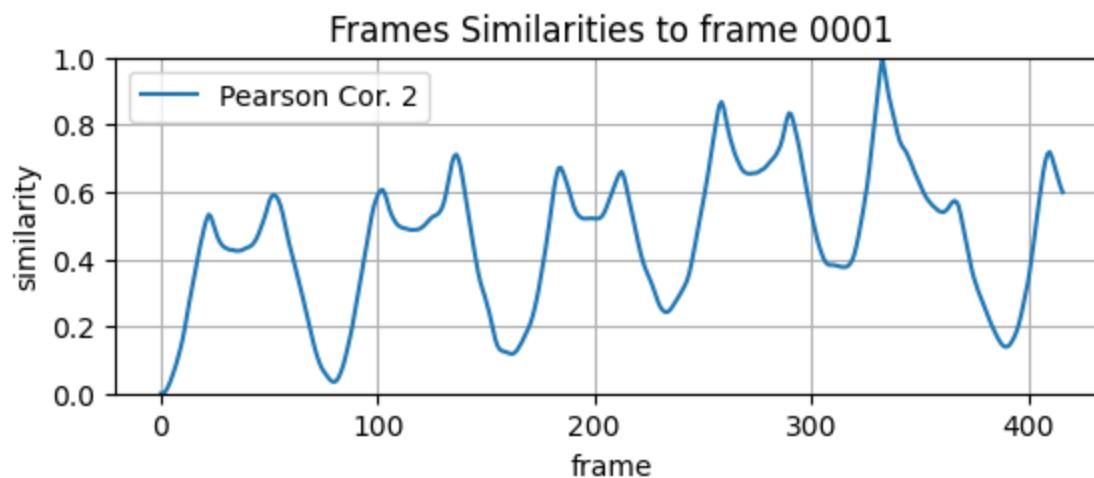


\* \* \* \* \* Video: 15 Reference frame at: (80%) 332 \* \* \* \* \*

Similarity Signal - Histogram

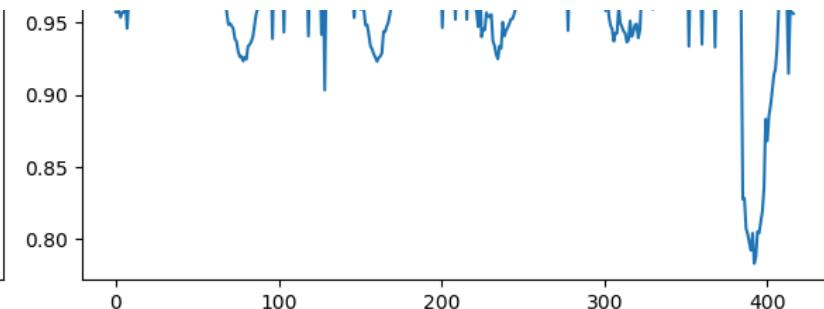
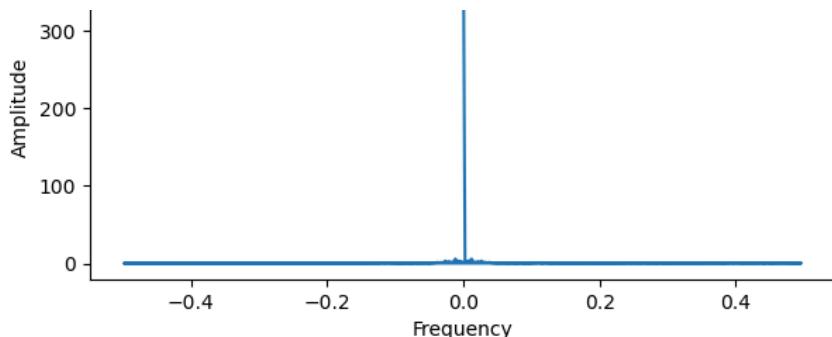


Similarity Signal - Pearson Correlation



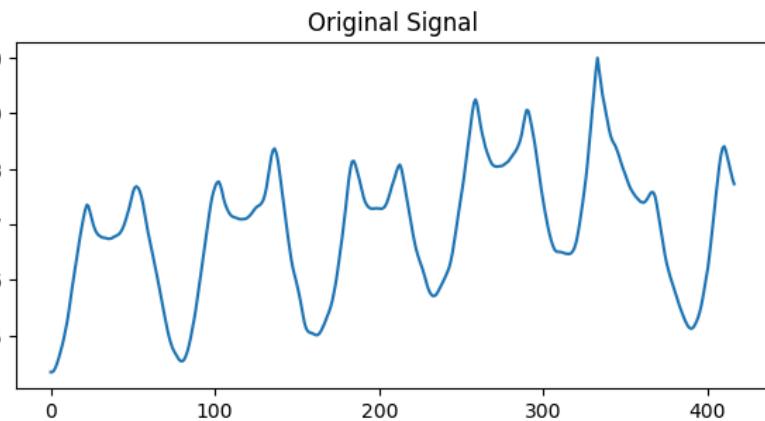
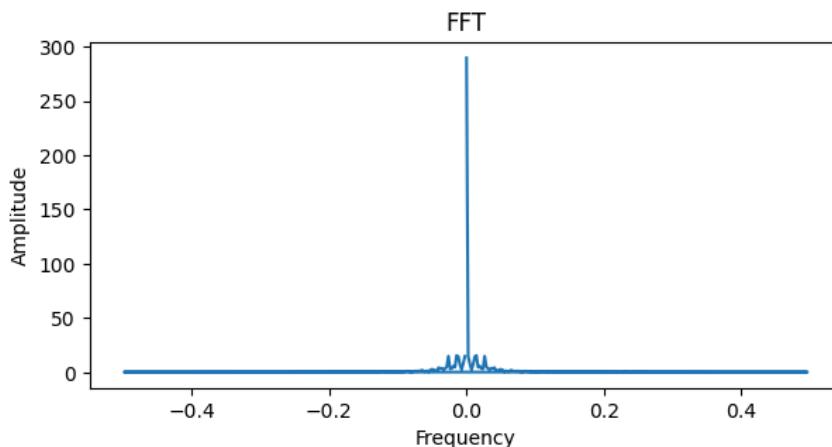
Histogram - FFT





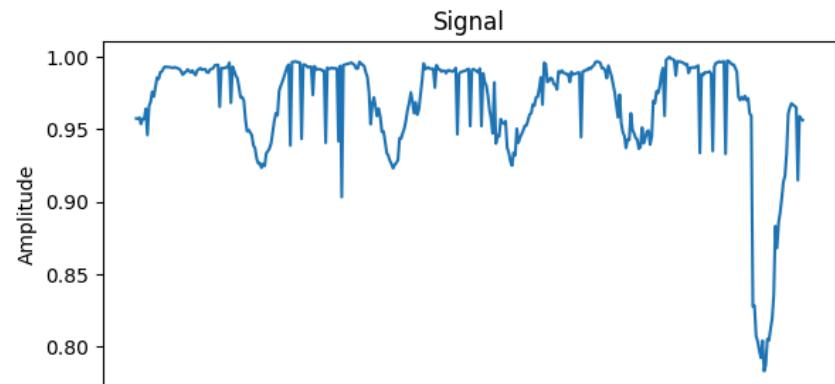
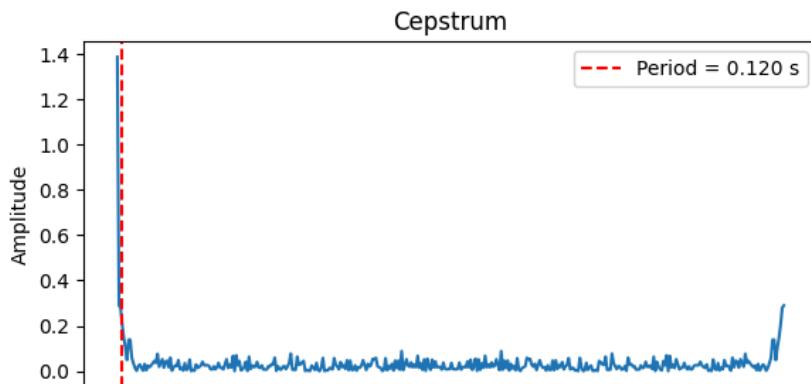
Dominant Frequency: 0.012 , Period: 83.400

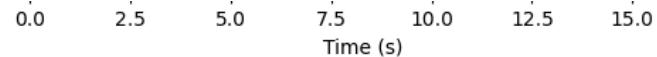
PCC - FFT



Dominant Frequency: 0.014 , Period: 69.500

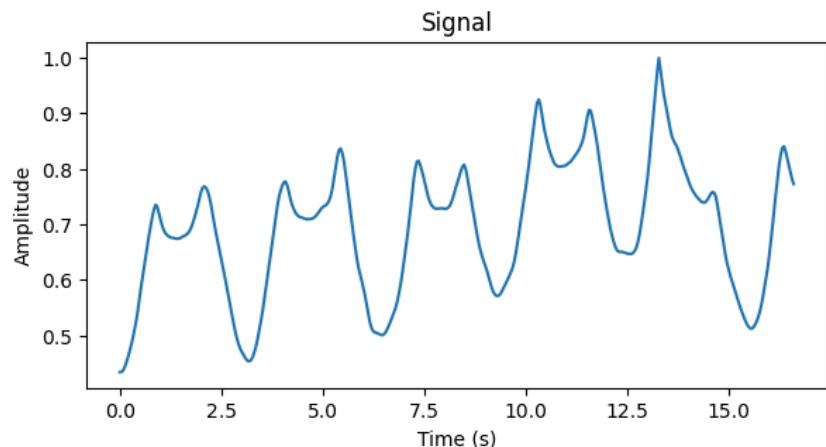
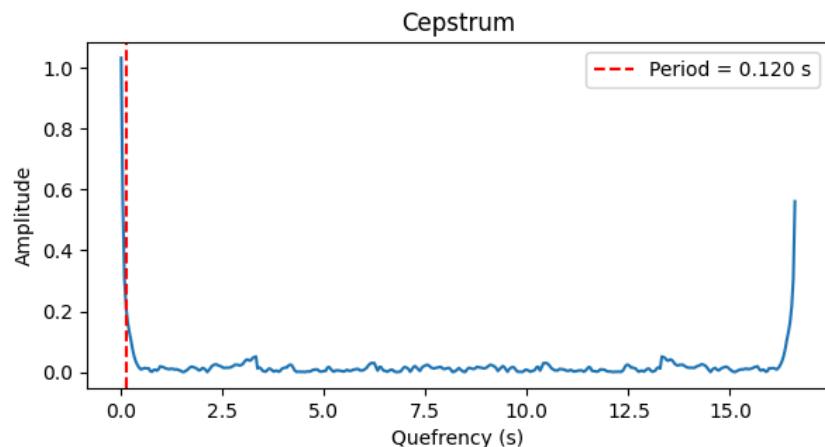
Histogram - Cepstrum





Period: 0.120 seconds      Period: 3.000 frames

PCC - Cepstrum

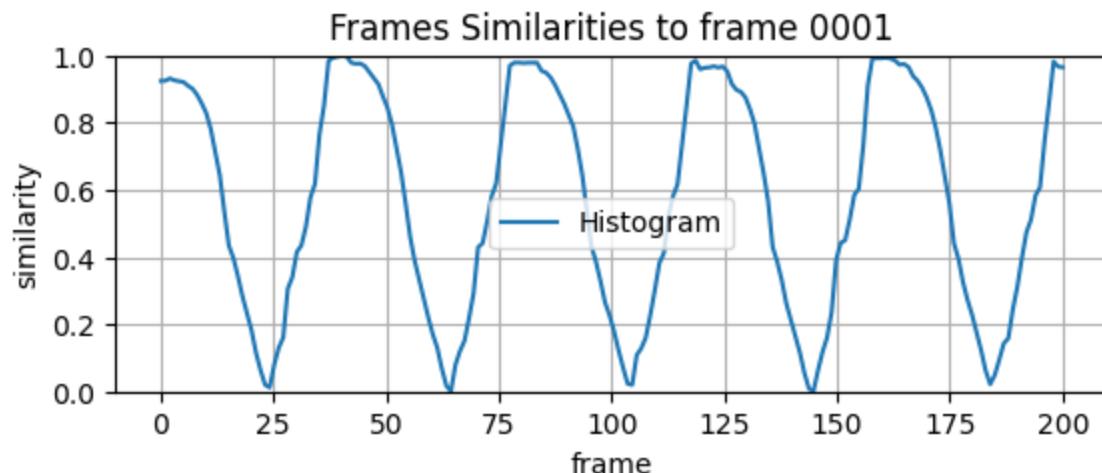


Period: 0.120 seconds      Period: 3.000 frames

\* \* \* \* \* 16.webm    Frames:200 FPS:25.0 \* \* \* \* \*

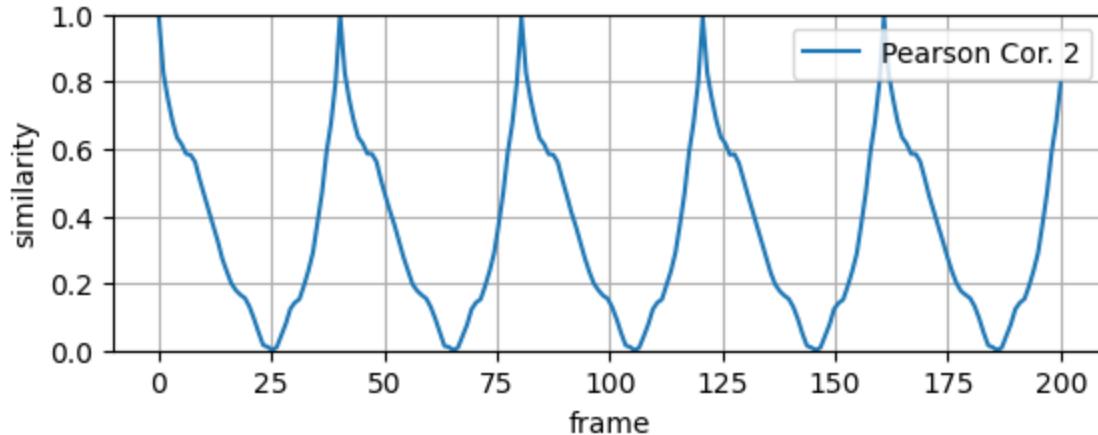
\* \* \* \* \* Video: 16 Reference frame at: (20%) 40 \* \* \* \* \*

Similarity Signal - Histogram

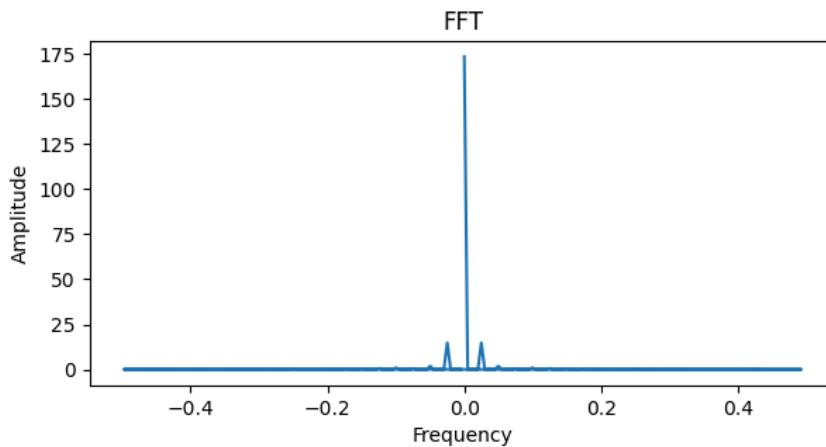


Similarity Signal - Pearson Correlation

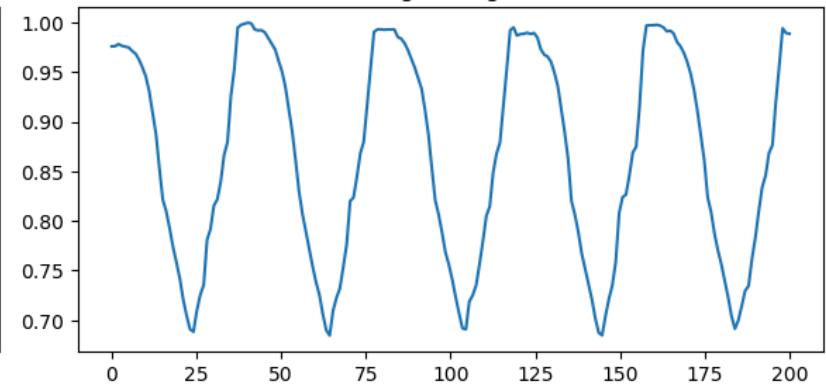
### Frames Similarities to frame 0001



Histogram - FFT

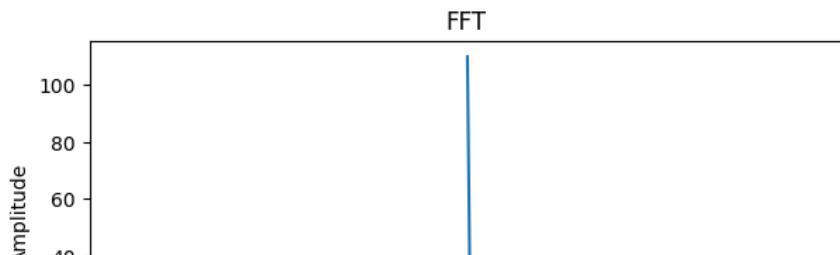


Original Signal

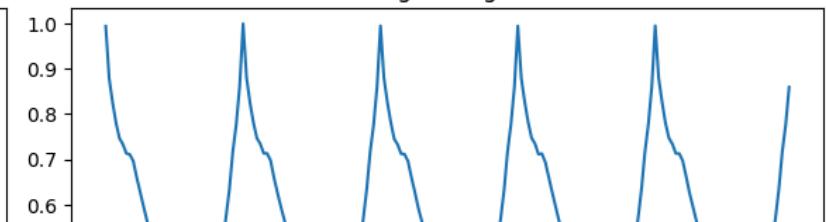


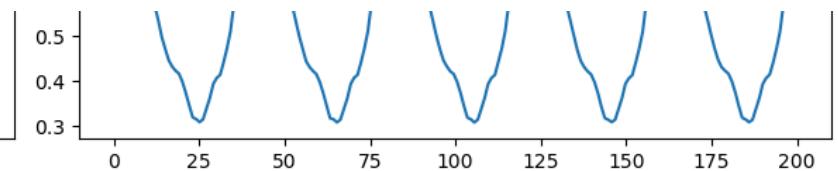
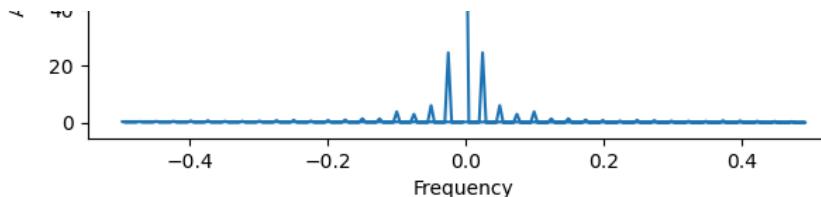
Dominant Frequency: 0.025 , Period: 40.201

PCC - FFT



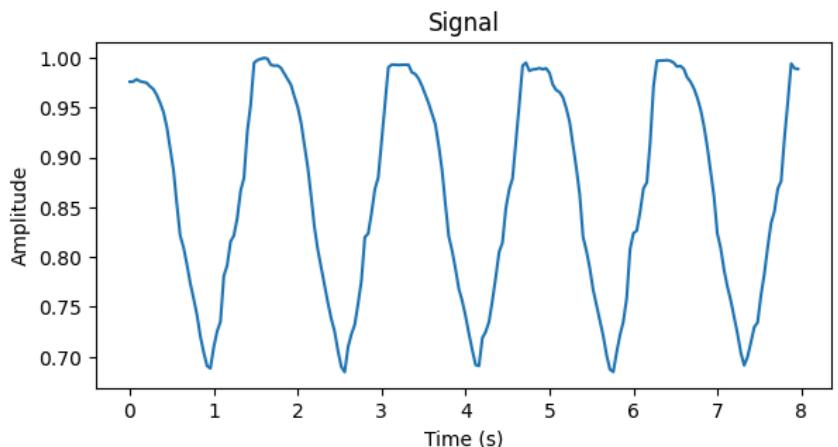
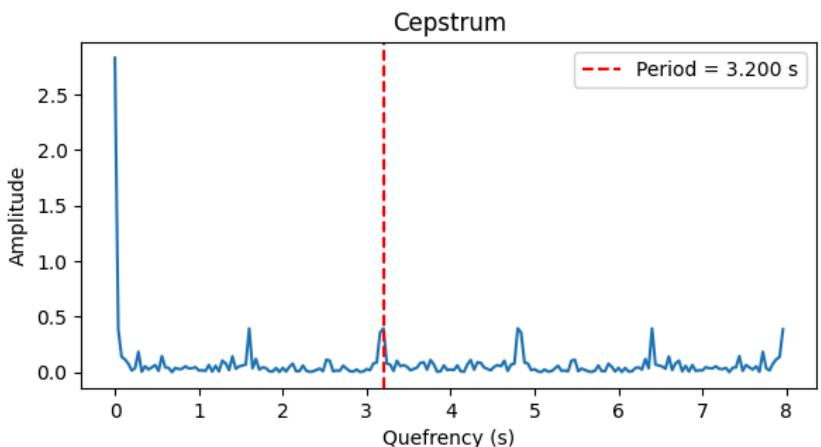
Original Signal





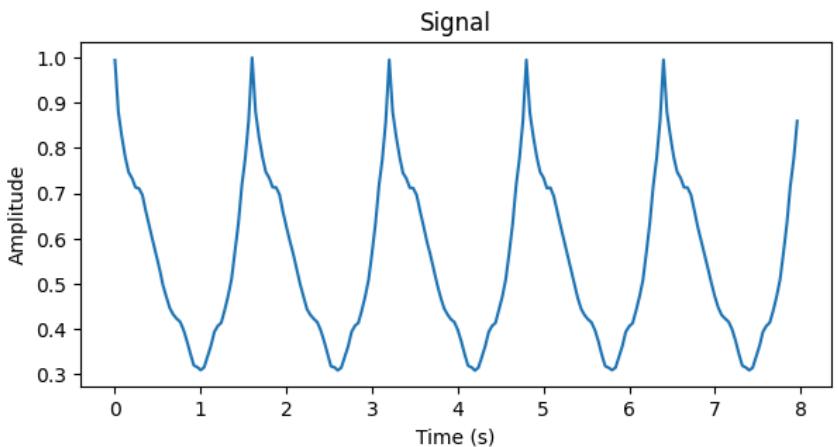
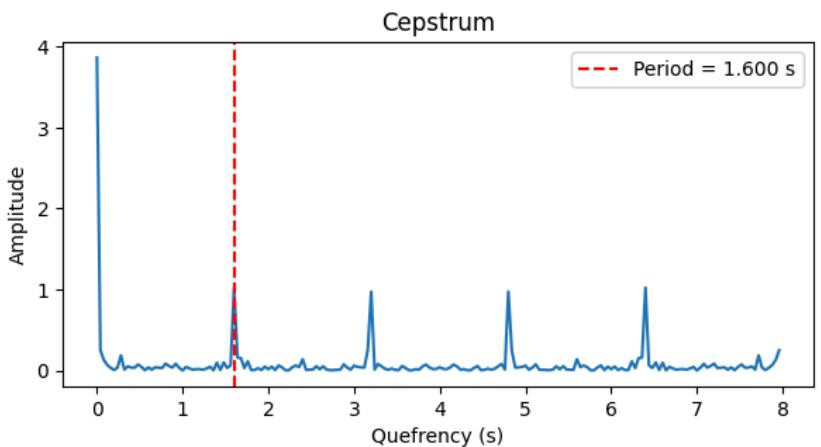
Dominant Frequency: 0.025 , Period: 40.201

Histogram - Cepstrum



Period: 3.200 seconds      Period: 80.000 frames

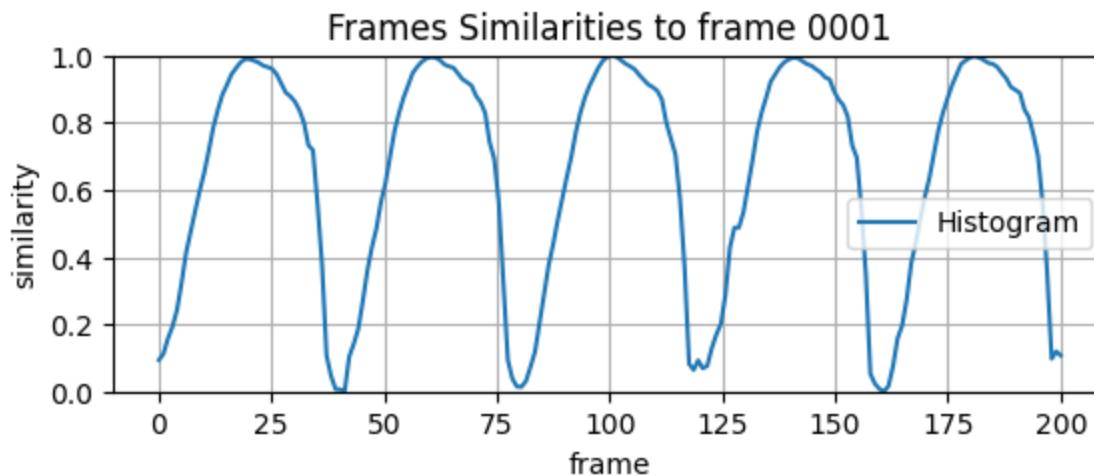
PCC - Cepstrum



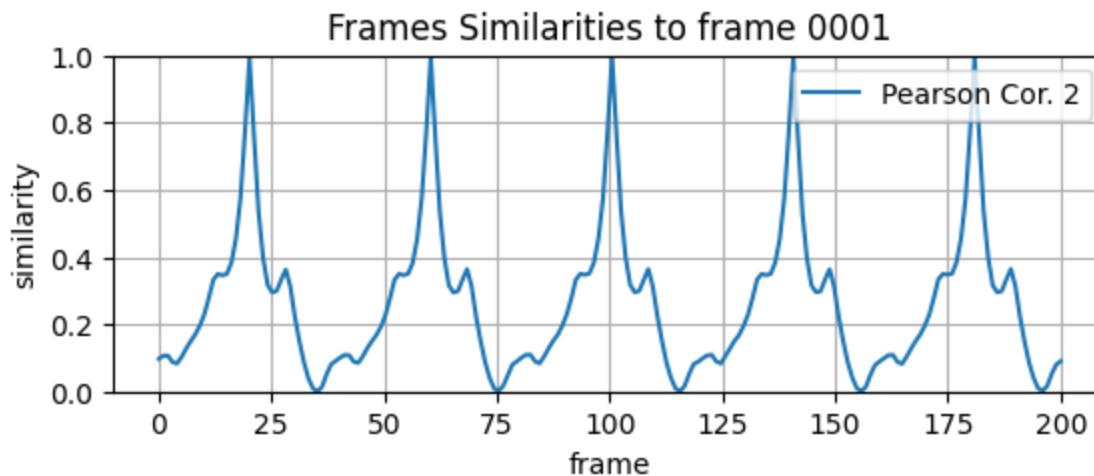
Period: 1.600 seconds      Period: 40.000 frames

