DECAF – The Description for the single-trial classification data and time-continuous regression

This Document belongs to DECAF dataset documentations.

Dear user,

In this document we cover the description of the information that are used for Single-Trial Classifications and for time-continuous regression as explained in the paper.

We assume the reader of this document has already read the paper well and hence we skip some of the details.

This document may be updated in future.

In this document, we cover the description of the content of the following two items:

1- DECAF-CLS-Features.zip, type: zip file
2- DECAF-TCR-Features.zip, type: zip file

In this document, we use the following notations to simplify the description:

- NS: Number of subjects that is equal to 30.
- NV: Number of movie video clips that is equal to 36.
- NM: Number of movie video clips that is equal to 40.
- NR: Number of group of MEG channels that is equal to 9.

Item 1: DECAF-CLS-Features.zip

Upon extracting the "DECAF-CLS-Features.zip" file, you will get a folder namely, "DECAF-CLS-Features" that contains the following files with ".mat" extensions that can be loaded in Octave or in MATLAB:

Dt_ECG_Movie_Sorted.mat

This file contains a 3 dimensional matrix including the employed electrocardiography features of **movie** video clips in the classification tasks. The matrix name is ECGFeatures that is an NSx**NV**x92 matrix where 92 is the total number of ECG features employed for the classification tasks as explained in the paper.

Dt_ECG_Music_Sorted.mat

This file contains a 3 dimensional matrix including the employed electrocardiography features of **music** video clips in the classification tasks. The matrix name is ECGFeatures that is an NSx**NM**x92 matrix where 92 is the total number of ECG features employed for the classification tasks as explained in the paper.

Dt_EMG_Movie_Sorted.mat

This file contains a 3 dimensional matrix including the employed trapezius electromyography features of **movie** video clips in the classification tasks. The matrix name is EMGFeatures that is an NSx**NV**x66 matrix where 66 is the total number of tEMG features employed for the classification tasks as explained in the paper.

ECG Features
01-06: statistical measurements over Inter-Beat-Intervals
07-12: statistical measurements over Heart-Rate
13-18: statistical measurements over Heart-Rate-Variability
19-22: Welch power spectral density of the ECG signal over [0; 0.1), [0.1; 0.2), [0.2; 0.3), and [0.3; 0.4)
23-32: logarithm PSD obtained for the sub-bands obtained on dividing [0, 2.4] into 10 equal intervals
33-38: statistical measurements over power spectral density of the [0.1; 0.2) band of the ECG signal
39-44: statistical measurements over power spectral density of the [0.2; 0.3) band of the ECG signal
45-50: statistical measurements over power spectral density of the [0.3; 0.4) band of the ECG signal
51-56: statistical measurements over power spectral density of the [0.4; 0.5) band of the ECG signal
57-62: statistical measurements over power spectral density of the [0.5; 0.6) band of the ECG signal
63-68: statistical measurements over power spectral density of the [0.6; 1) band of the ECG signal
69-74: statistical measurements over power spectral density of the [1; 1.5) band of the ECG signal
75-80: statistical measurements over power spectral density of the [1.5; 2) band of the ECG signal
81-86: statistical measurements over power spectral density of the [2; 2.5) band of the ECG signal
87-92: statistical measurements over power spectral density of the [2.5; 5) band of the ECG signal
Statistical measurements mean, std, skewness, kurtosis, %values>mean+std, %values<mean-std

Dt_EMG_Music_Sorted.mat

This file contains a 3 dimensional matrix including the employed trapezius electromyography features of **music** video clips in the classification tasks. The matrix name is EMGFeatures that is an NSx**NM**x66 matrix where 66 is the total number of tEMG features employed for the classification tasks as explained in the paper.

tEMG Features
01-06: statistical measurements over power spectral density of the [0; 0.5) band of the tEMG signal
07-12: statistical measurements over power spectral density of the [0.5; 1.5) band of the tEMG signal
13-18: statistical measurements over power spectral density of the [1.5; 2.5) band of the tEMG signal
19-24: statistical measurements over power spectral density of the [2.5; 3.5) band of the tEMG signal
25-30: statistical measurements over power spectral density of the [3.5; 5.0) band of the tEMG signal
31-36: statistical measurements over power spectral density of the [5.0; 10) band of the tEMG signal
37-42: statistical measurements over power spectral density of the [10; 15) band of the tEMG signal
43-48: statistical measurements over power spectral density of the [15; 25) band of the tEMG signal
49-54: statistical measurements over power spectral density of the [25; 45) band of the tEMG signal
55-60: statistical measurements over power spectral density of the [55; 95) band of the tEMG signal
61-66: statistical measurements over power spectral density of the [105; 145) band of the tEMG signal
Statistical measurements mean, std, skewness, kurtosis, %values>mean+std, %values<mean-std

Dt_EOG_Movie_Sorted.mat

This file contains a 3 dimensional matrix including the employed horizontal electrooculography features of **movie** video clips in the classification tasks. The matrix name is EOGFeatures that is an NSx**NV**x66 matrix where 66 is the total number of hEOG features employed for the classification tasks as explained in the paper.

Dt_EOG_Music_Sorted.mat

This file contains a 3 dimensional matrix including the employed horizontal electrooculography features of **music** video clips in the classification tasks. The matrix name is EOGFeatures that is an NSx**NM**x66 matrix where 66 is the total number of hEOG features employed for the classification tasks as explained in the paper.

hEOG Features
01-06: statistical measurements over power spectral density of the [0; 0.1) band of the hEOG signal
07-12: statistical