\* \* \* \* \* Video: 16 Reference frame at: (50%) 100 \* \* \* \* \*

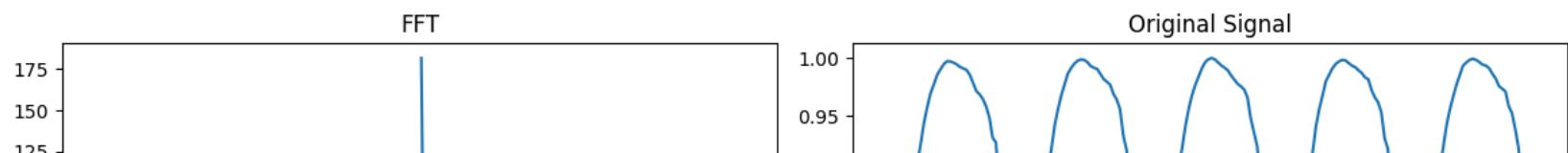
Similarity Signal - Histogram

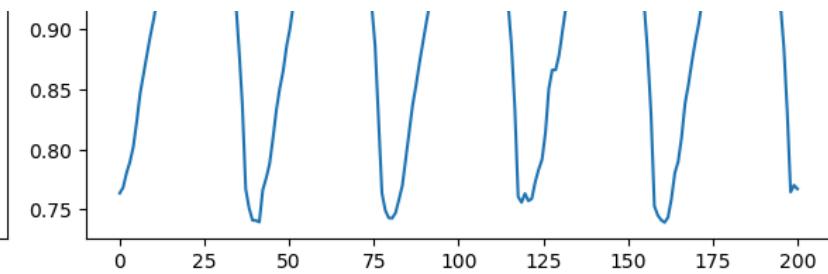
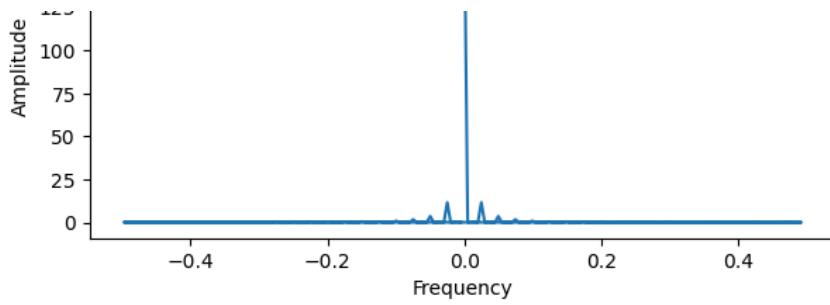


Similarity Signal - Pearson Correlation



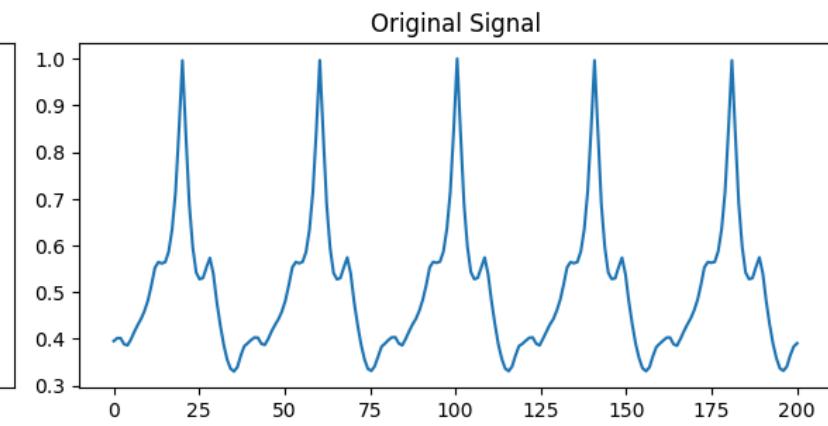
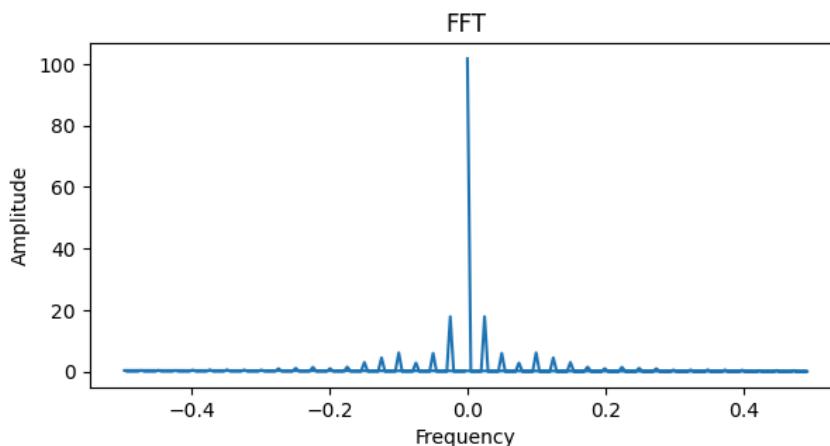
Histogram - FFT





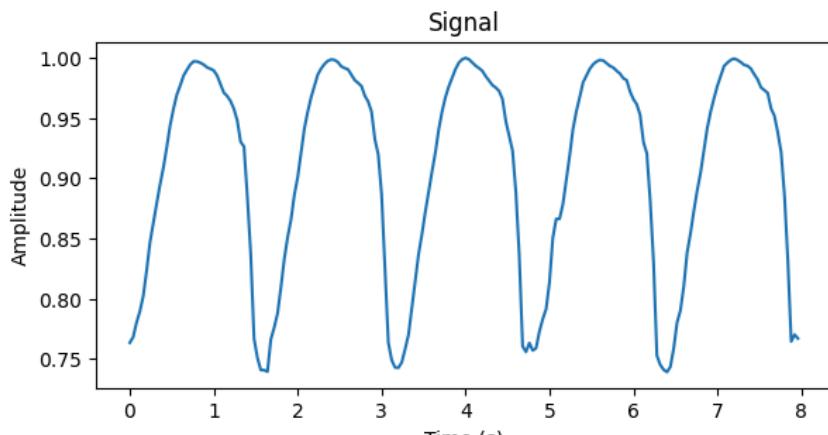
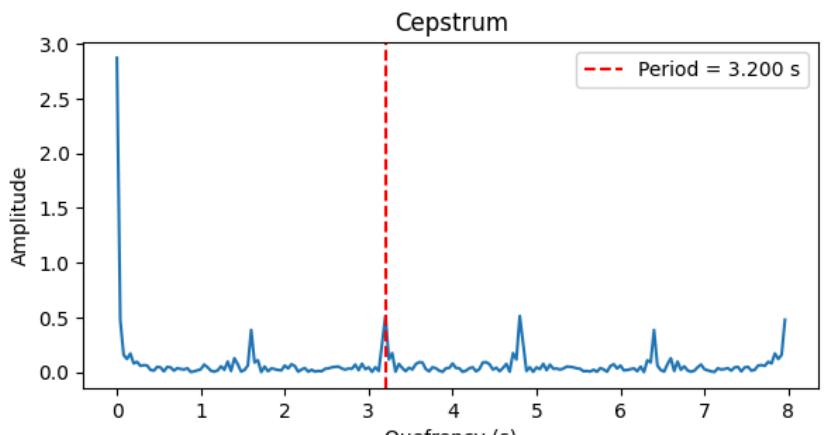
Dominant Frequency: 0.025 , Period: 40.201

PCC - FFT



Dominant Frequency: 0.025 , Period: 40.201

Histogram - Cepstrum

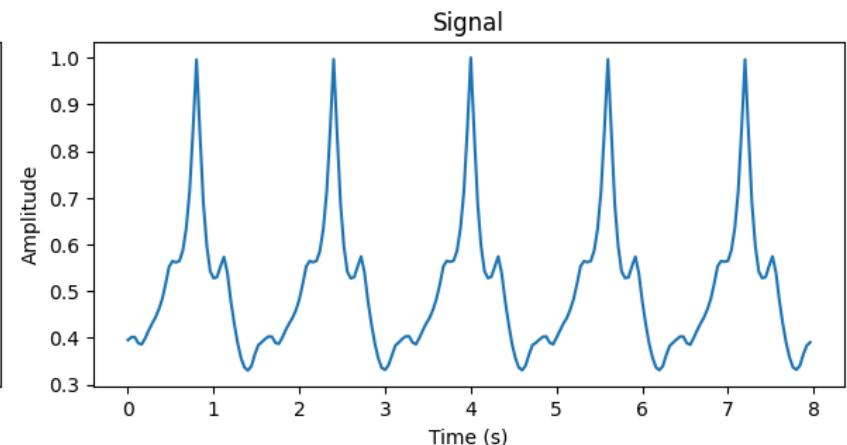
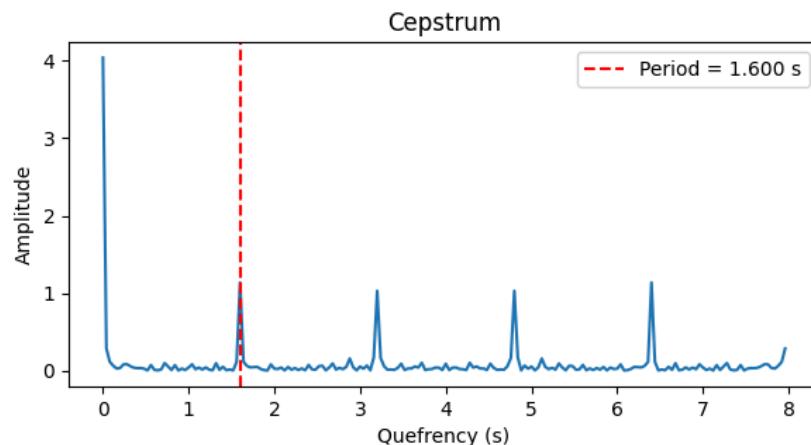


Question 15

Time (s)

Period: 3.200 seconds      Period: 80.000 frames

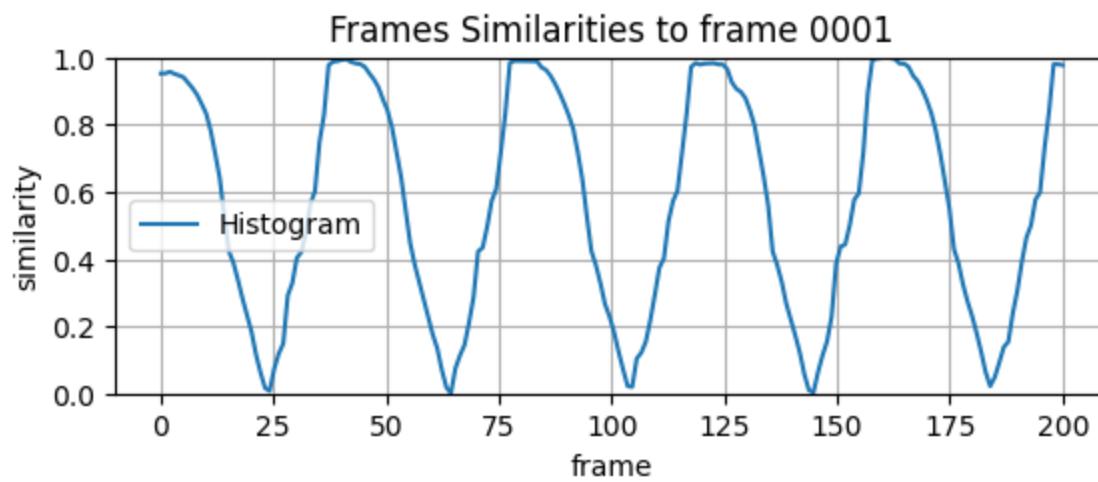
## PCC - Cepstrum



Period: 1.600 seconds      Period: 40.000 frames

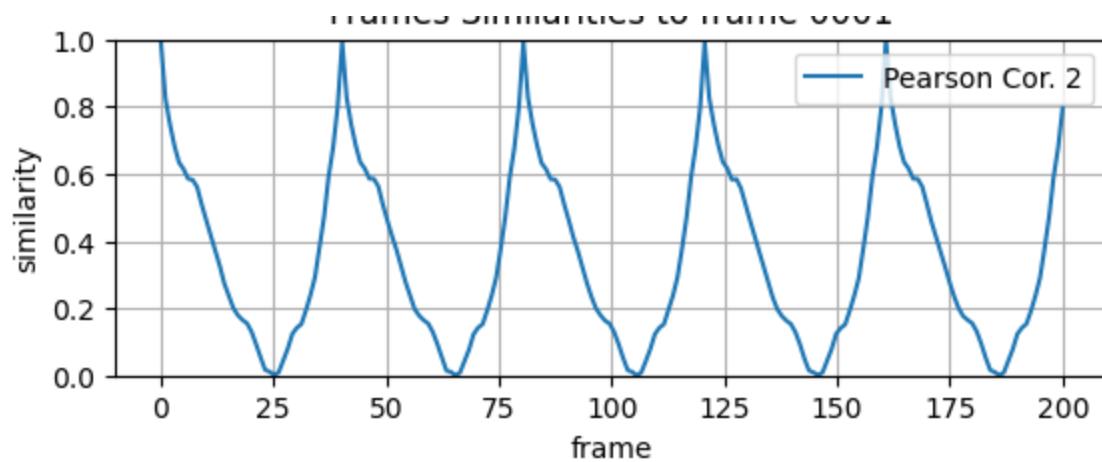
\* \* \* \* \* Video: 16 Reference frame at: (80%) 160 \* \* \* \* \*

## Similarity Signal - Histogram

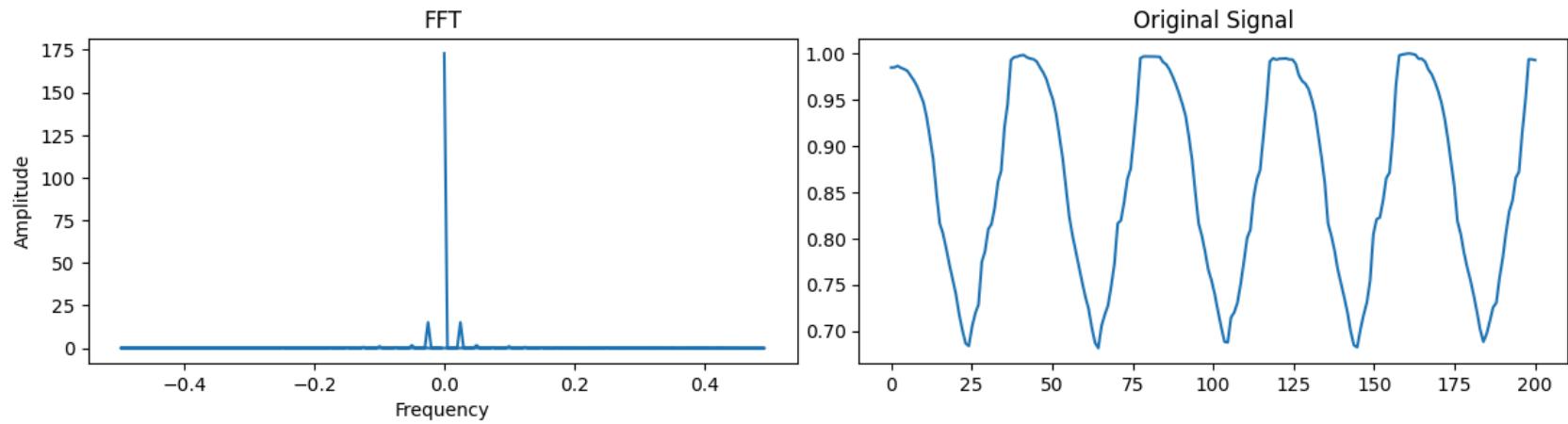


## Similarity Signal - Pearson Correlation

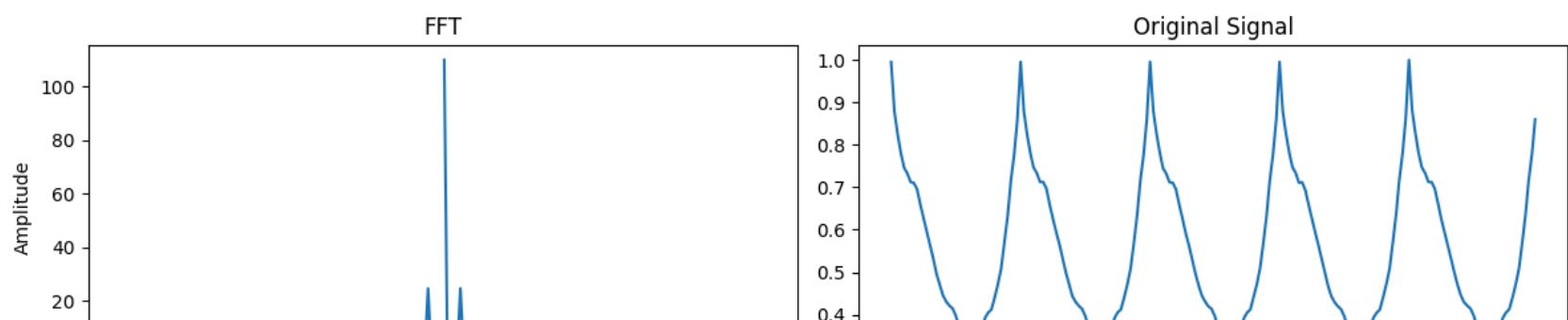
### Frames Similarities to frame 0001

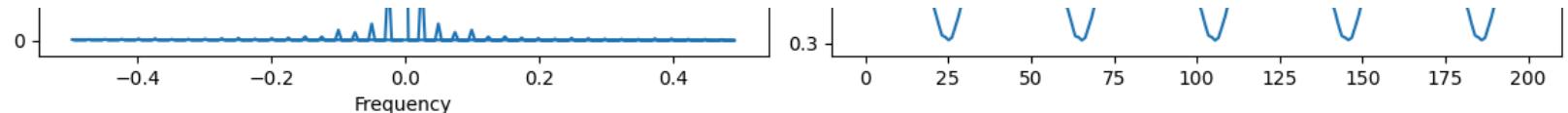


Histogram - FFT



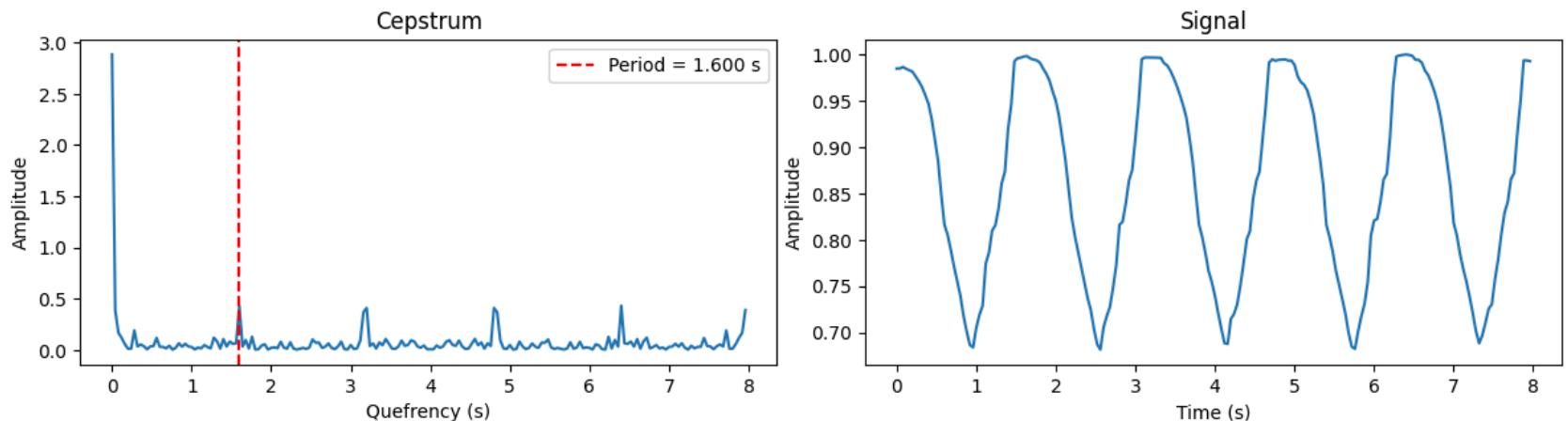
PCC - FFT





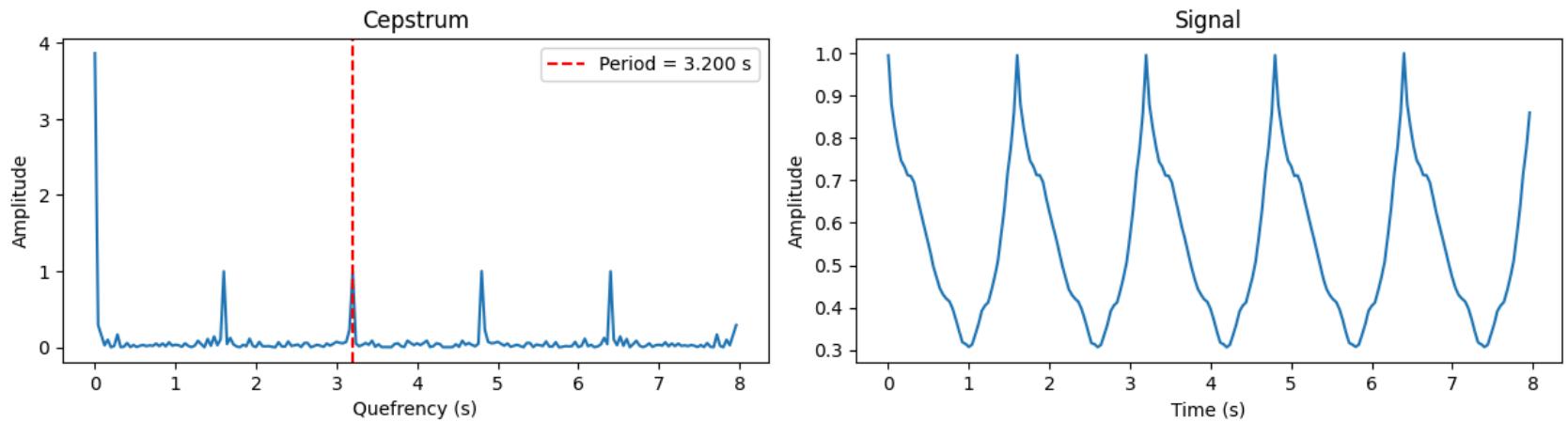
Dominant Frequency: 0.025 , Period: 40.201

## Histogram - Cepstrum



Period: 1.600 seconds Period: 40.000 frames

## PCC - Cepstrum

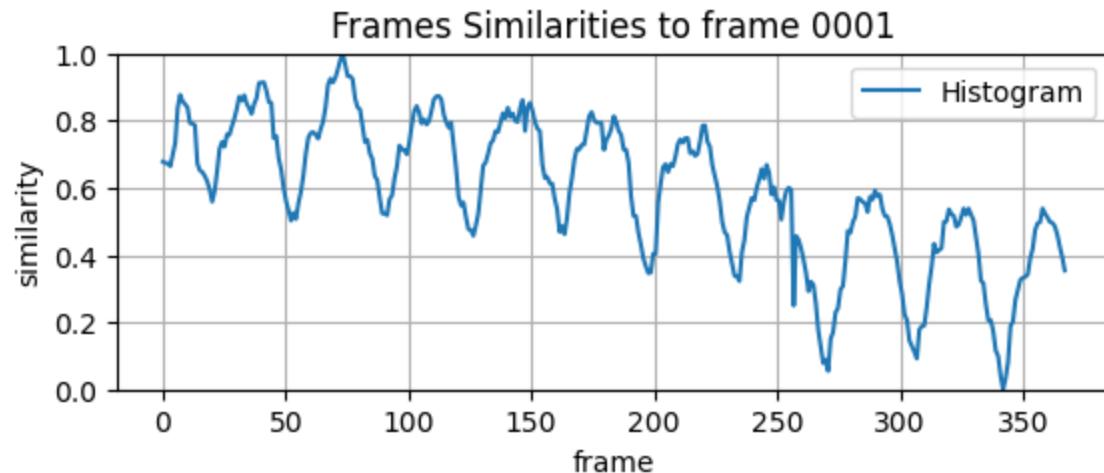


Period: 3.200 seconds      Period: 80.000 frames

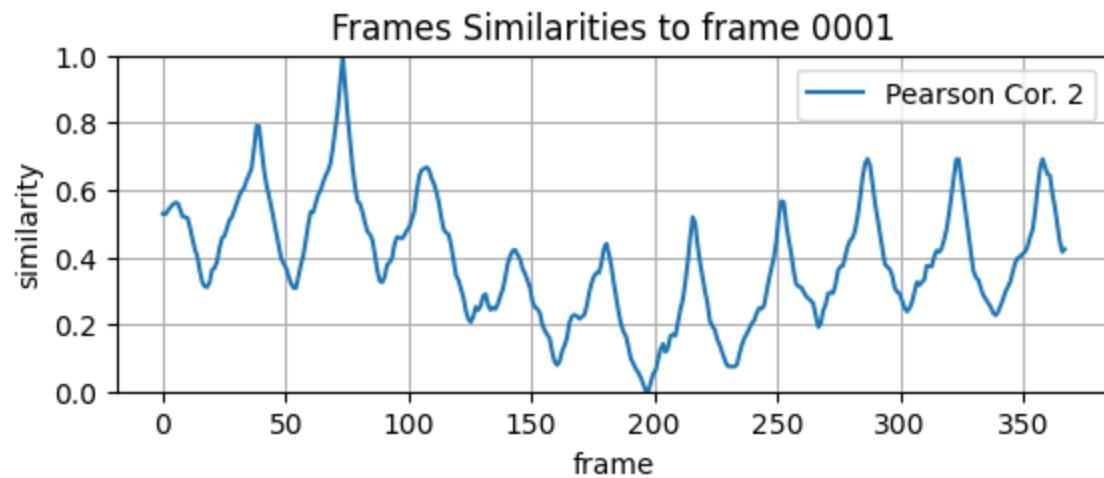
\* \* \* \* \* 17.webm Frames:367 FPS:23.976023976023978 \* \* \* \* \*

video: 1 / reference frame at: (20%) 15 frames

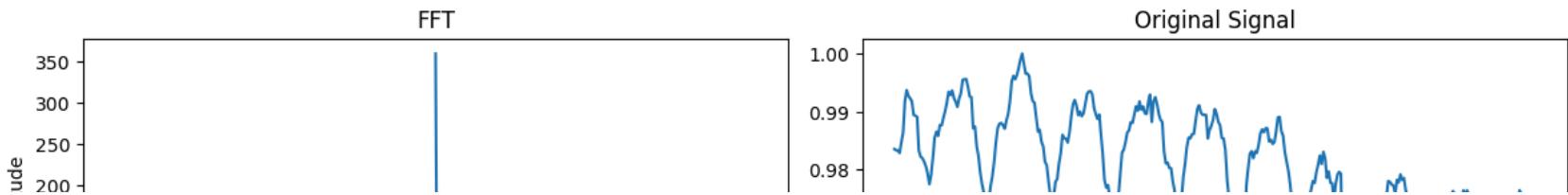
Similarity Signal - Histogram

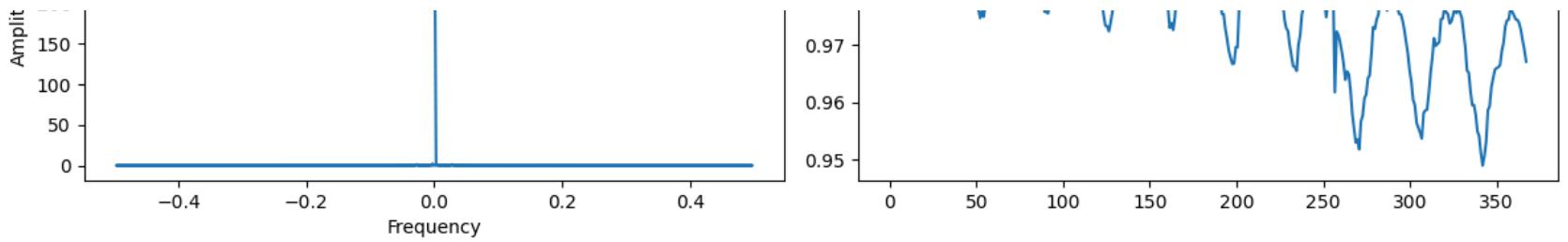


Similarity Signal - Pearson Correlation

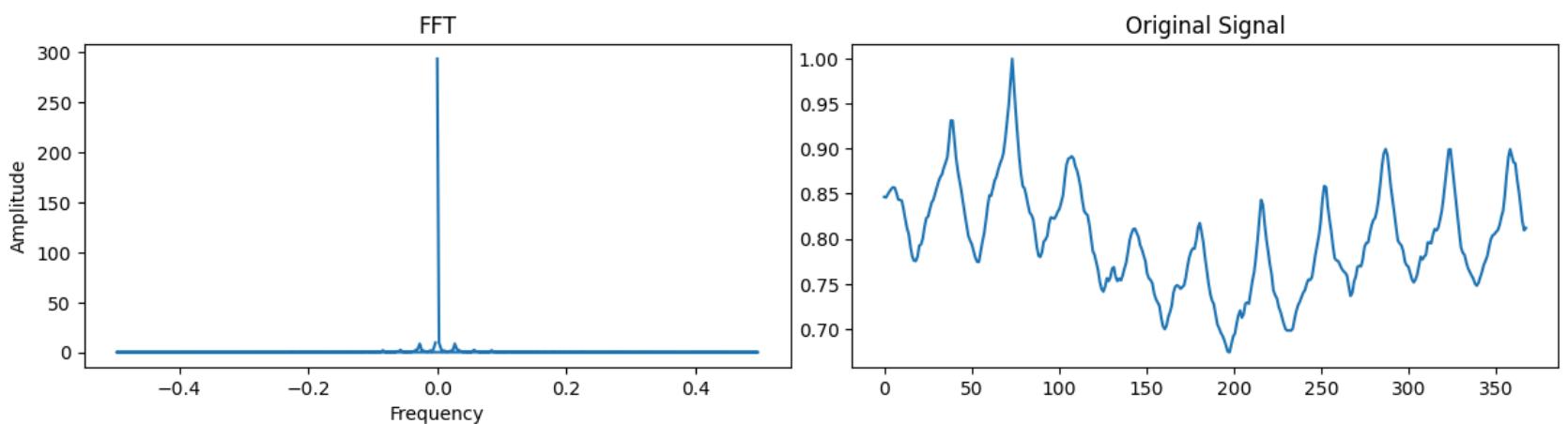


Histogram - FFT

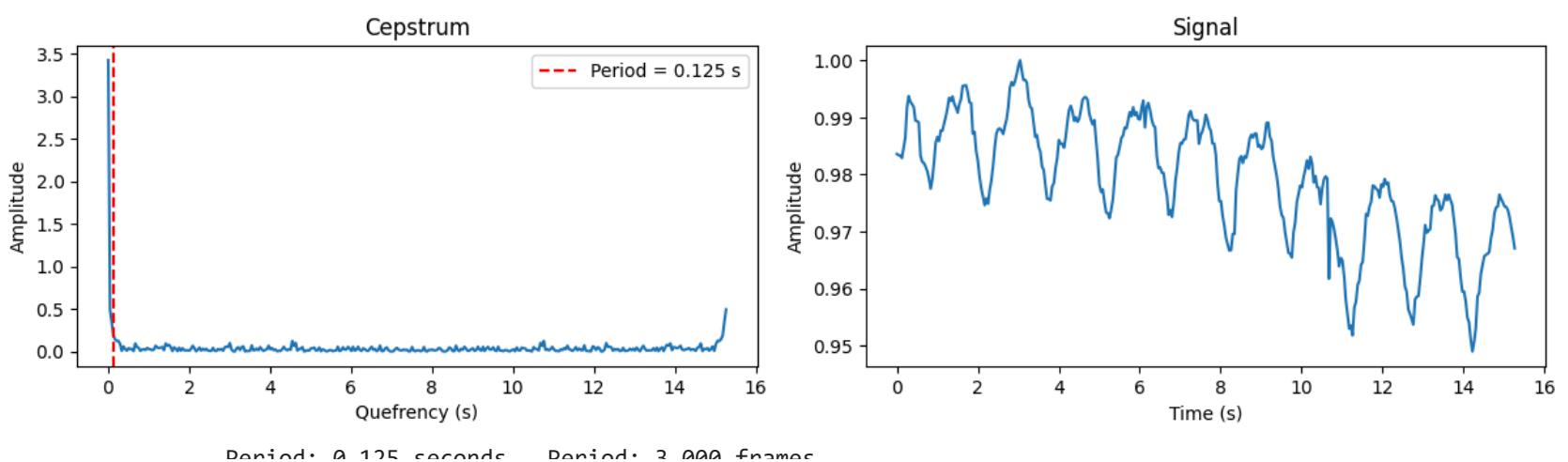




PCC - FFT

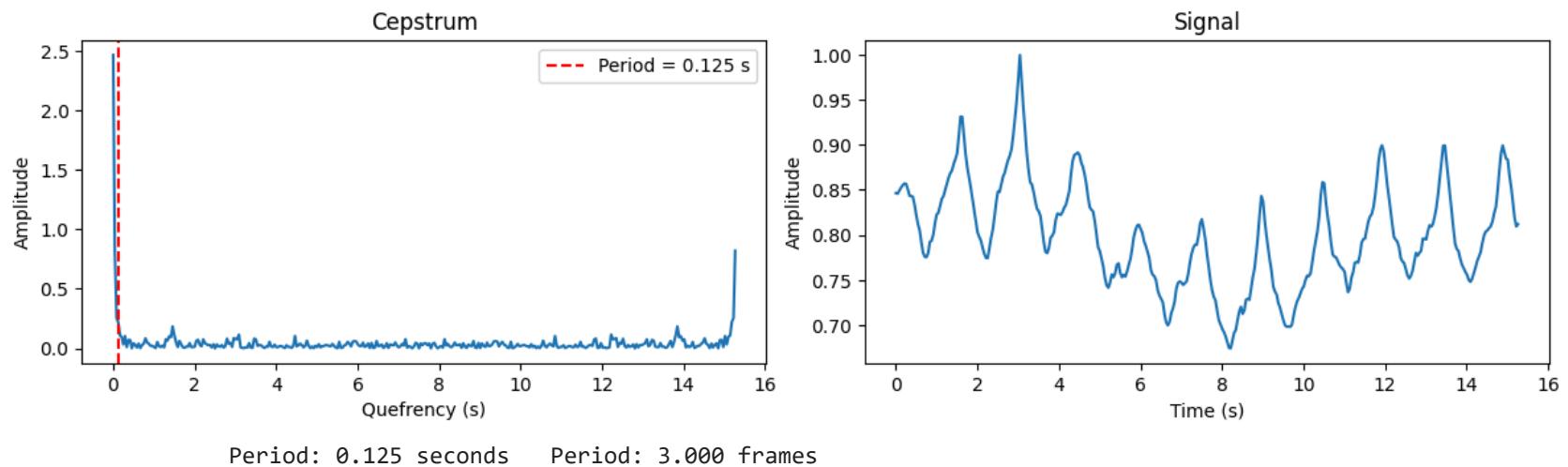


Histogram - Cepstrum



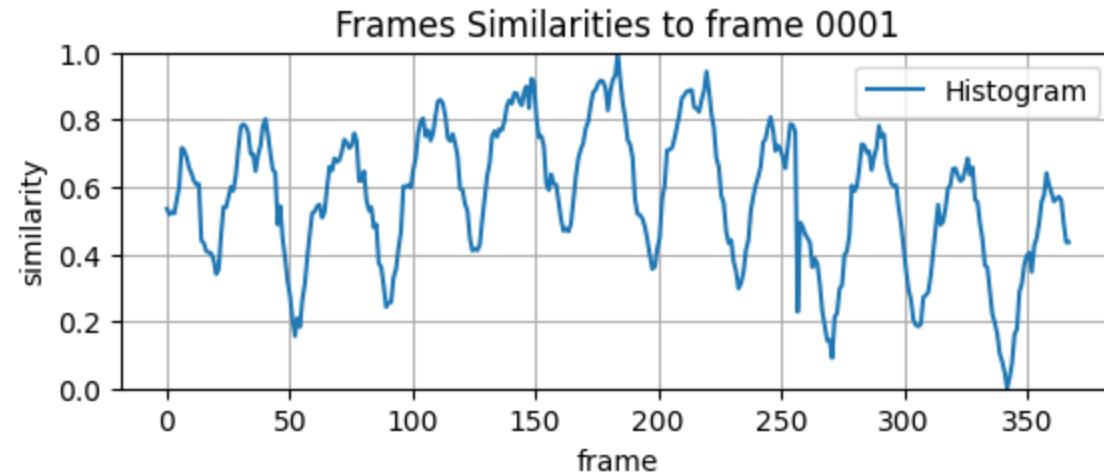
Period: 0.125 seconds      Period: 3.000 frames

### PCC - Cepstrum



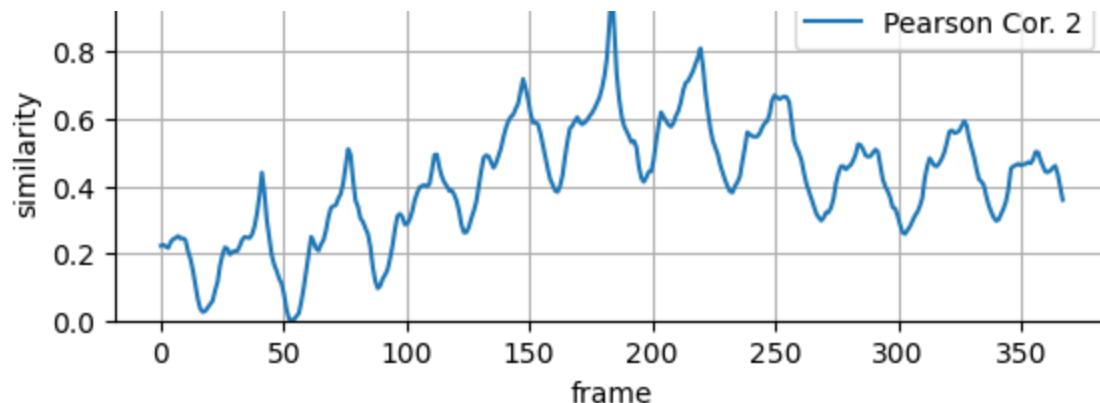
\* \* \* \* \* Video: 17 Reference frame at: (50%) 183 \* \* \* \* \*

### Similarity Signal - Histogram

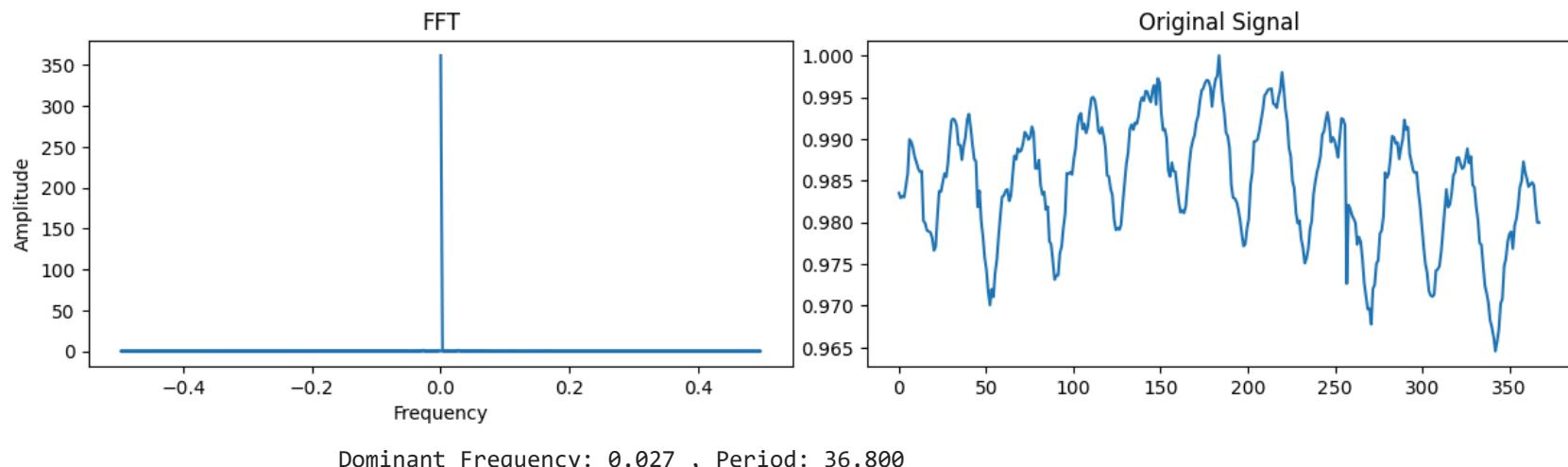


### Similarity Signal - Pearson Correlation

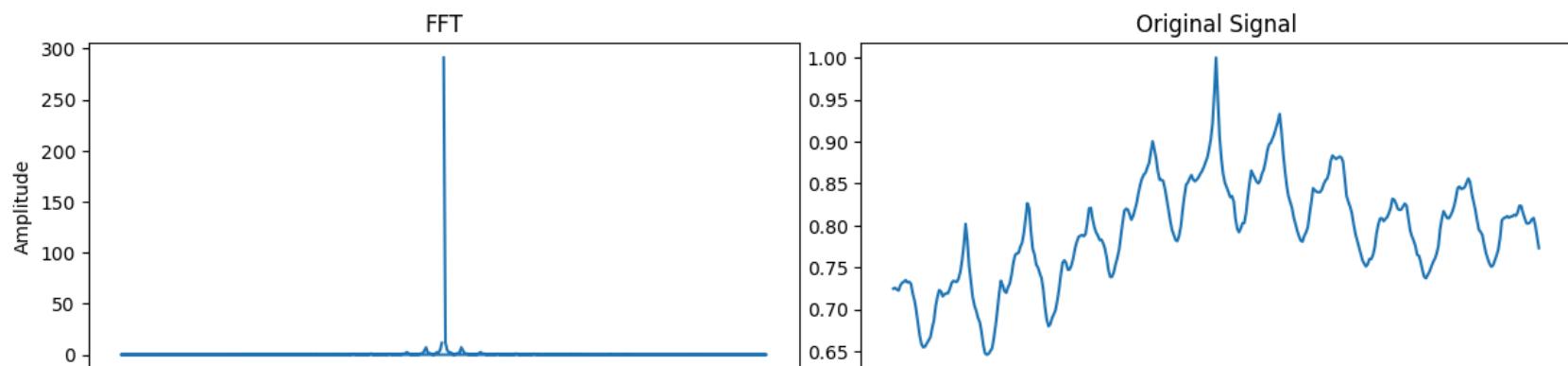


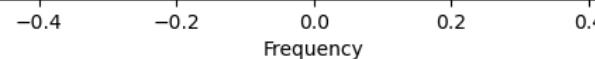


Histogram - FFT



PCC - FFT

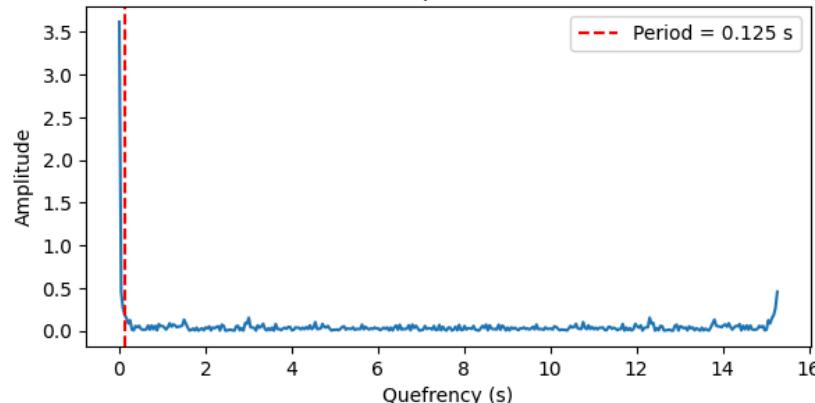




Dominant Frequency: 0.003 , Period: 368.003

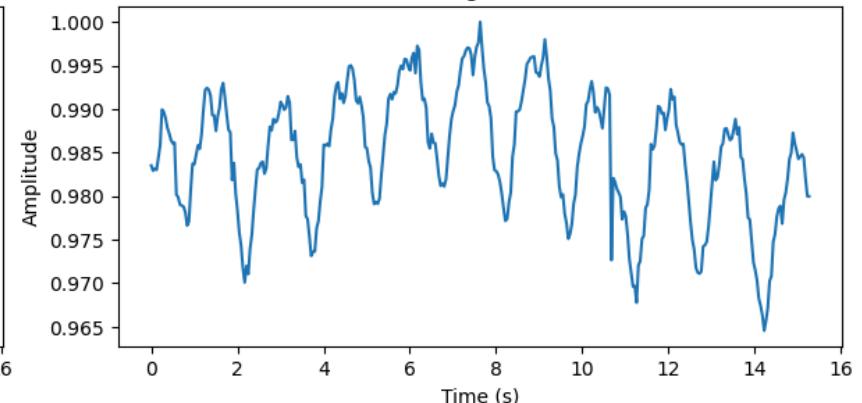
#### Histogram - Cepstrum

Cepstrum



Period: 0.125 seconds

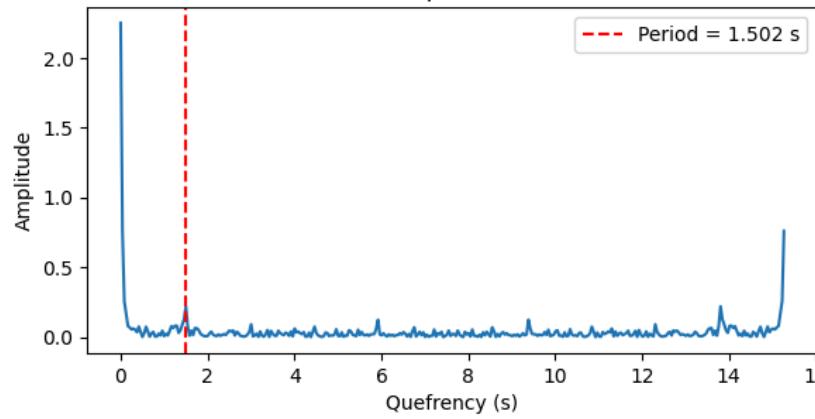
Signal



Period: 3.000 frames

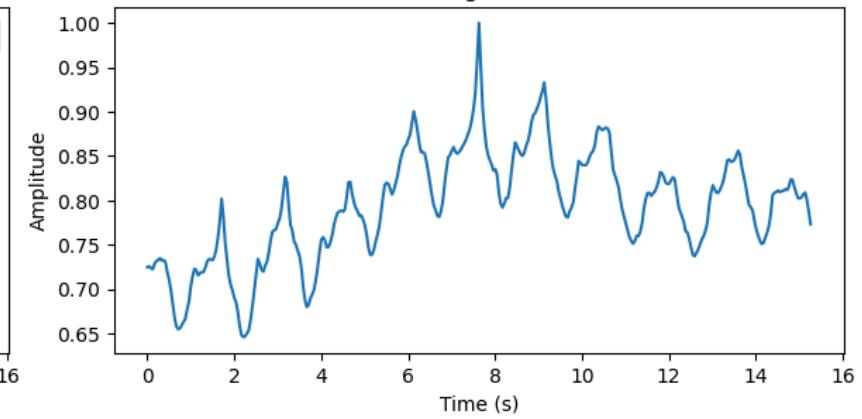
#### PCC - Cepstrum

Cepstrum



Period: 1.502 seconds      Period: 36.000 frames

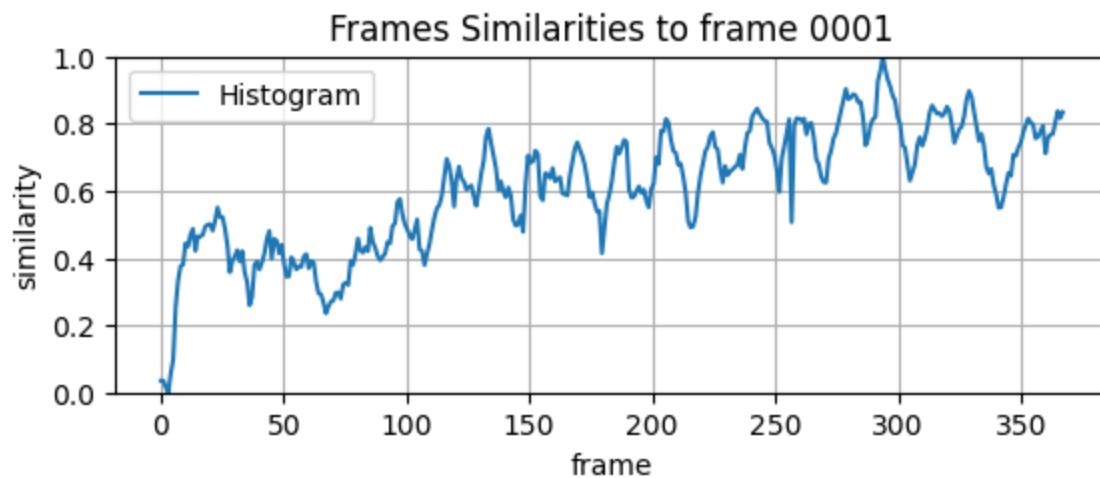
Signal



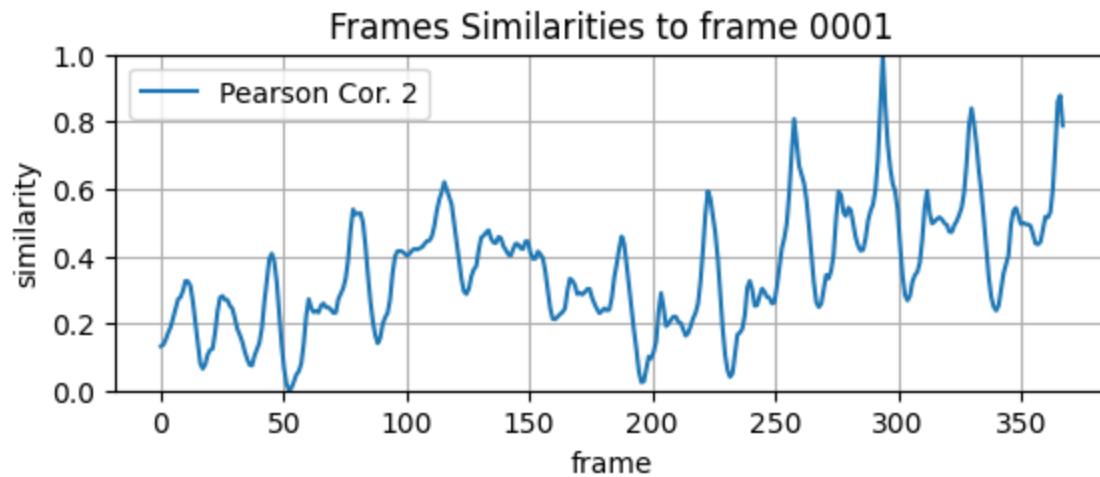
Period: 36.000 frames

\* \* \* \* \* Video: 17 Reference frame at: (80%) 293 \* \* \* \* \*

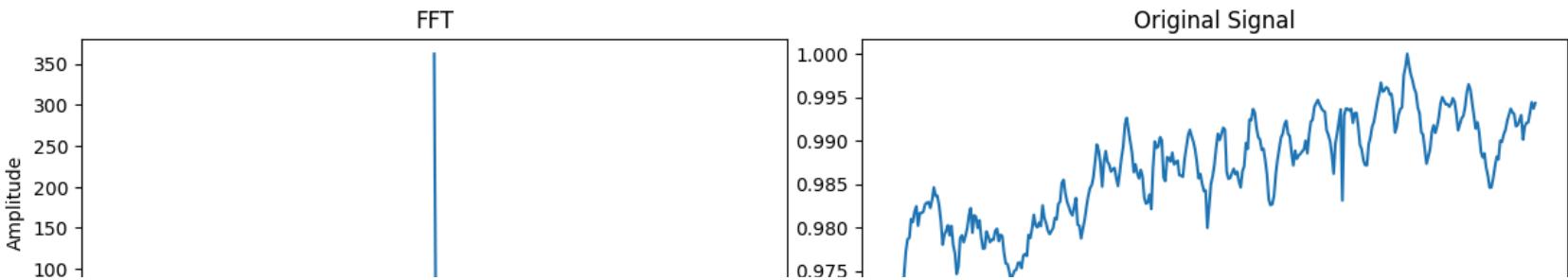
#### Similarity Signal - Histogram

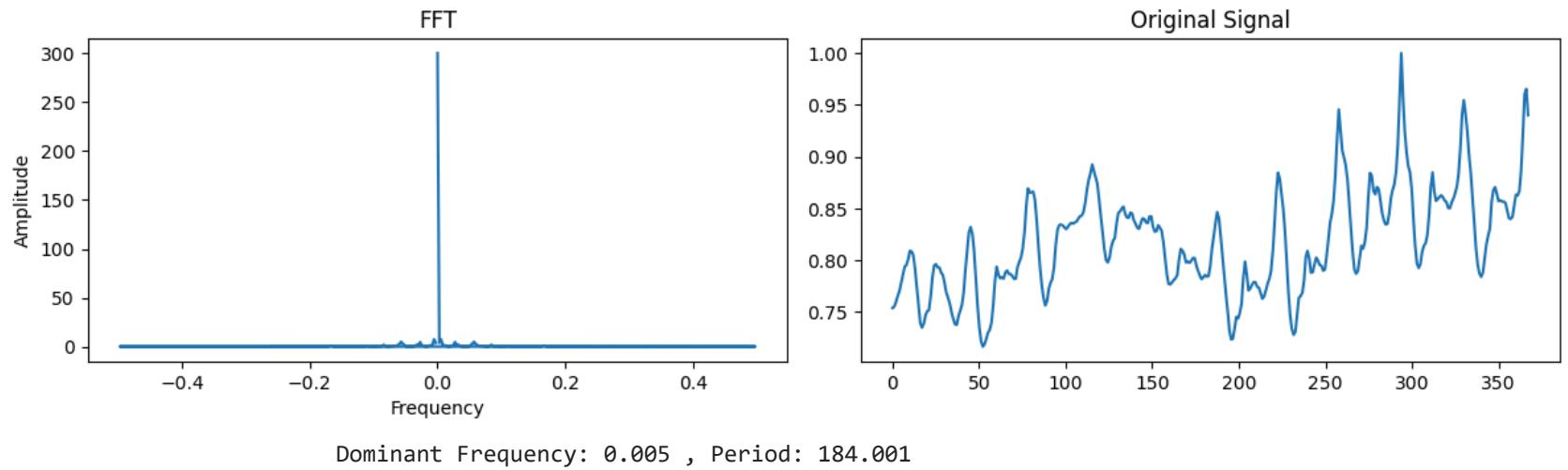
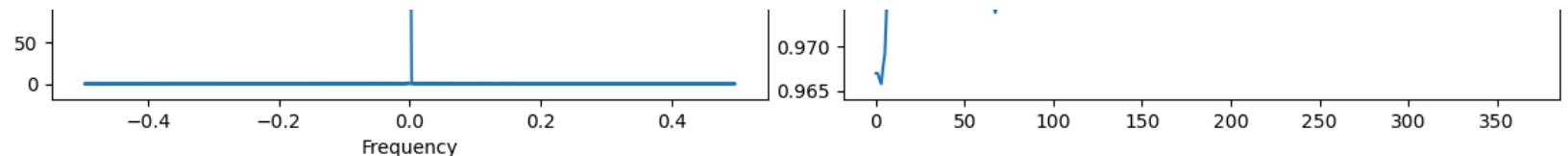


Similarity Signal - Pearson Correlation

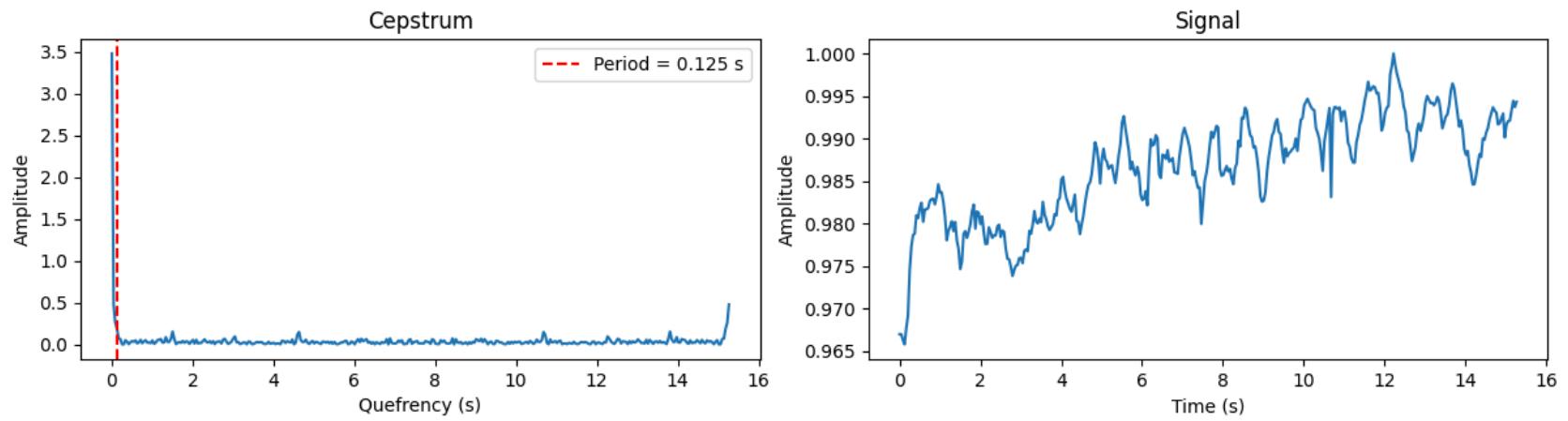


Histogram - FFT

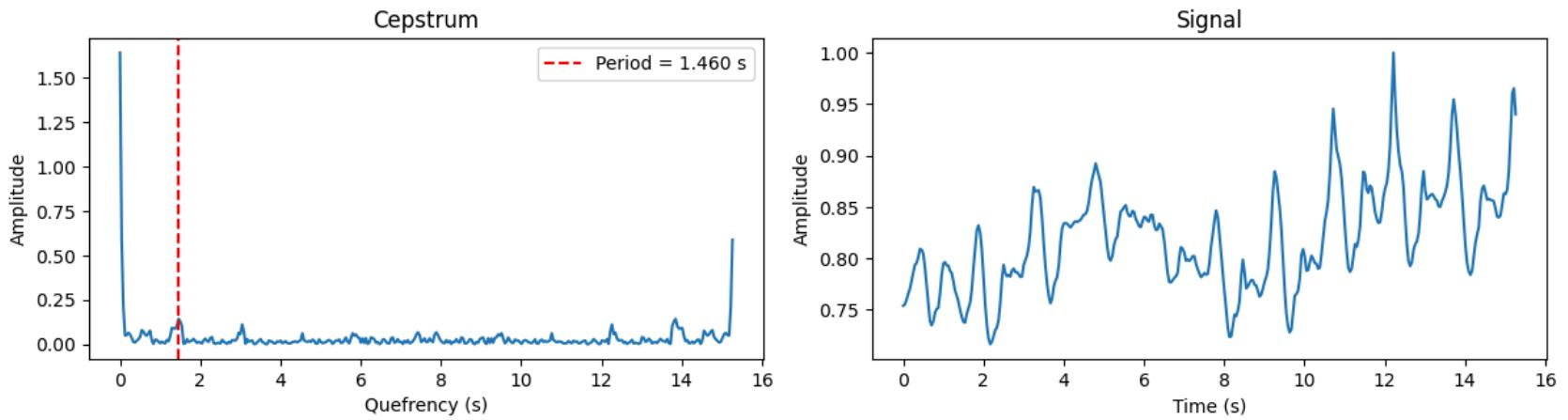




Histogram - Cepstrum



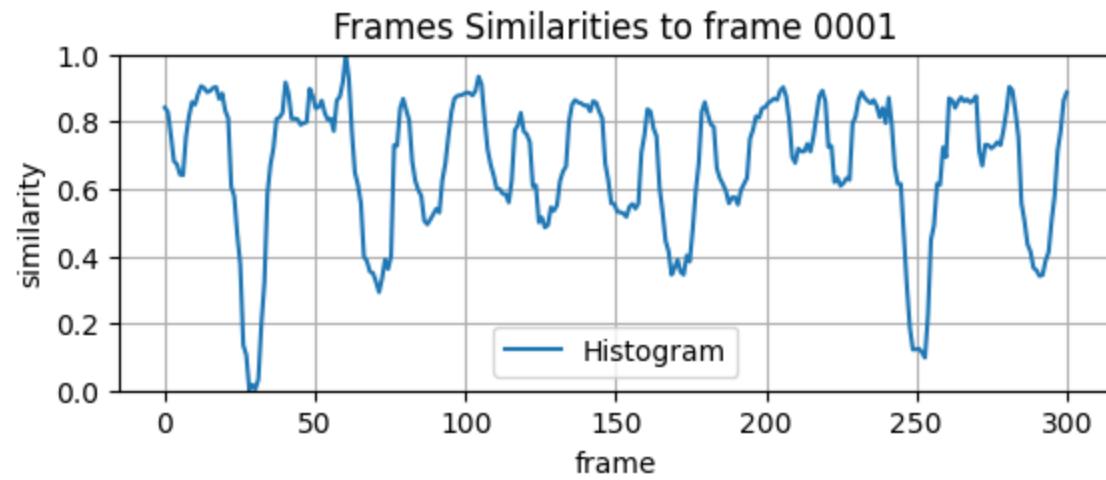
PCC - Cepstrum



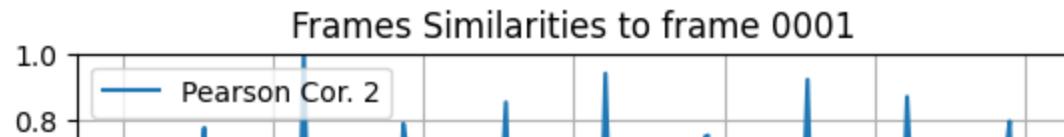
Period: 1.460 seconds      Period: 35.000 frames  
 \* \* \* \* \* 18.webm    Frames:300 FPS:30.0 \* \* \* \* \*

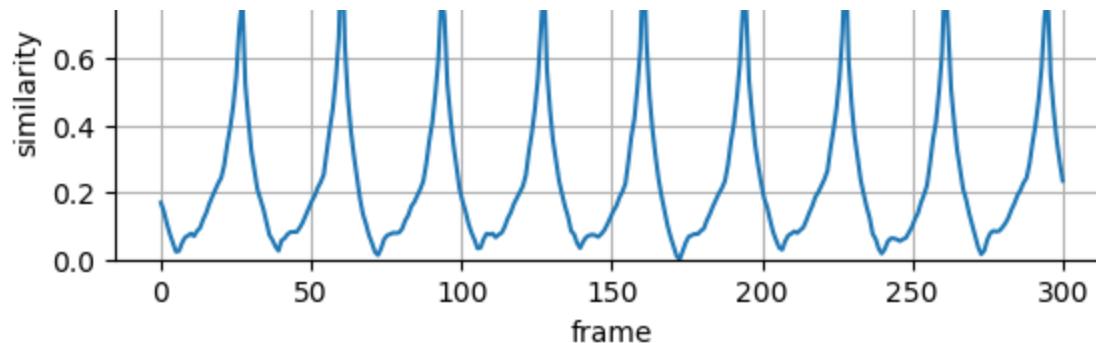
\* \* \* \* \* Video: 18 Reference frame at: (20%) 60 \* \* \* \* \*

Similarity Signal - Histogram

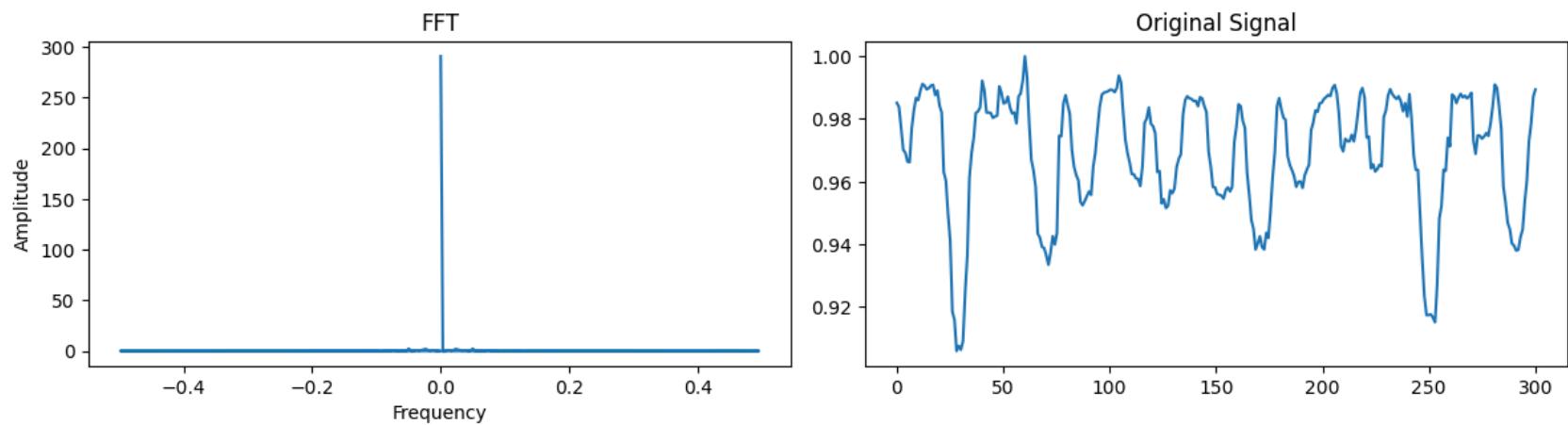


Similarity Signal - Pearson Correlation

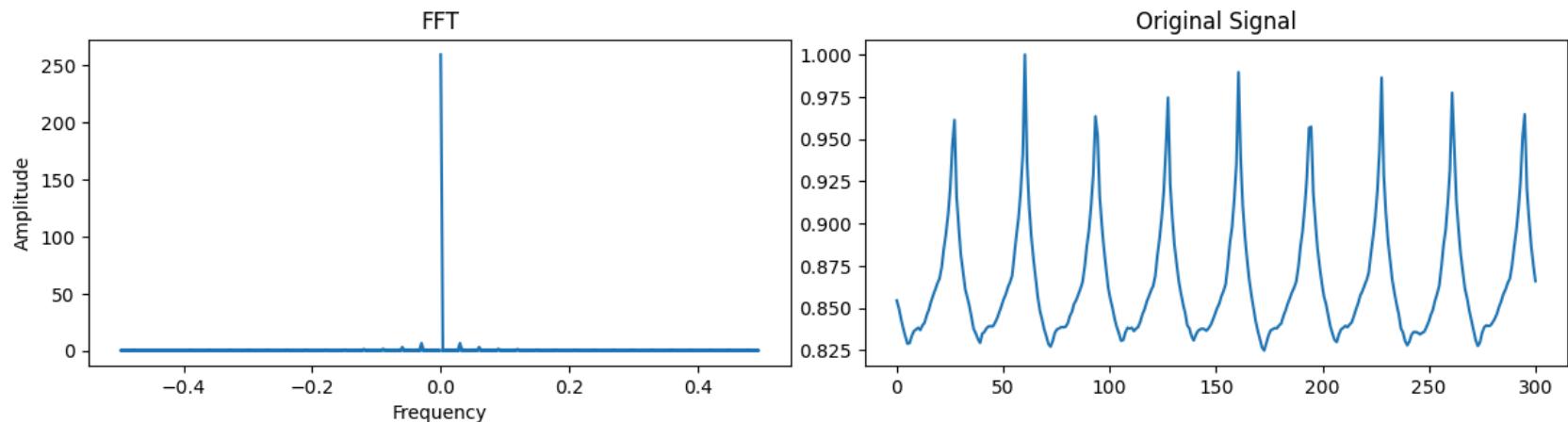




Histogram - FFT

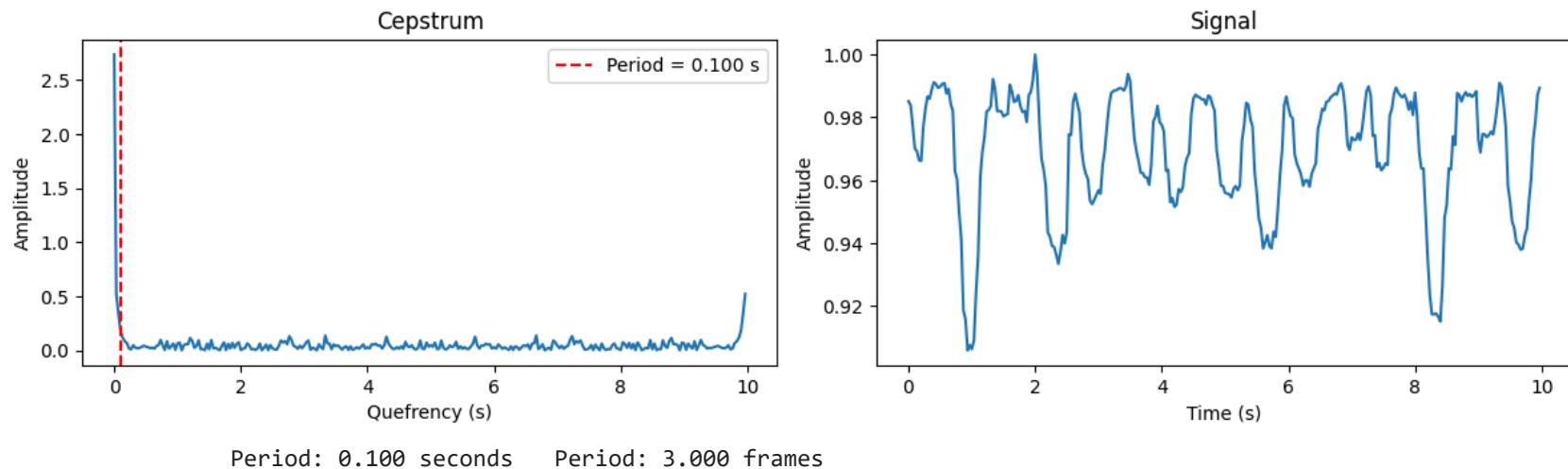


PCC - FFT

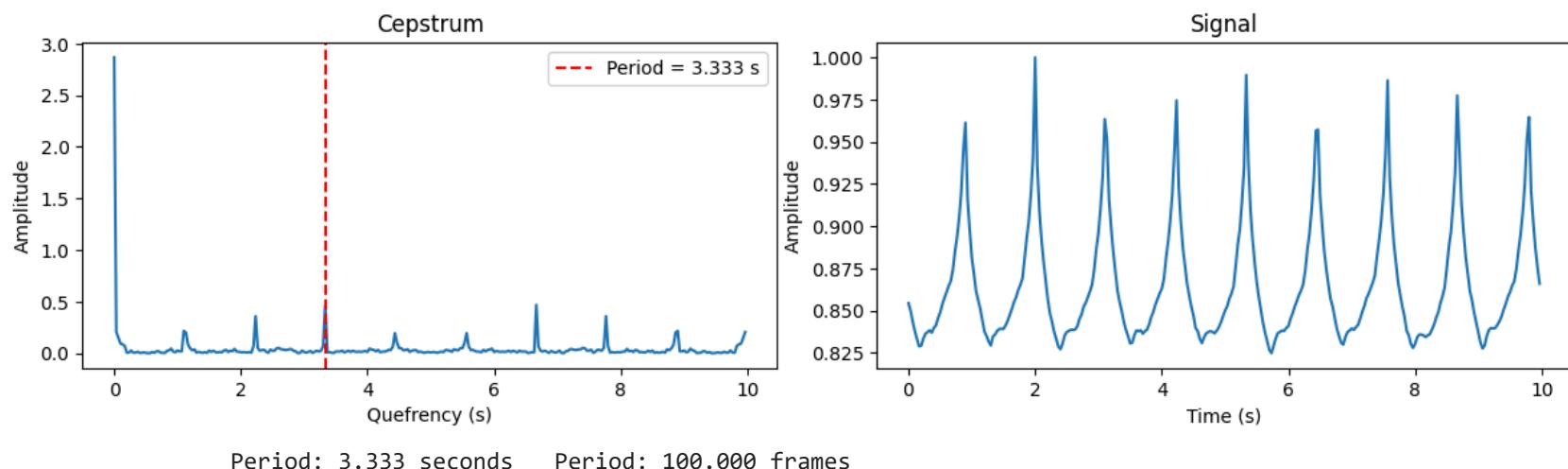


Dominant Frequency: 0.030 , Period: 33.445

## Histogram - Cepstrum

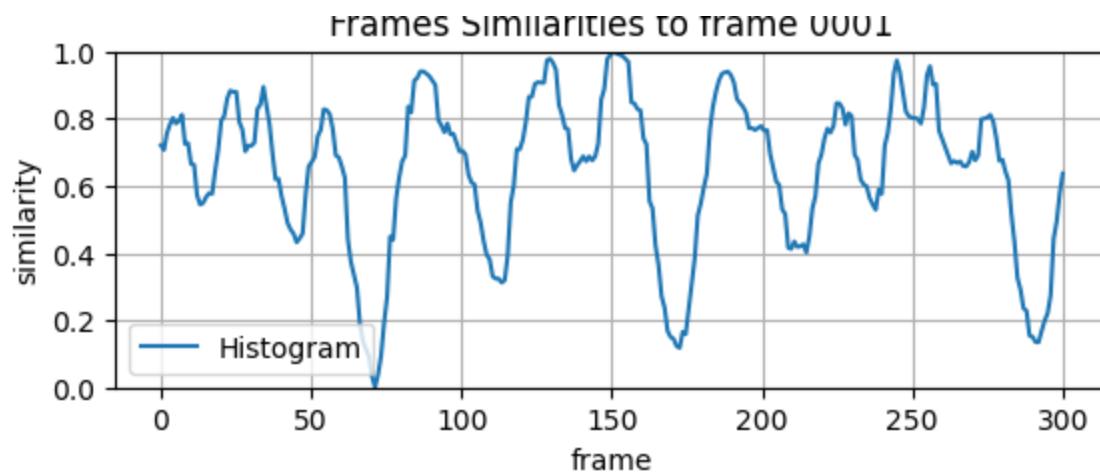


PCC - Cepstrum

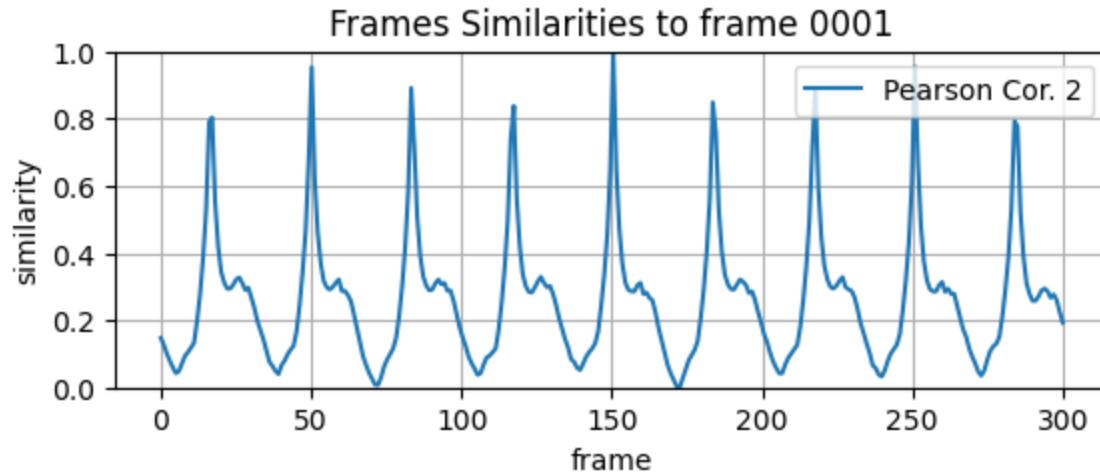


\* \* \* \* \* Video: 18 Reference frame at: (50%) 150 \* \* \* \* \*

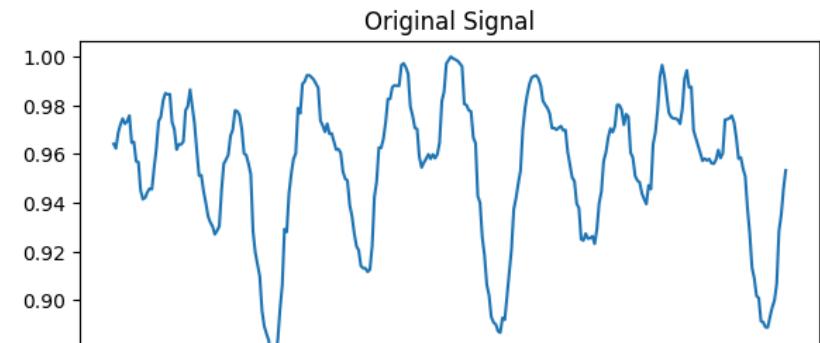
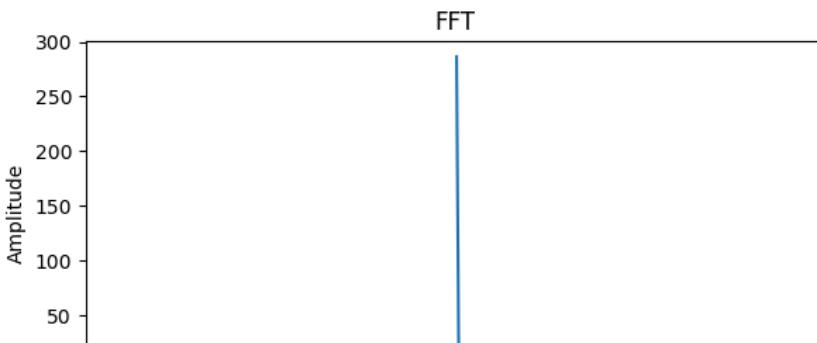
Similarity Signal - Histogram

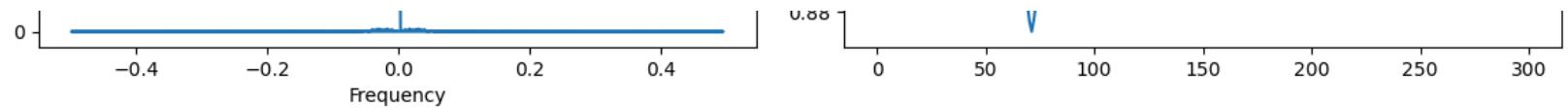


Similarity Signal - Pearson Correlation



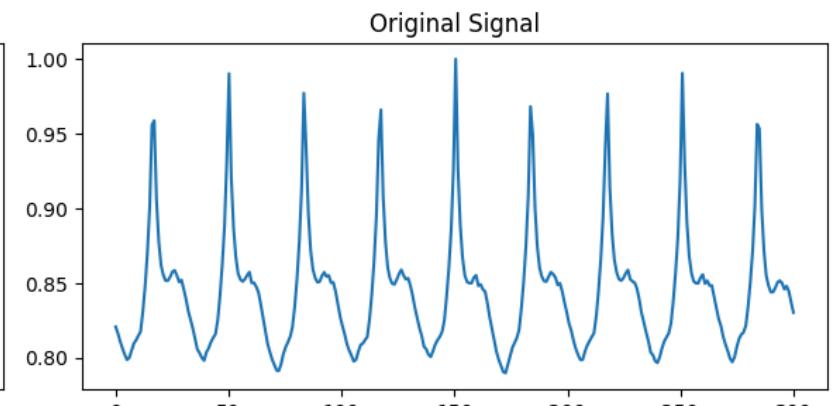
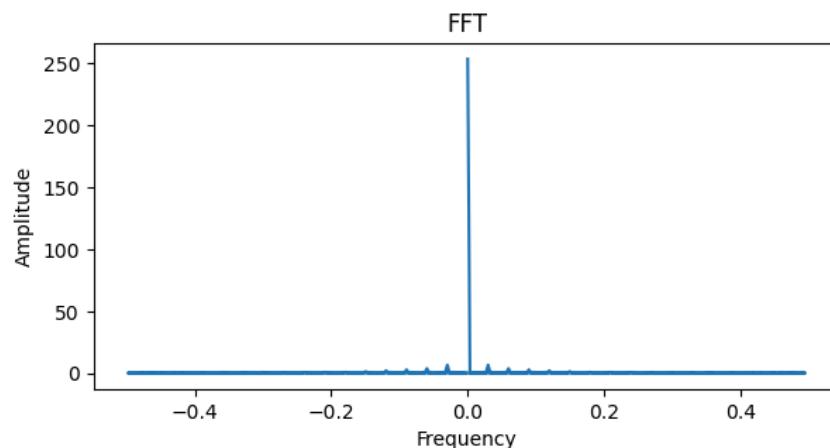
Histogram - FFT





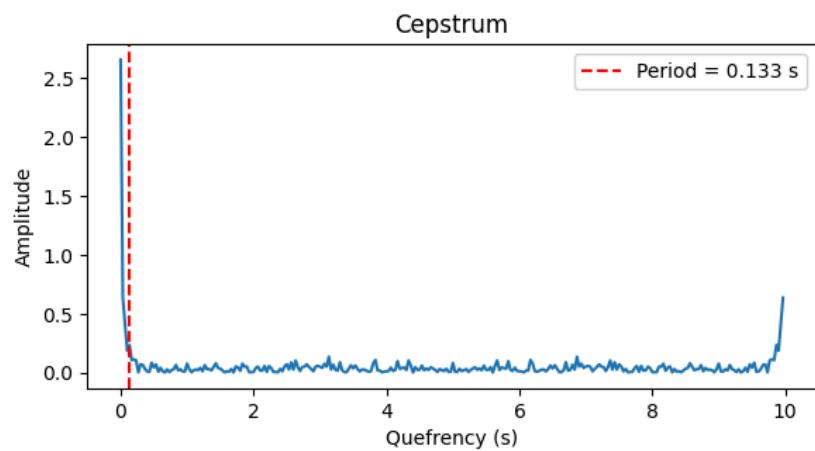
Dominant Frequency: 0.017 , Period: 60.201

PCC - FFT

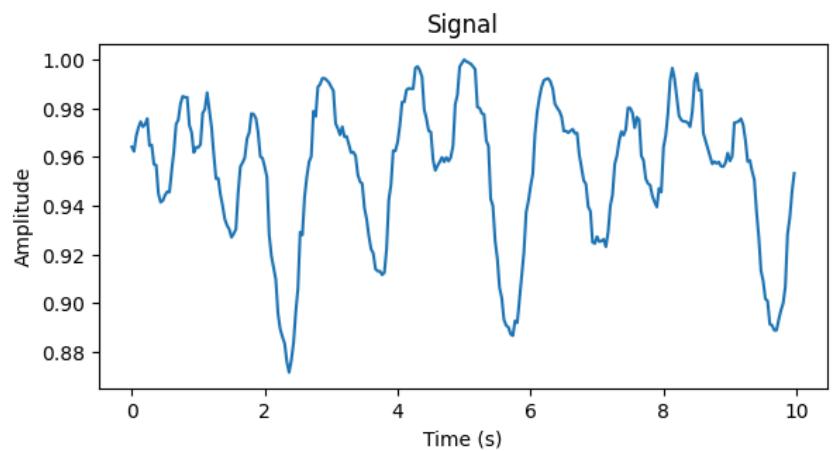


Dominant Frequency: 0.030 , Period: 33.445

Histogram - Cepstrum



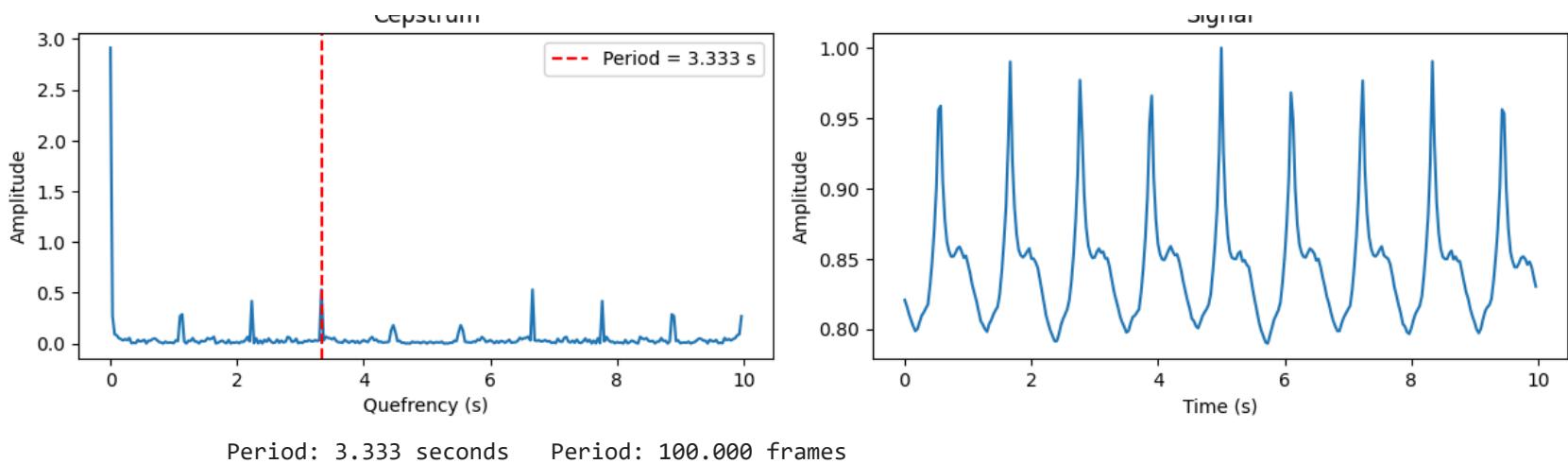
Period: 0.133 seconds      Period: 4.000 frames



PCC - Cepstrum

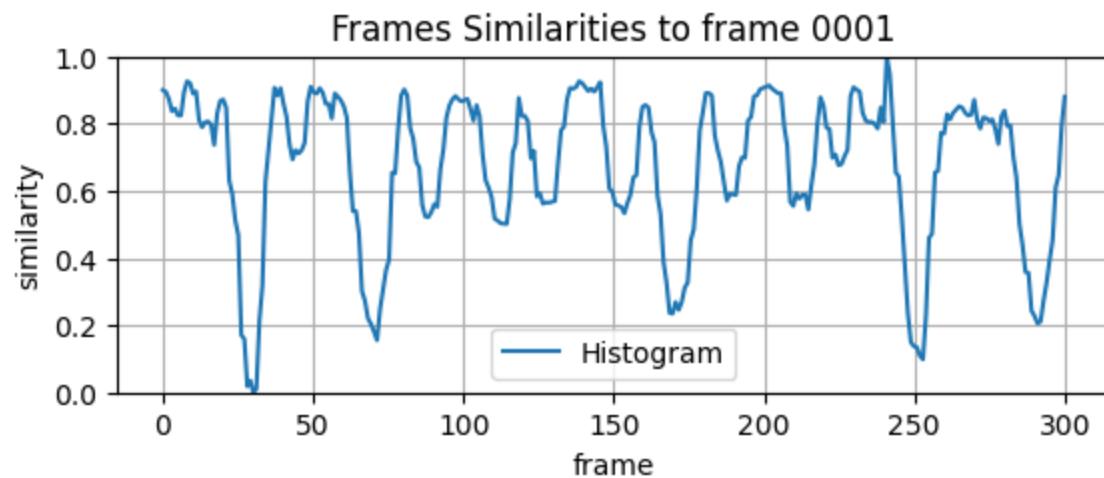
Cepstrum

Signal

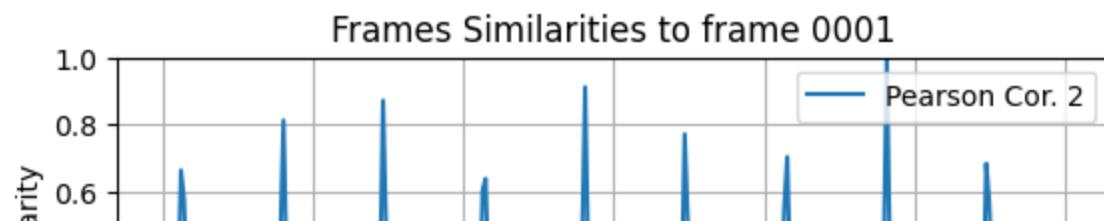


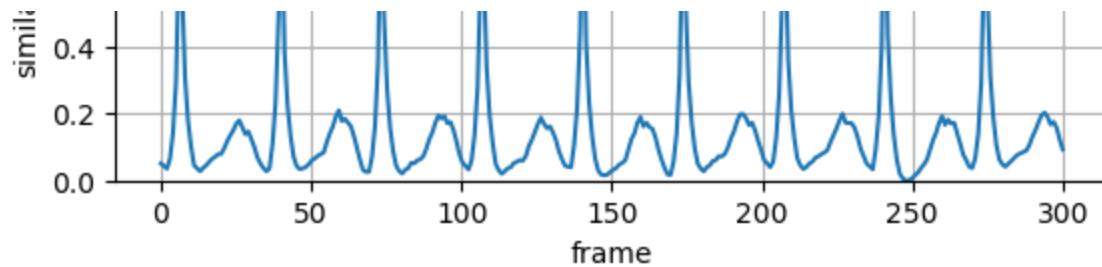
\* \* \* \* \* Video: 18 Reference frame at: (80%) 240 \* \* \* \* \*

Similarity Signal - Histogram

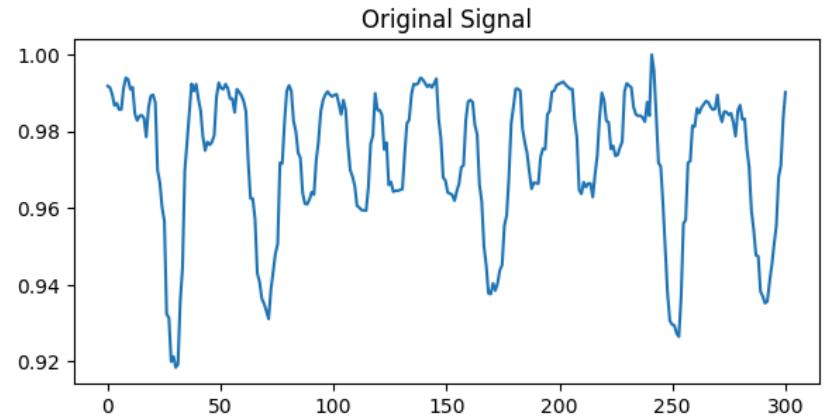
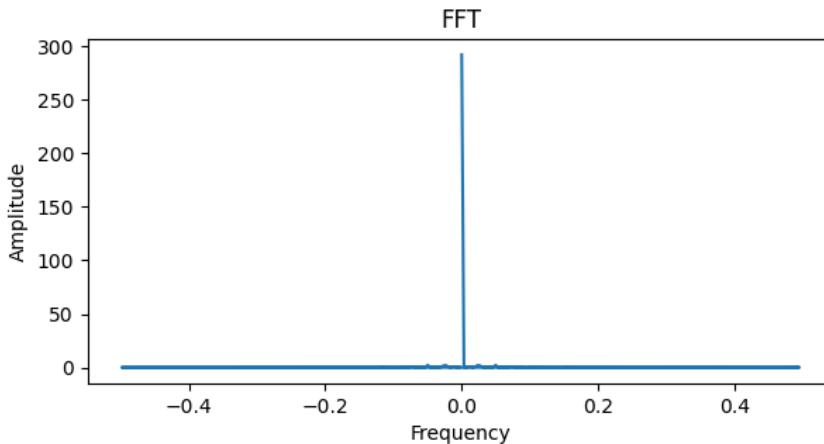


Similarity Signal - Pearson Correlation



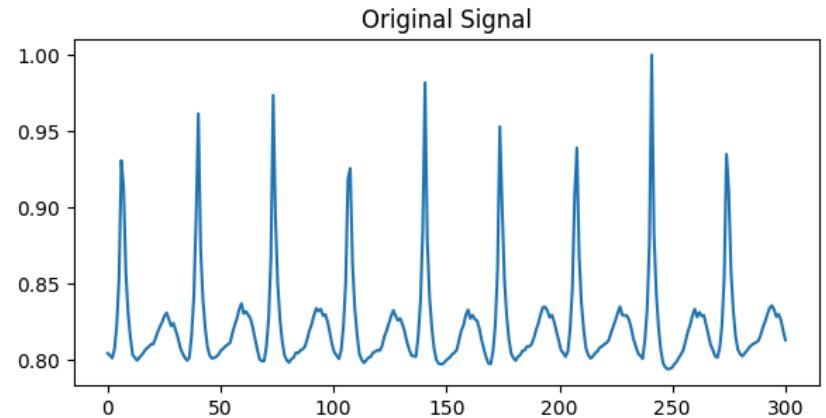
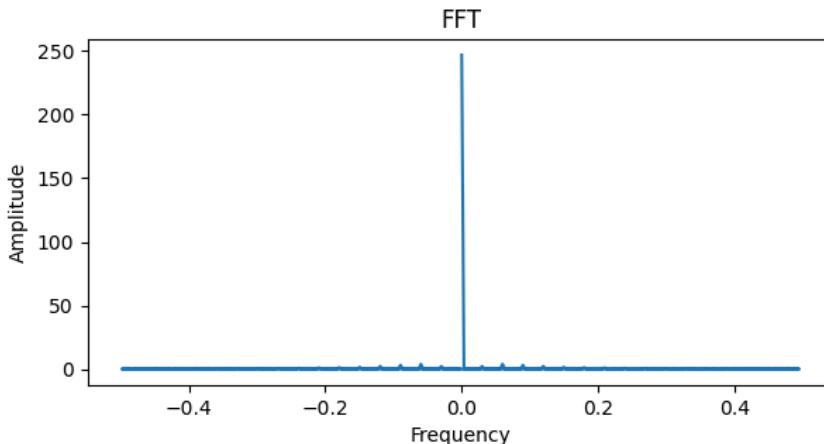


Histogram - FFT



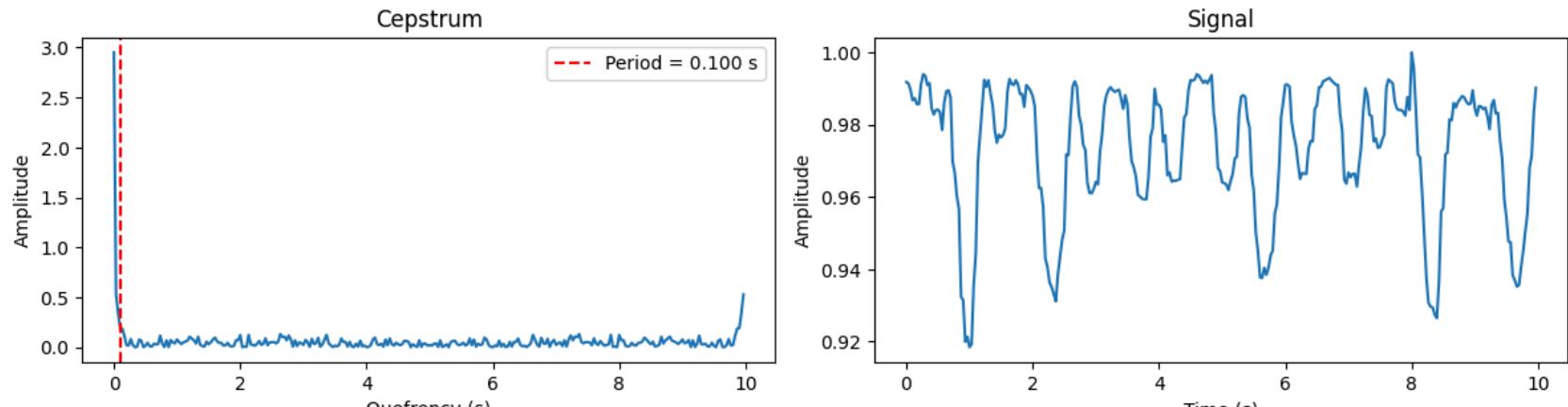
Dominant Frequency: 0.050 , Period: 20.067

PCC - FFT



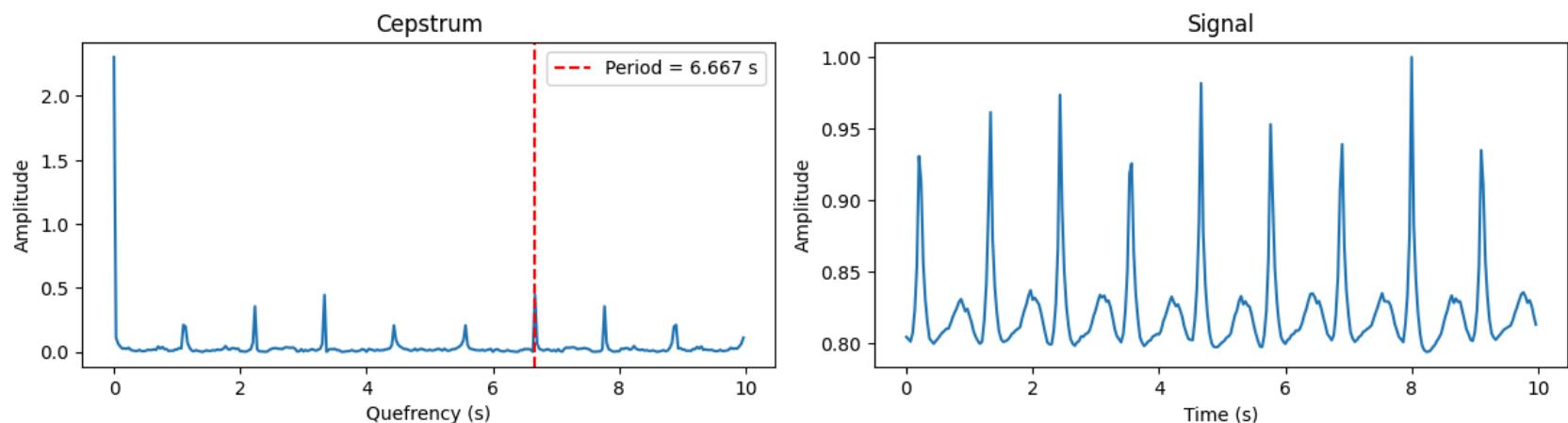
Dominant Frequency: 0.060 , Period: 16.722

Histogram - Cepstrum



Period: 0.100 seconds      Period: 3.000 frames

PCC - Cepstrum



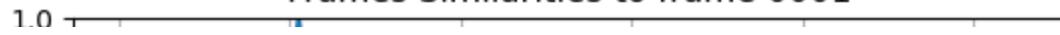
Period: 6.667 seconds      Period: 200.000 frames

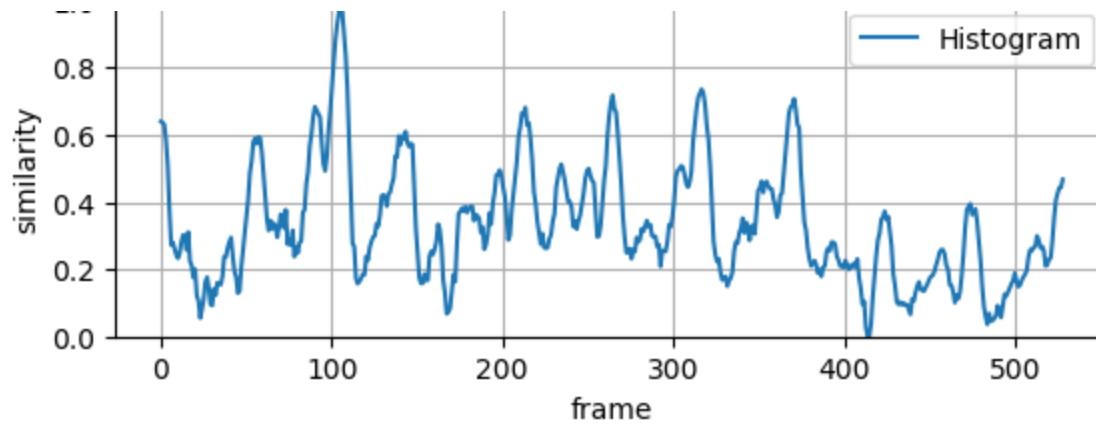
\* \* \* \* \* 19.mp4    Frames:528 FPS:25.0 \* \* \* \* \*

\* \* \* \* \* Video: 19 Reference frame at: (20%) 105 \* \* \* \* \*

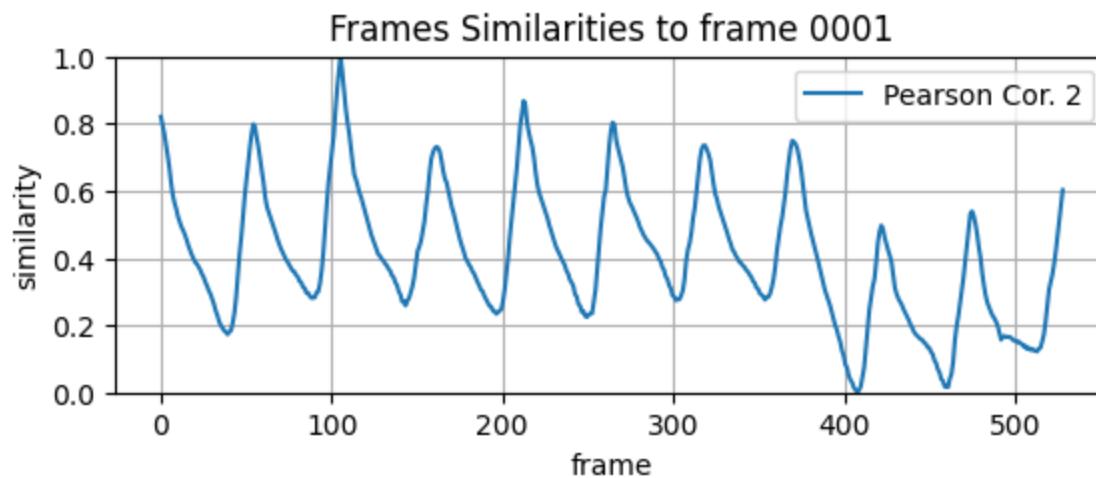
Similarity Signal - Histogram

### Frames Similarities to frame 0001

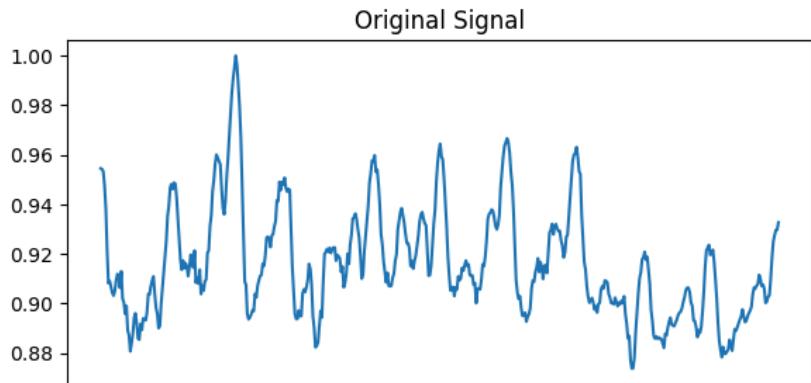
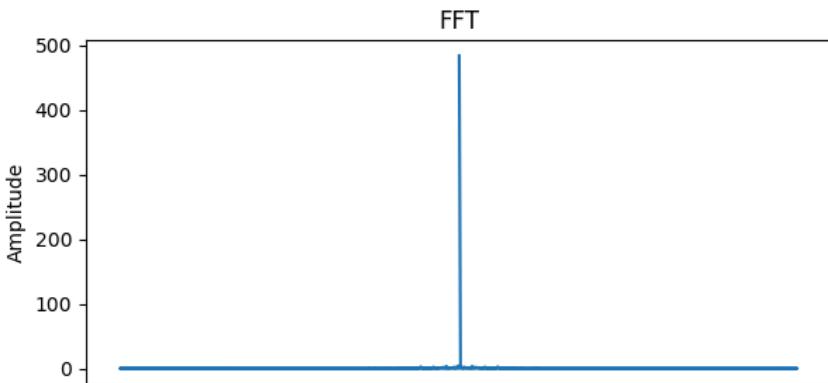




Similarity Signal - Pearson Correlation

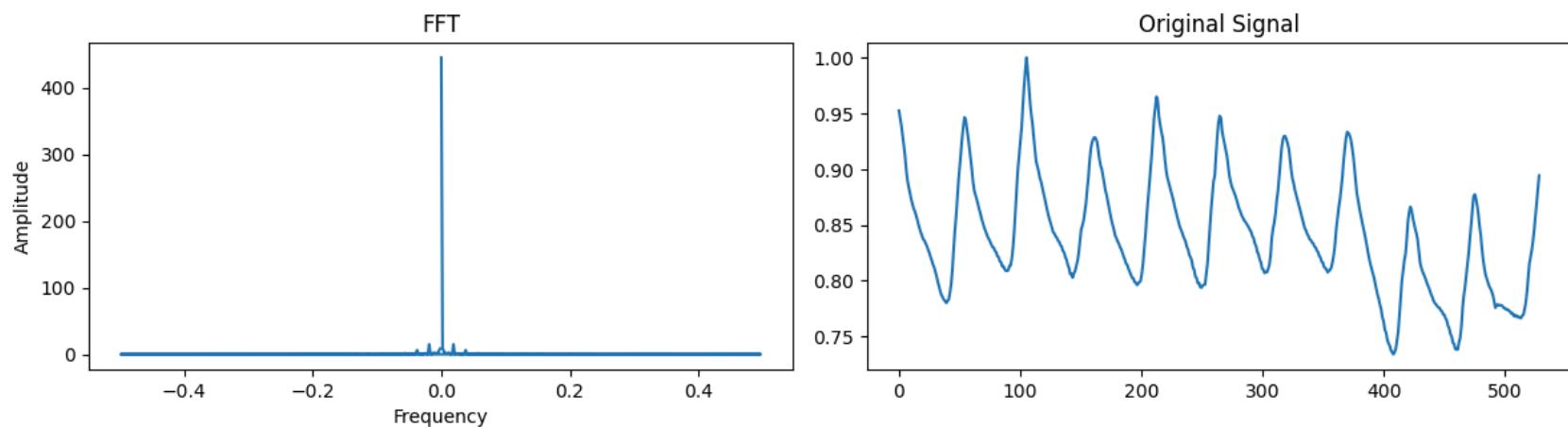


Histogram - FFT



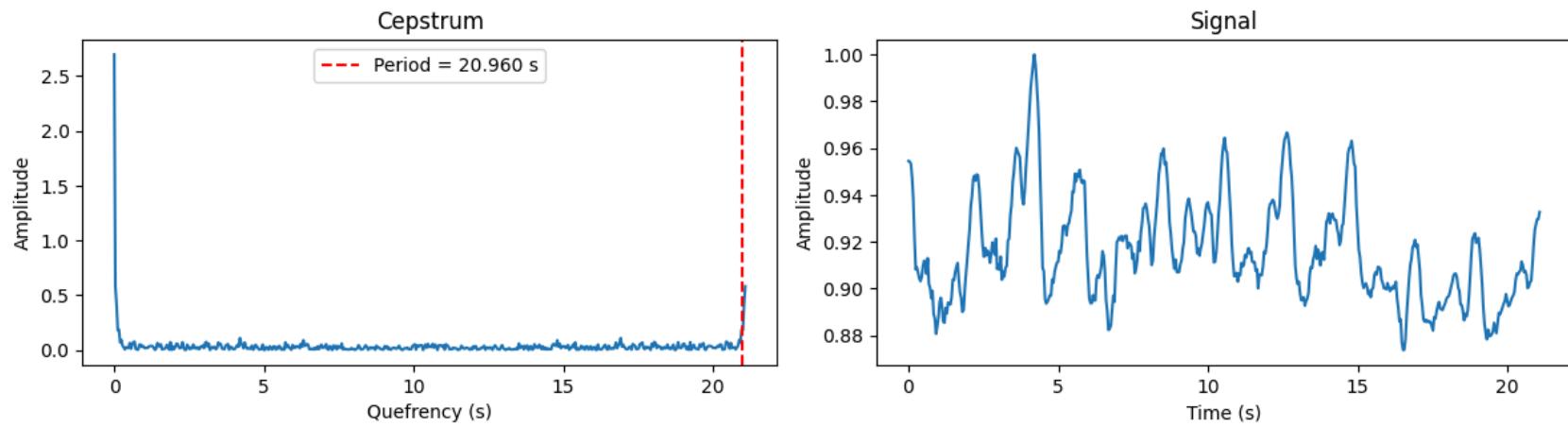


PCC - FFT



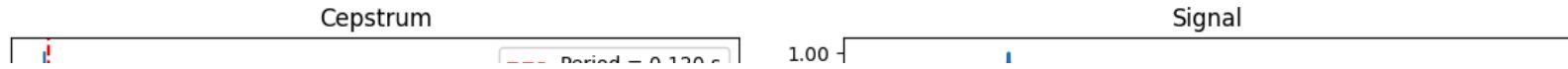
Dominant Frequency: 0.019 , Period: 52.900

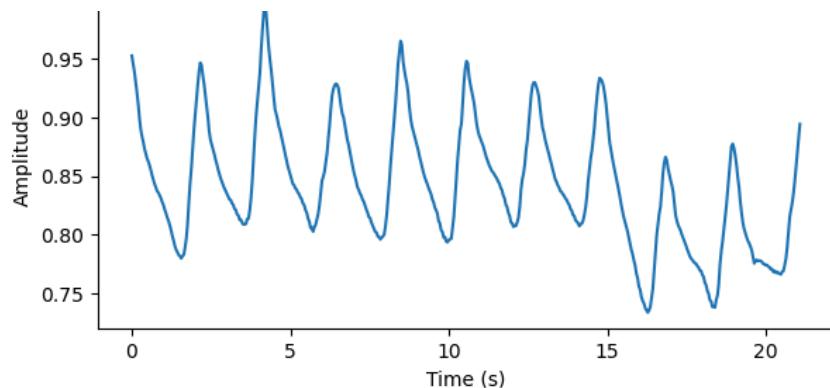
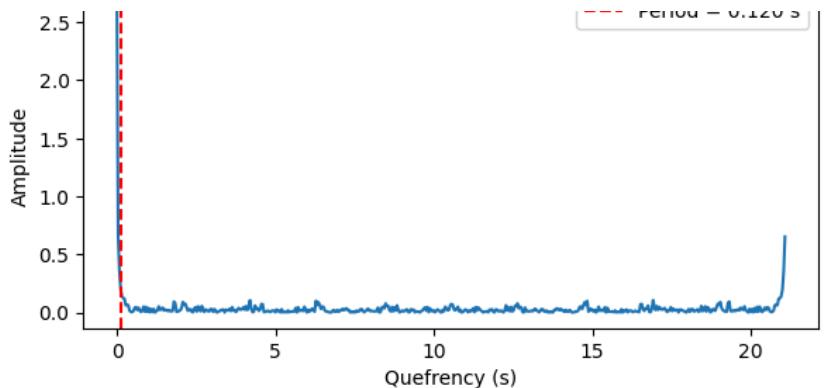
Histogram - Cepstrum



Period: 20.960 seconds Period: 524.000 frames

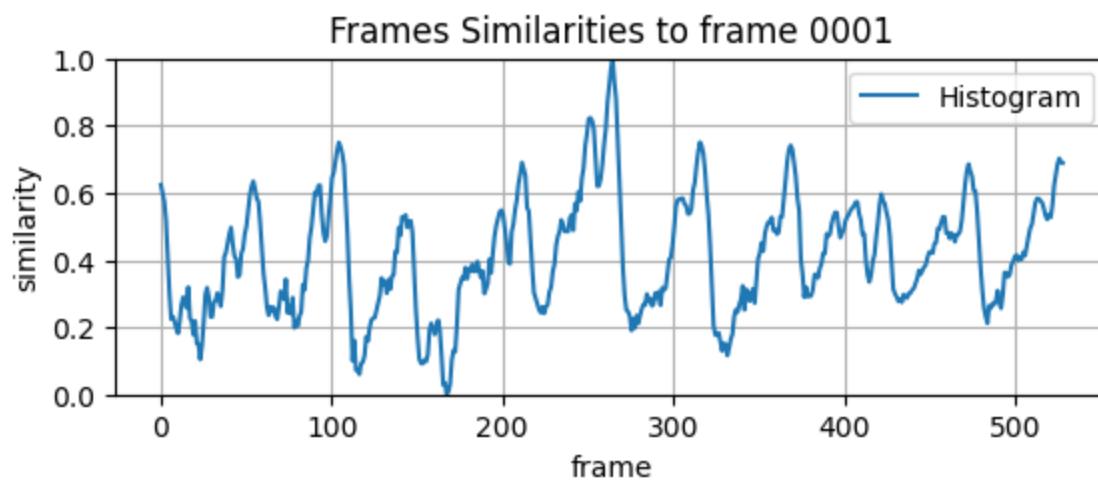
PCC - Cepstrum



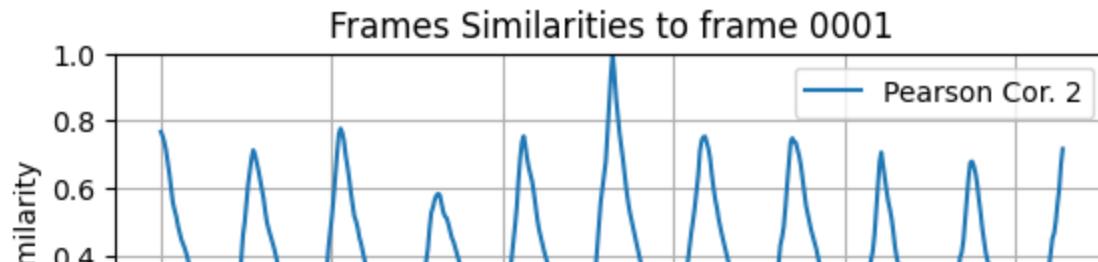


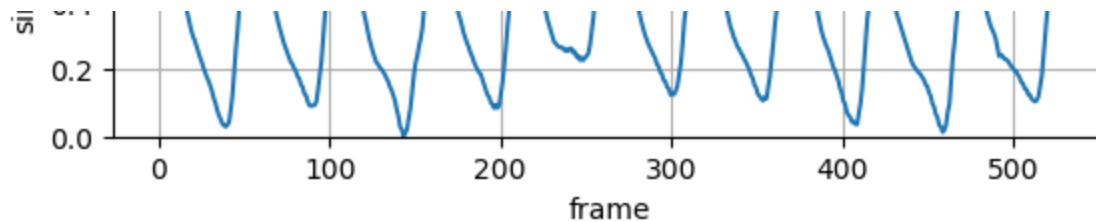
\* \* \* \* \* Video: 19 Reference frame at: (50%) 264 \* \* \* \* \*

#### Similarity Signal - Histogram

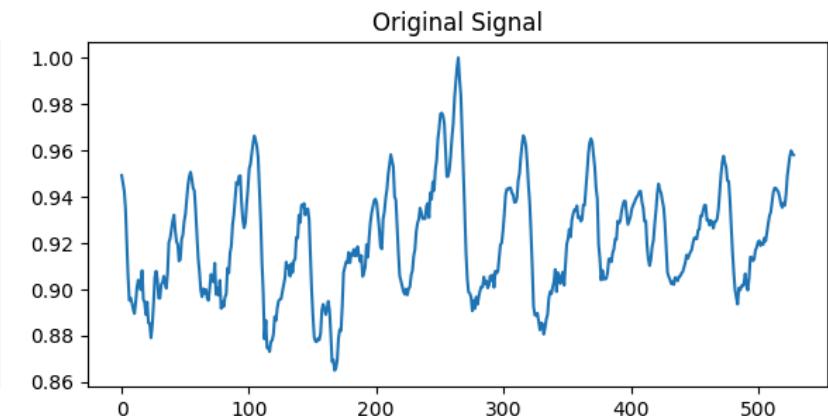
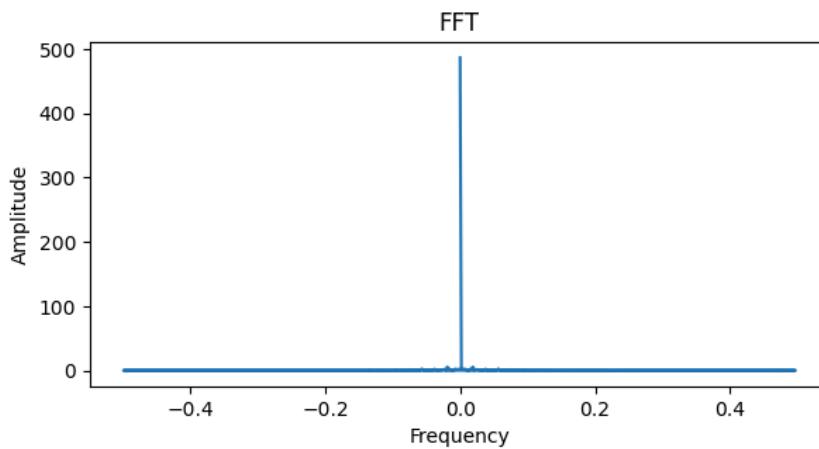


#### Similarity Signal - Pearson Correlation



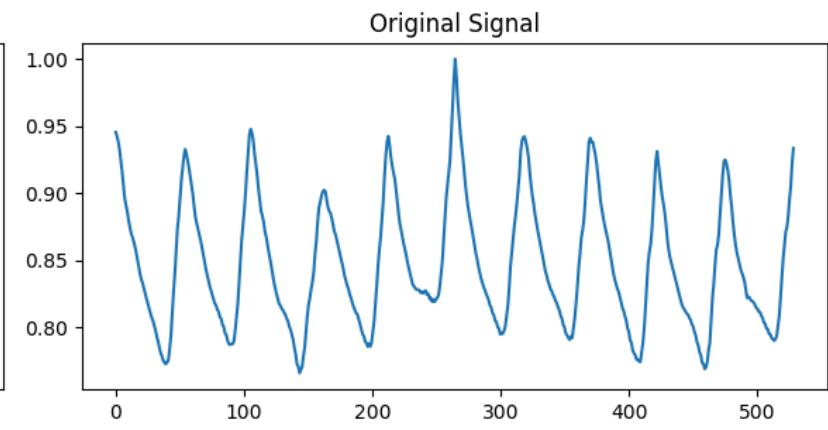
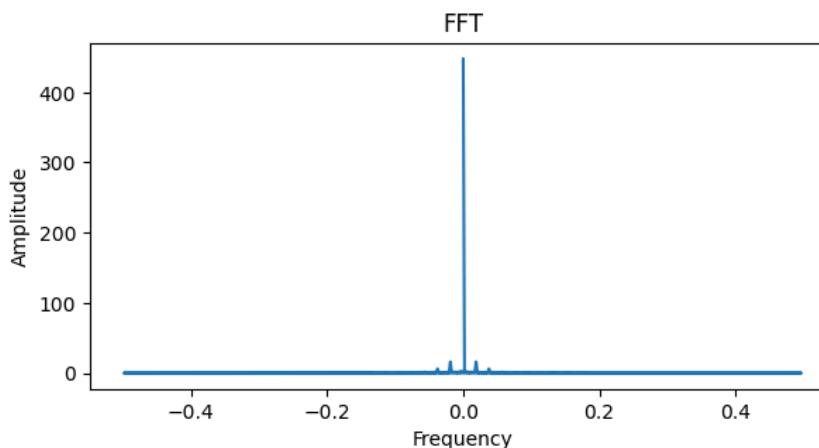


Histogram - FFT



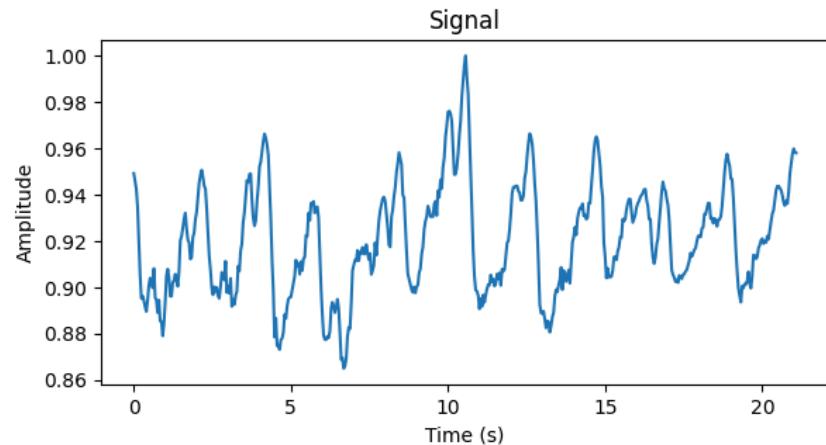
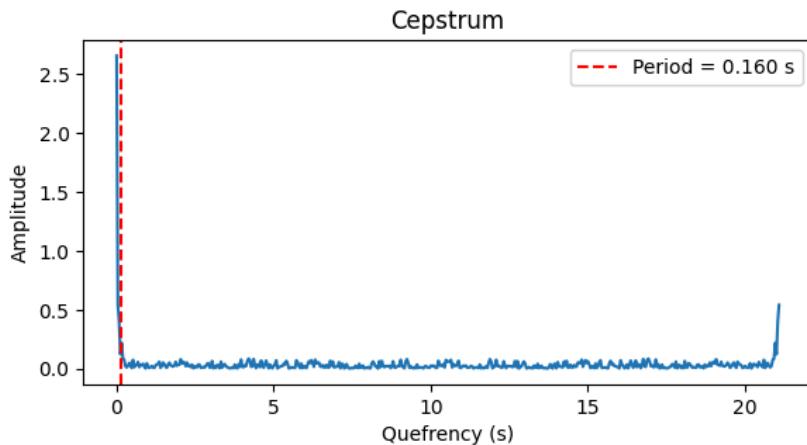
Dominant Frequency: 0.019 , Period: 52.900

PCC - FFT



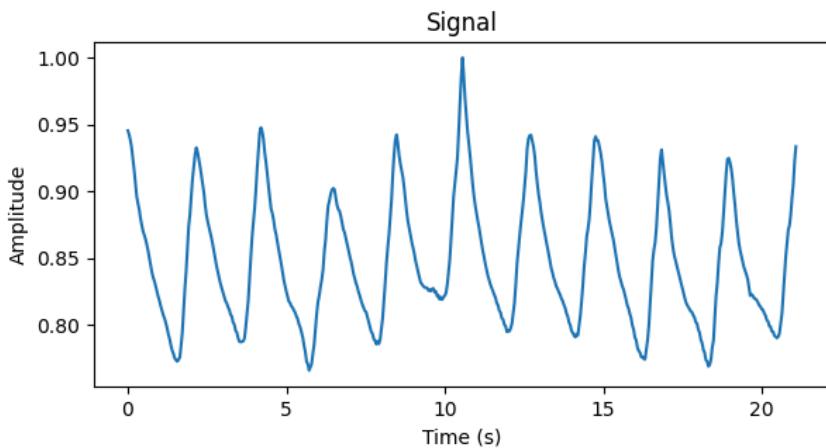
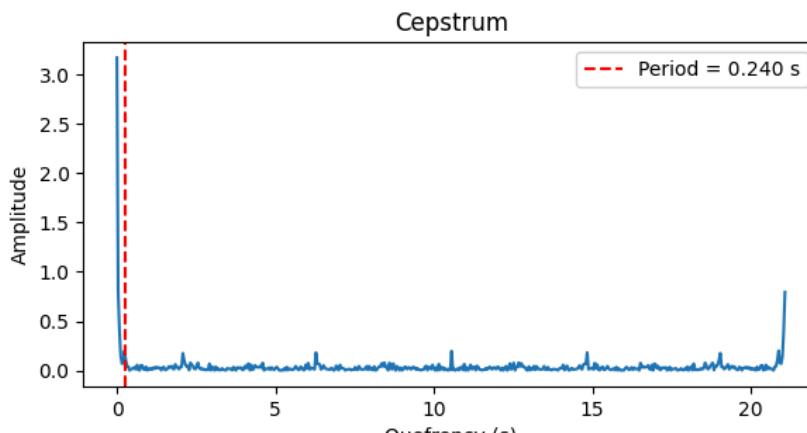
Dominant Frequency: 0.019 , Period: 52.900

Histogram - Cepstrum



Period: 0.160 seconds      Period: 4.000 frames

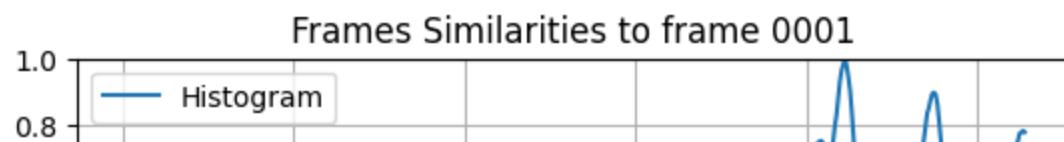
PCC - Cepstrum

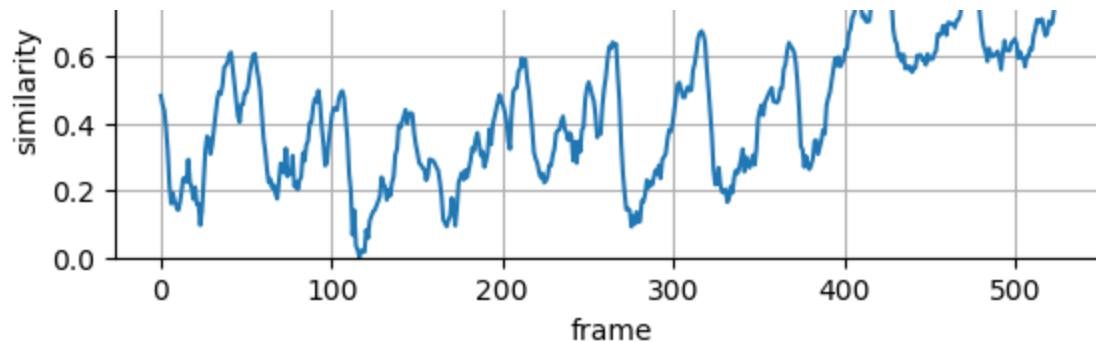


Period: 0.240 seconds      Period: 6.000 frames

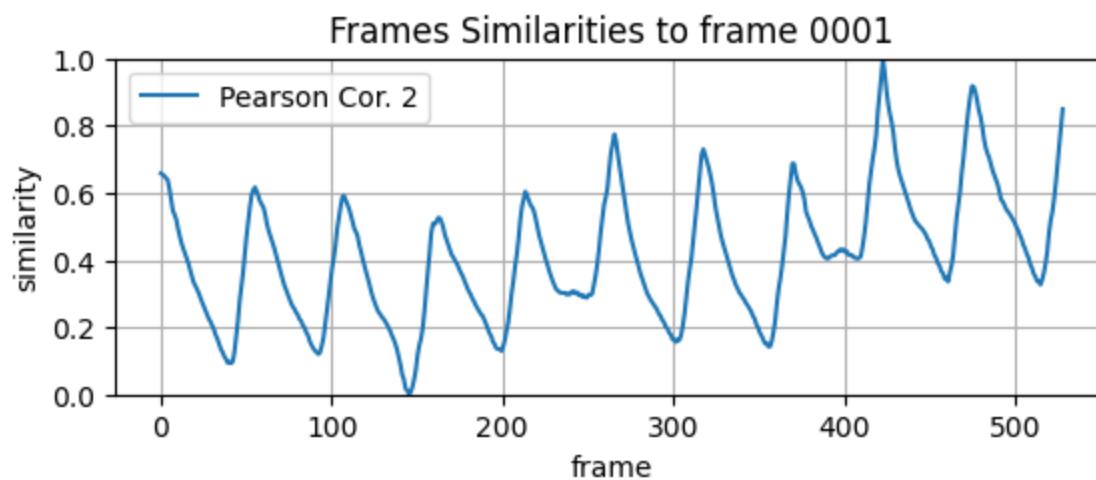
\* \* \* \* \* Video: 19 Reference frame at: (80%) 422 \* \* \* \* \*

Similarity Signal - Histogram

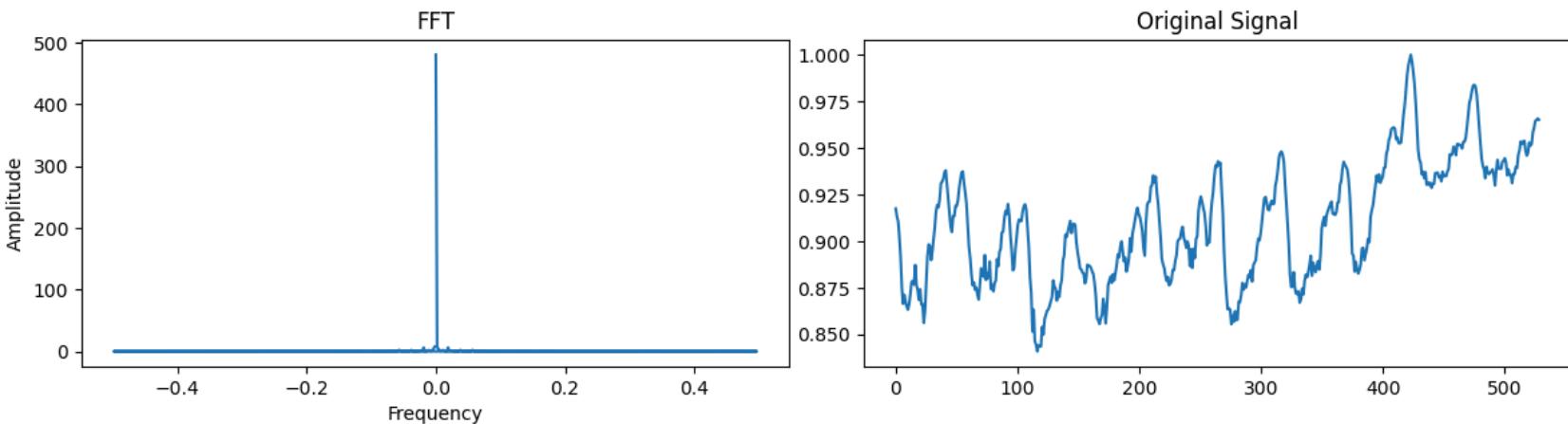




Similarity Signal - Pearson Correlation

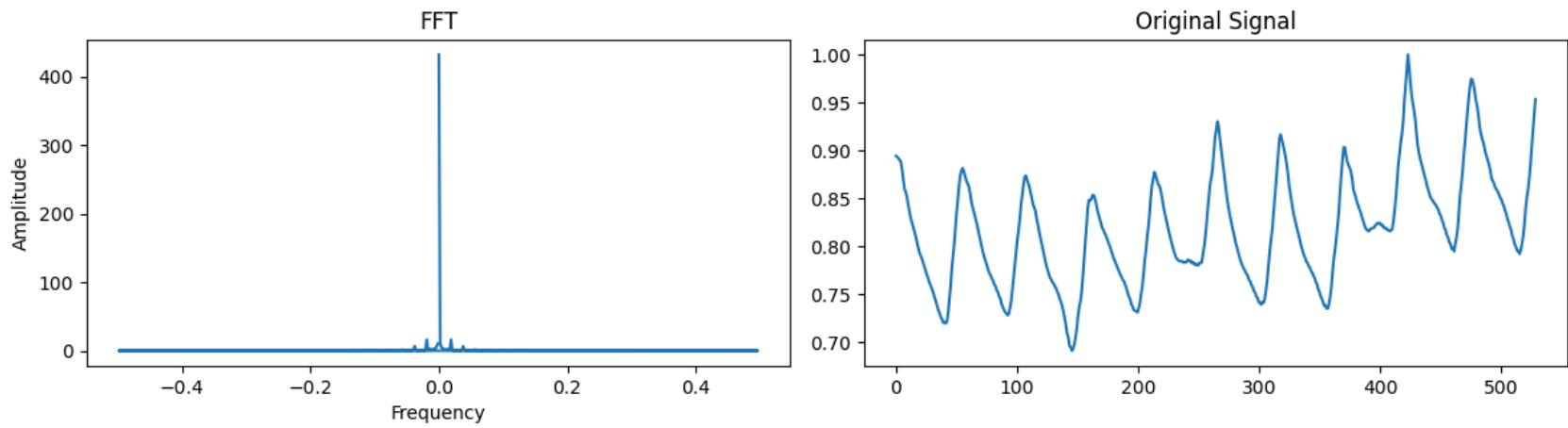


Histogram - FFT



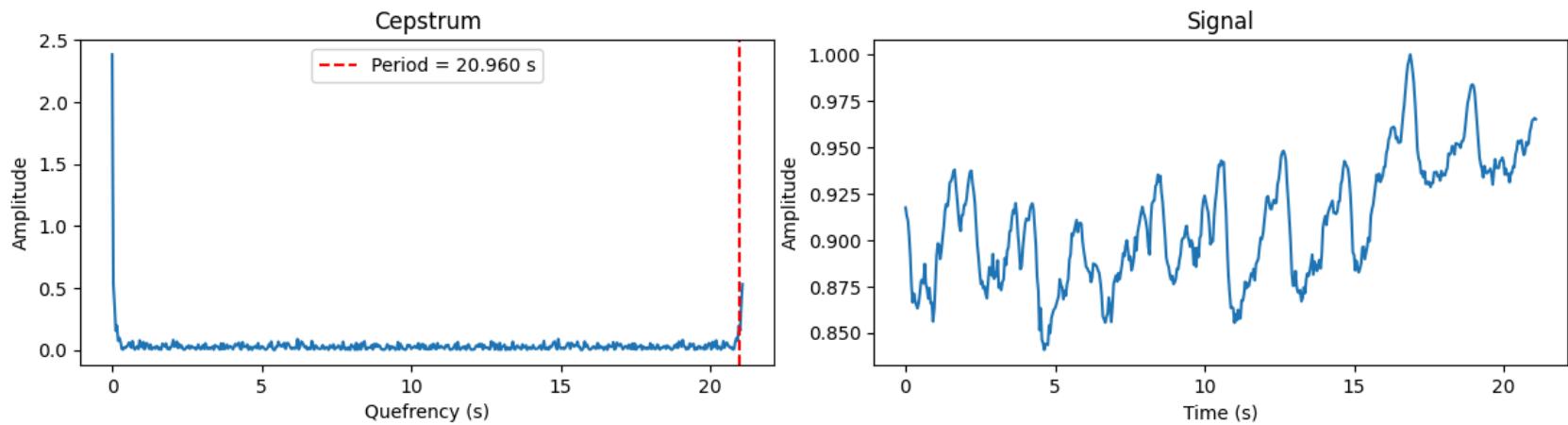
Dominant Frequency: 0.002 , Period: 529.002

PCC - FFT



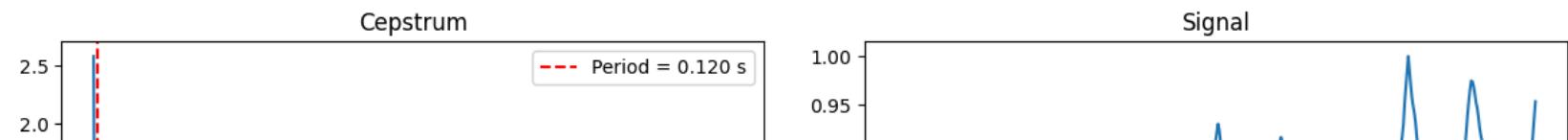
Dominant Frequency: 0.019 , Period: 52.900

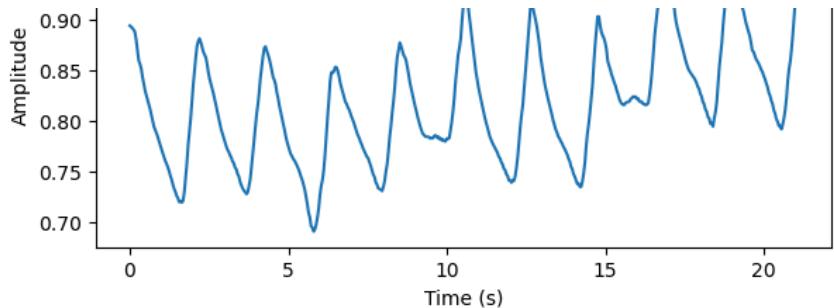
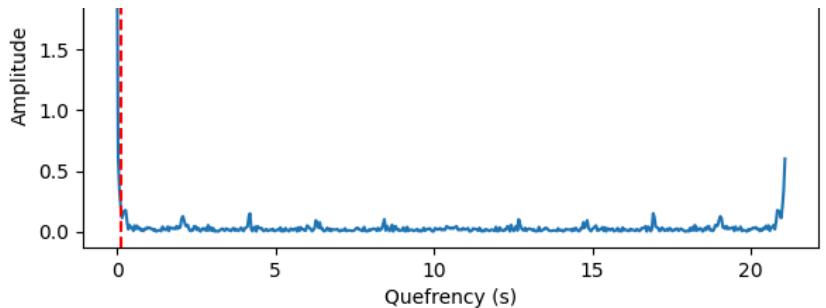
Histogram - Cepstrum



Period: 20.960 seconds   Period: 524.000 frames

PCC - Cepstrum



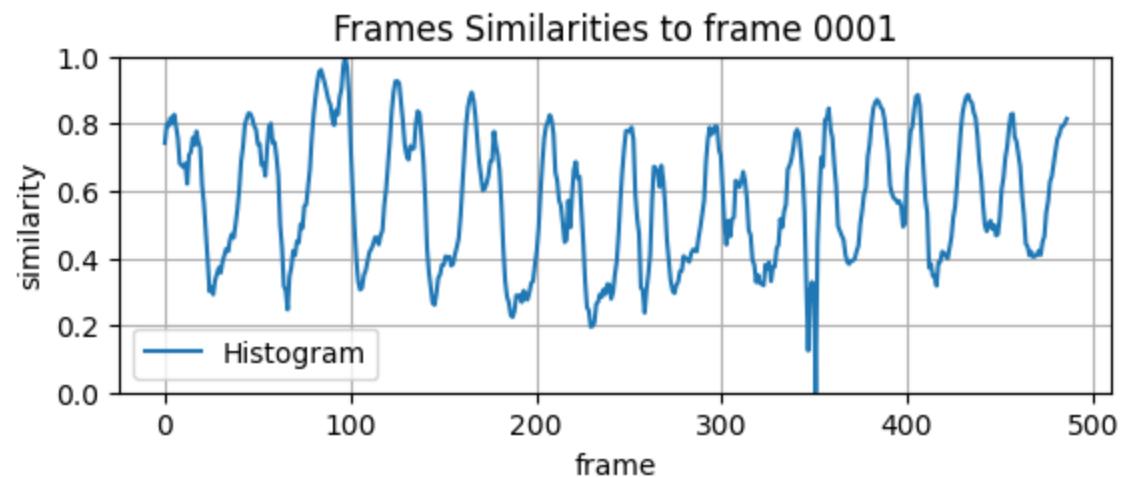


Period: 0.120 seconds      Period: 3.000 frames

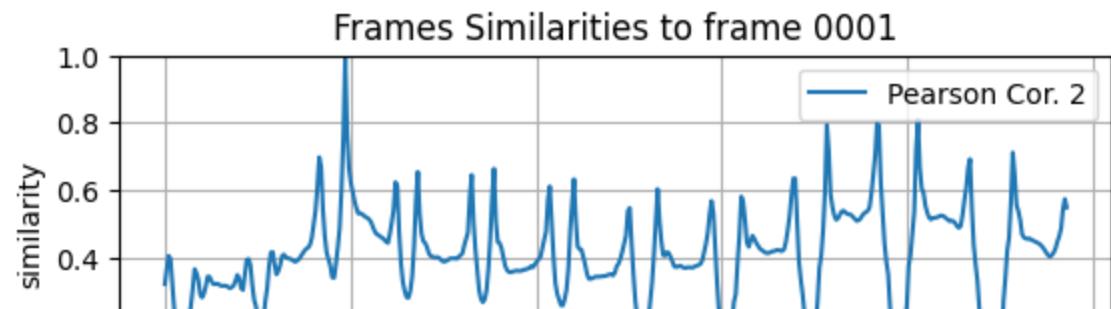
\* \* \* \* \* 20.mp4    Frames:486 FPS:23.98 \* \* \* \* \*

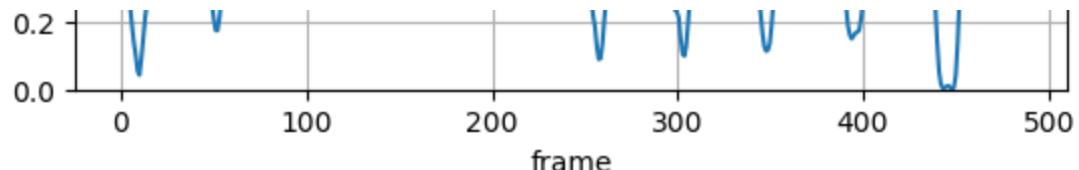
\* \* \* \* \* Video: 20 Reference frame at: (20%) 97 \* \* \* \* \*

Similarity Signal - Histogram

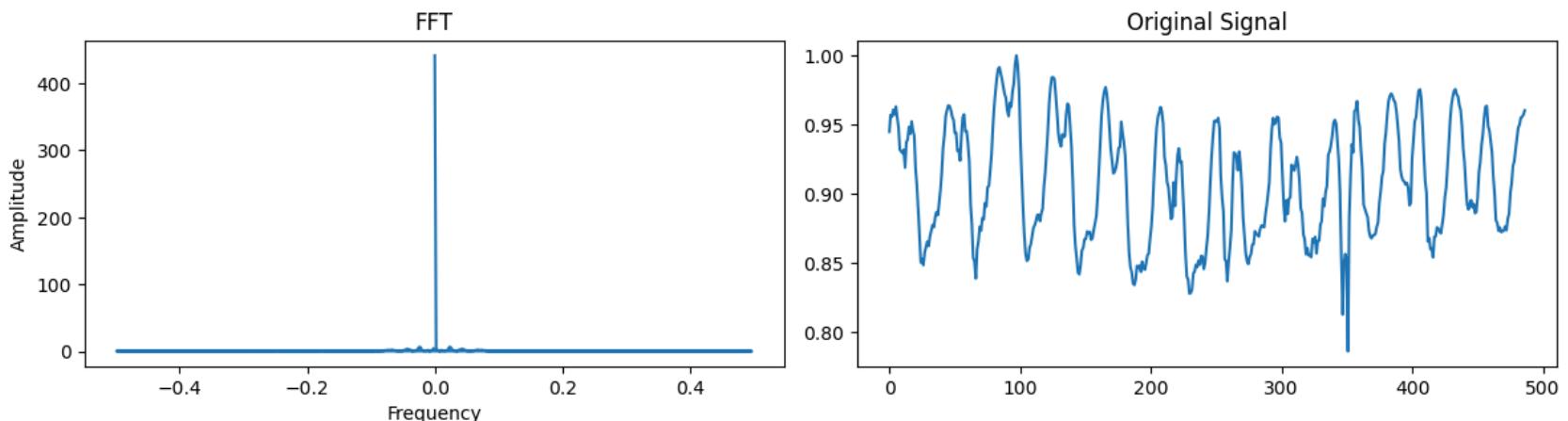


Similarity Signal - Pearson Correlation



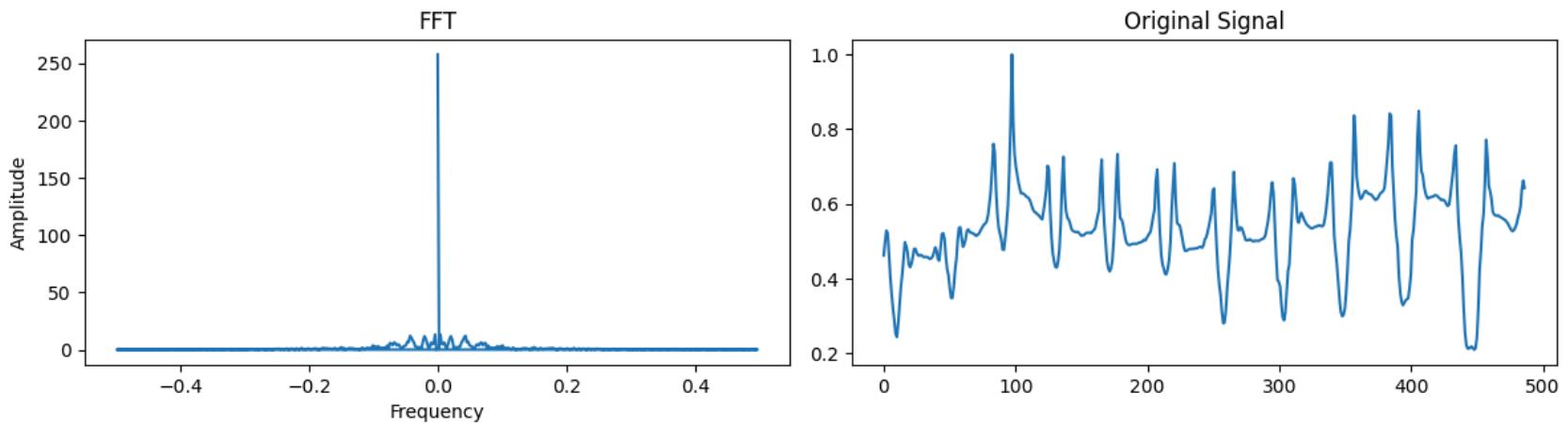


Histogram - FFT



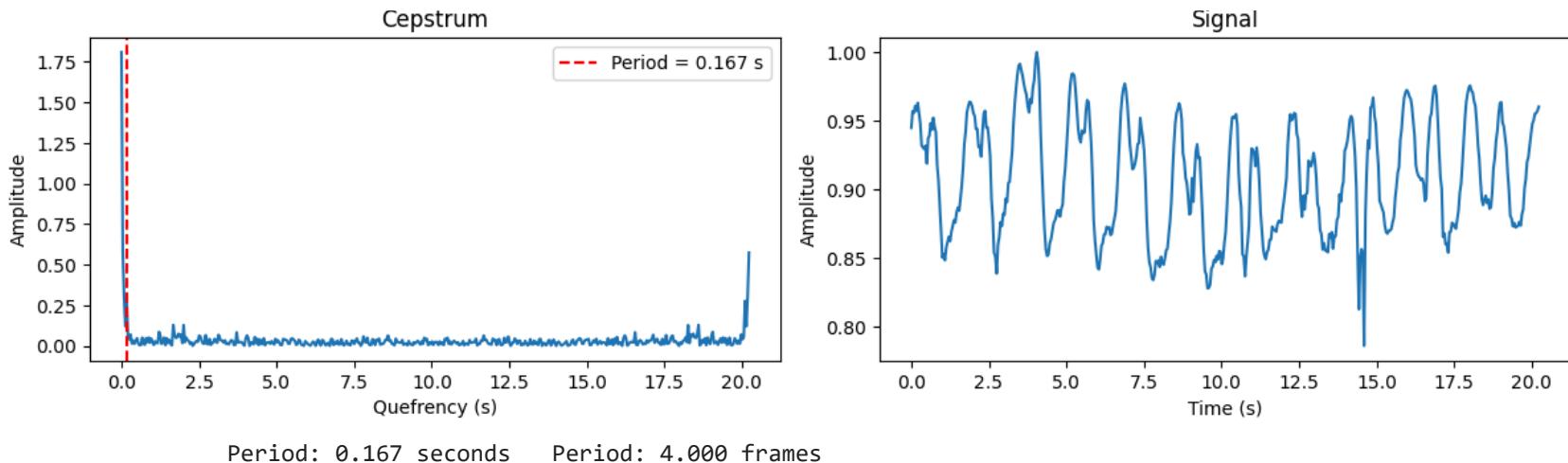
Dominant Frequency: 0.025 , Period: 40.584

PCC - FFT

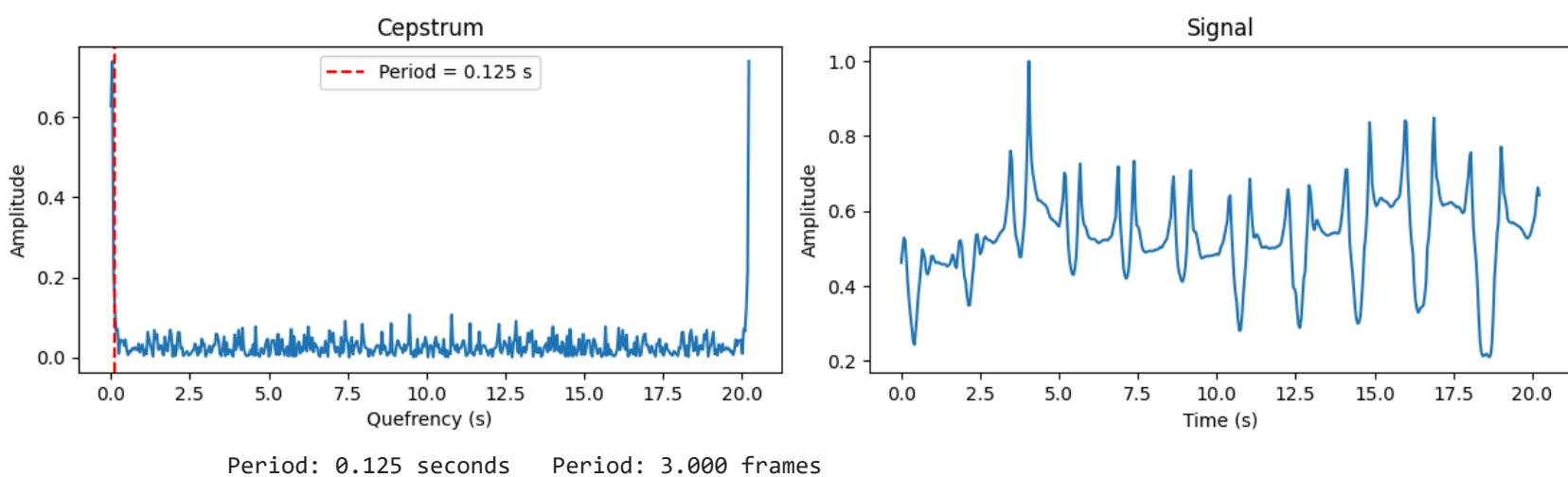


Dominant Frequency: 0.004 , Period: 243.501

Histogram - Cepstrum

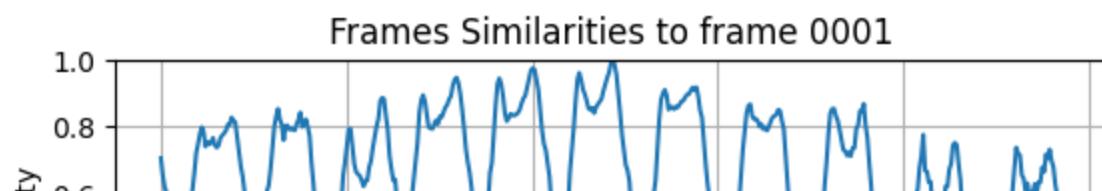


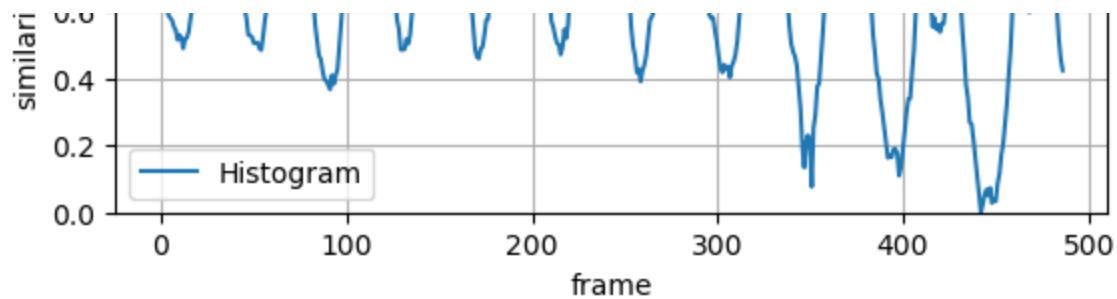
PCC - Cepstrum



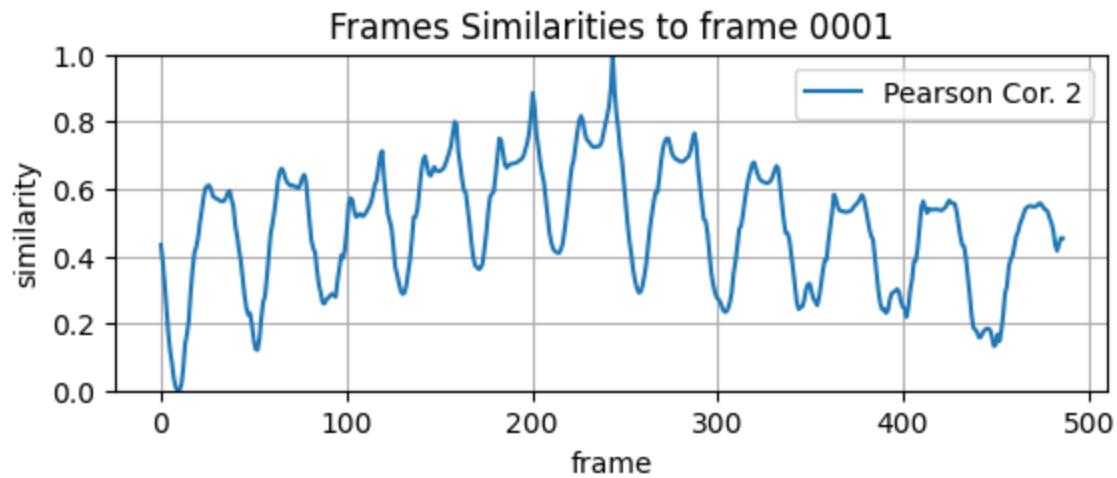
\* \* \* \* \* Video: 20 Reference frame at: (50%) 243 \* \* \* \* \*

Similarity Signal - Histogram

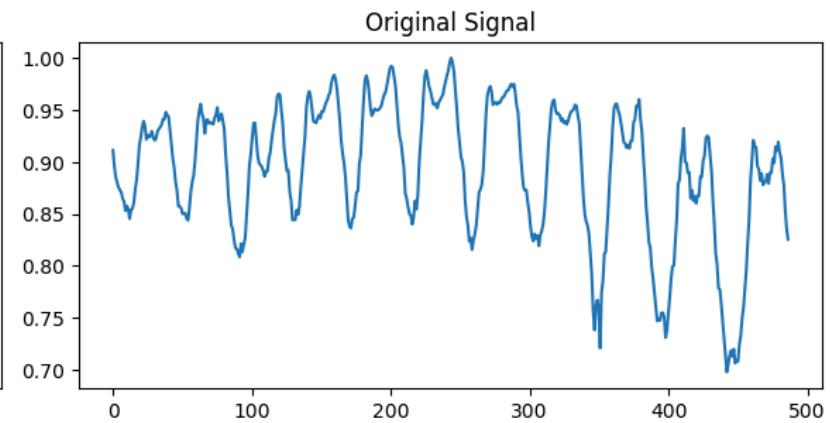
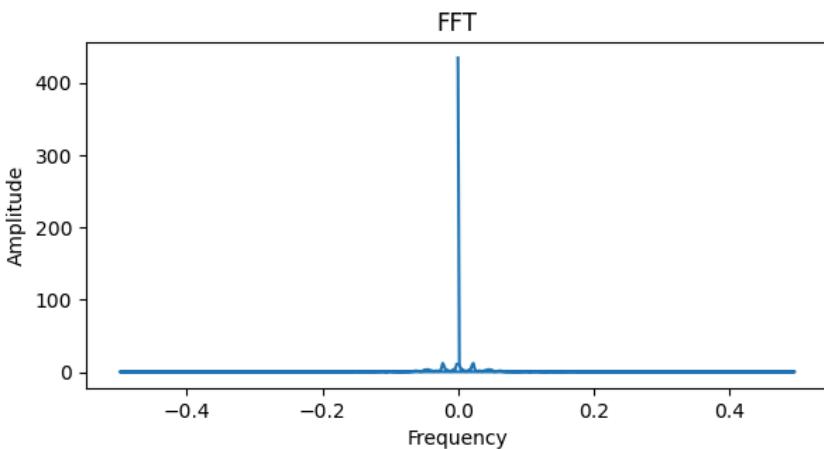




Similarity Signal - Pearson Correlation

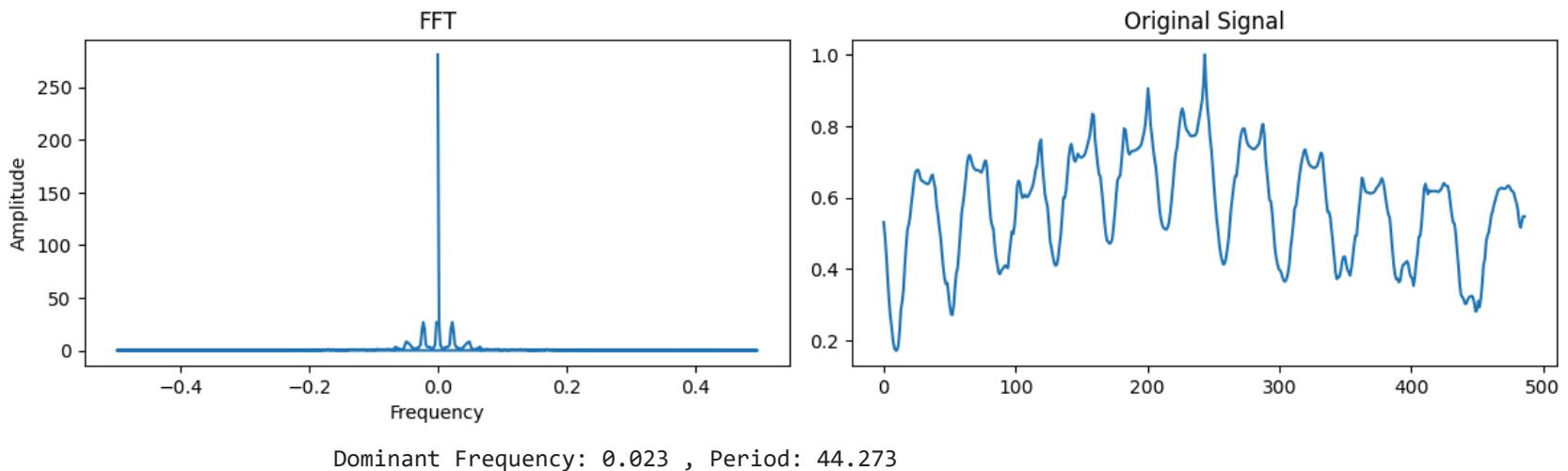


Histogram - FFT

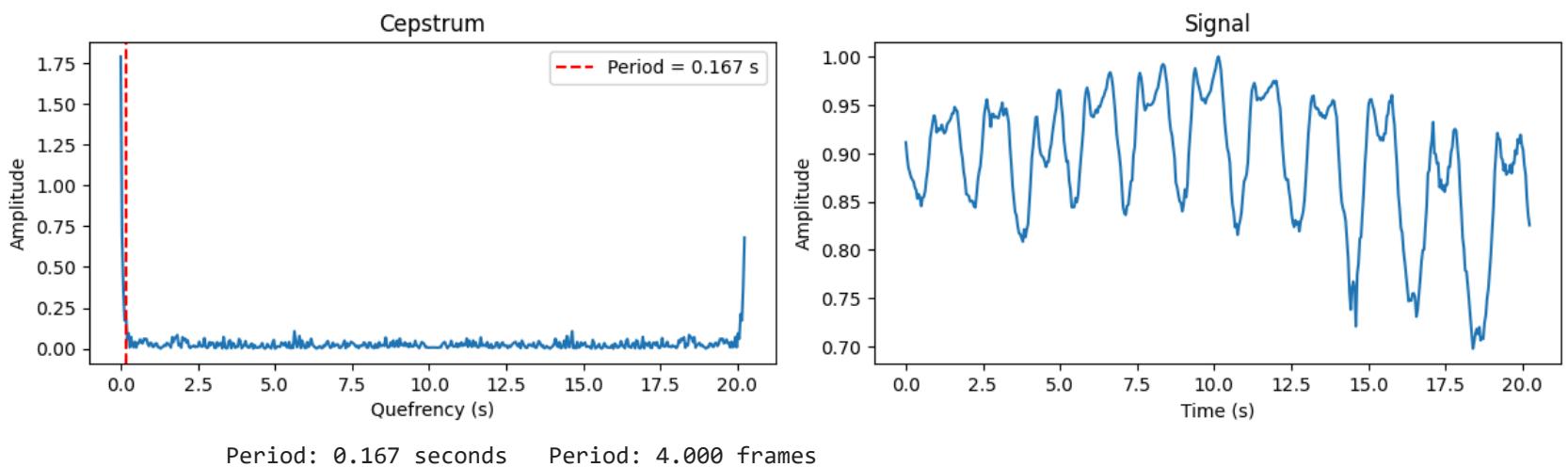


Dominant Frequency: 0.023 , Period: 44.273

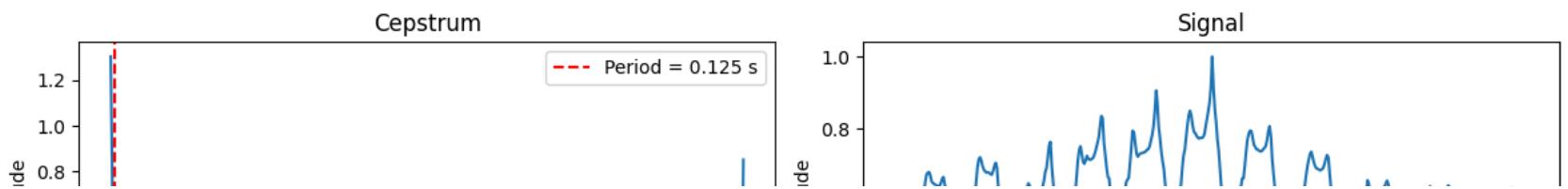
### PCC - FFT

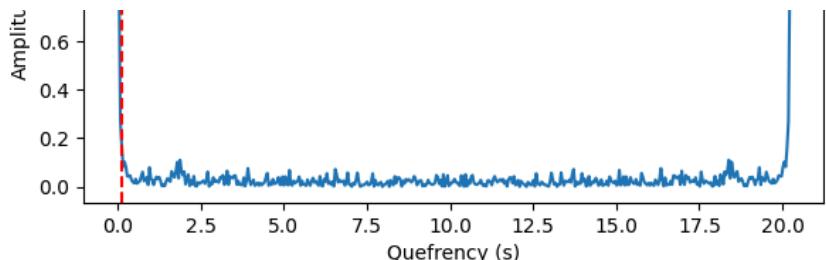


### Histogram - Cepstrum

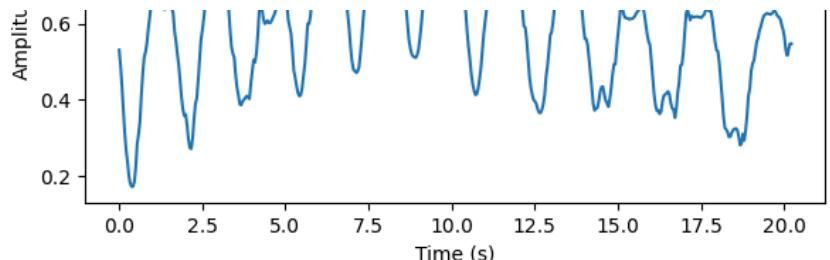


### PCC - Cepstrum



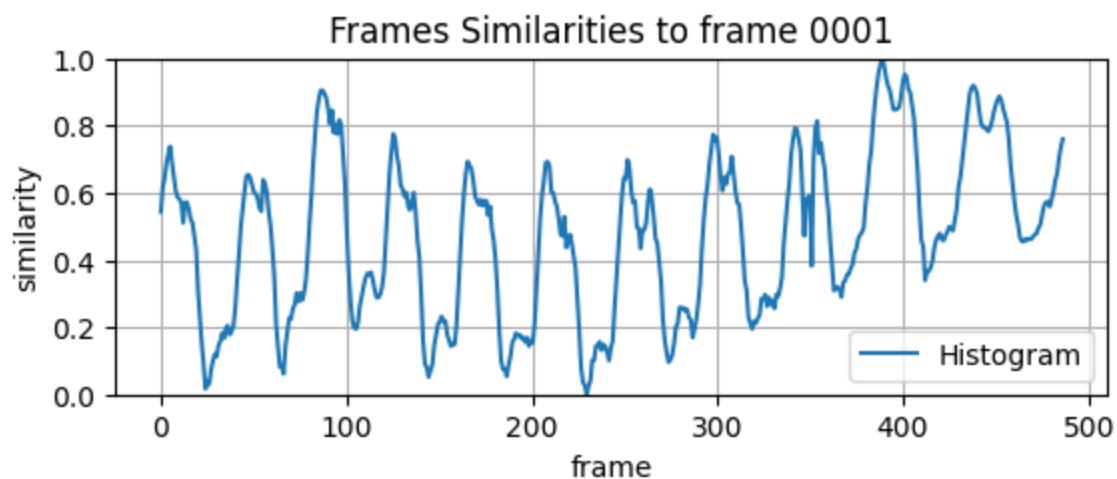


Period: 0.125 seconds      Period: 3.000 frames

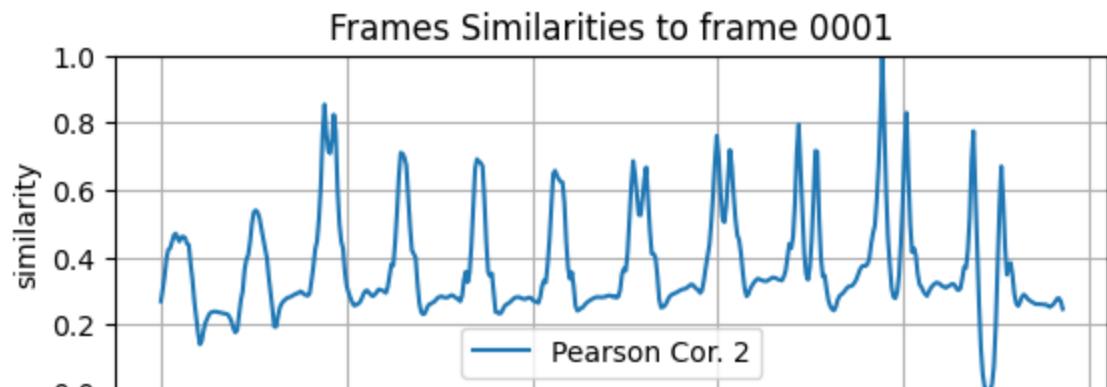


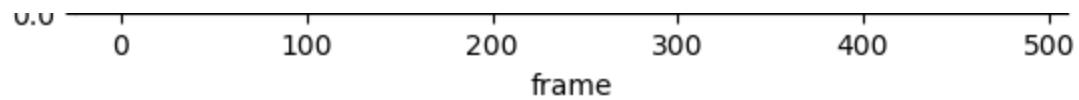
\* \* \* \* \* Video: 20 Reference frame at: (80%) 388 \* \* \* \* \*

Similarity Signal - Histogram

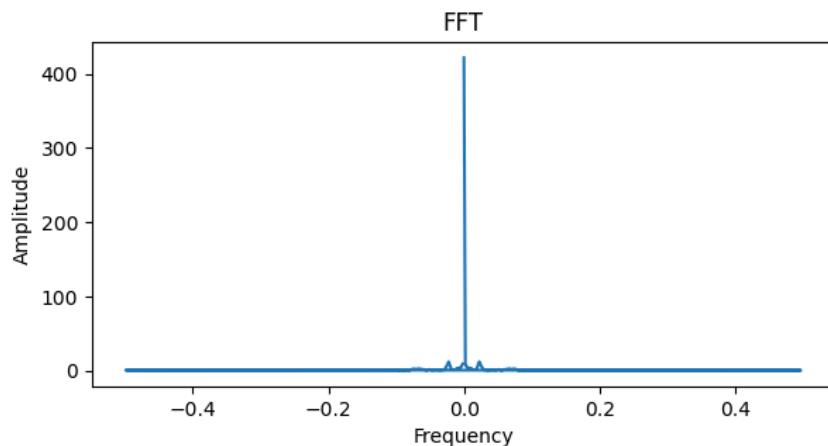


Similarity Signal - Pearson Correlation

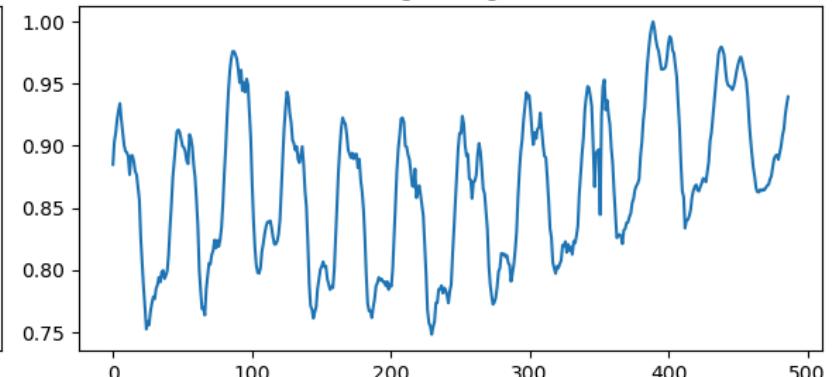




Histogram - FFT

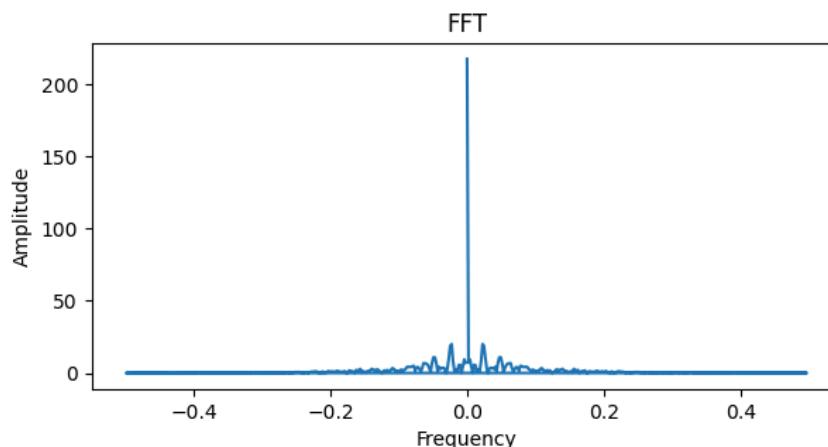


Original Signal

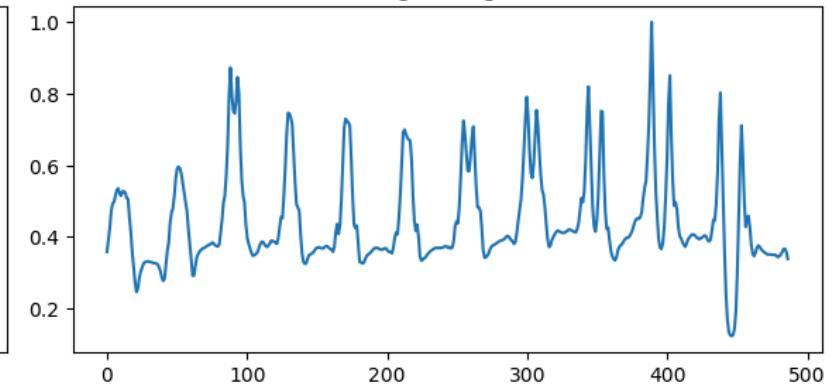


Dominant Frequency: 0.023 , Period: 44.273

PCC - FFT



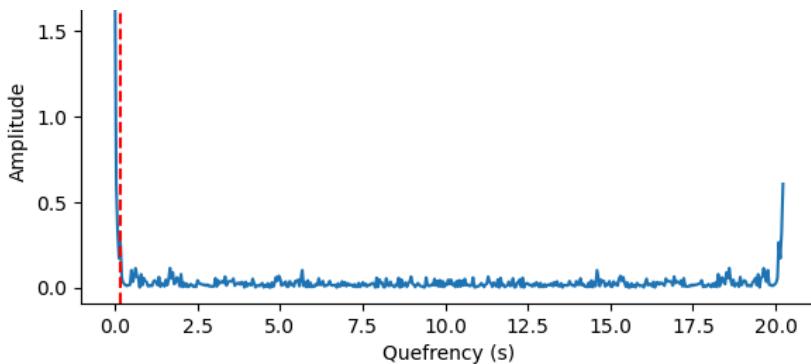
Original Signal



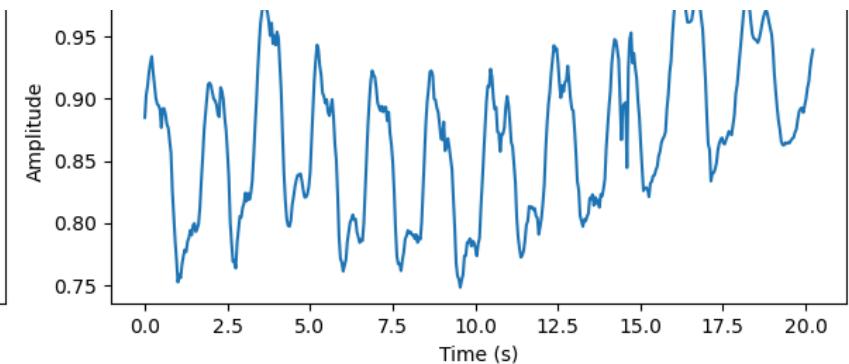
Dominant Frequency: 0.023 , Period: 44.273

Histogram - Cepstrum

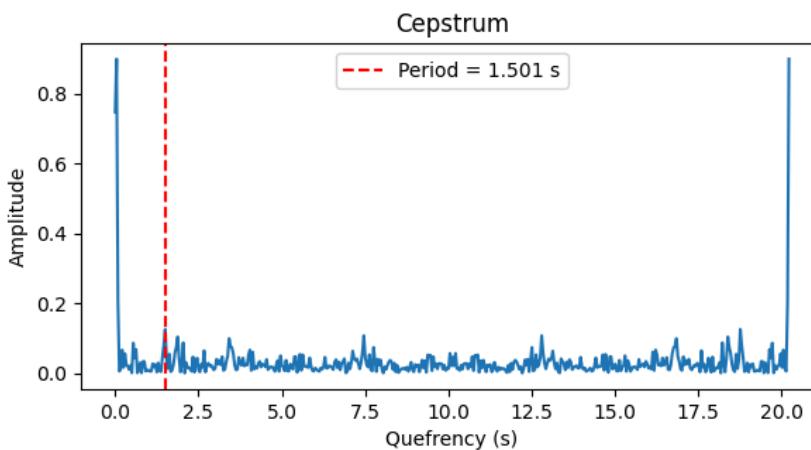




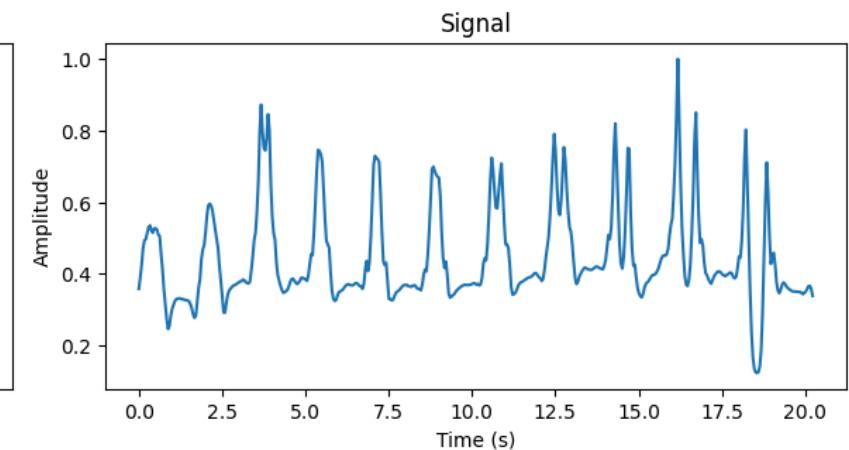
Period: 0.167 seconds      Period: 4.000 frames



PCC - Cepstrum



Period: 1.501 seconds      Period: 36.000 frames



In [ ]:

```
# STOP HERE
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In [ ]:

```
...
autoCorrelation(ls_Histogram)
autoCorrelation(ls_PearsonCor2)

find_period(ls_Histogram)
find_period(ls_PearsonCor2)

cepstrumAnalysis(ls_Histogram)
cepstrumAnalysis(ls_PearsonCor2)
...  
...
```

In [ ]:







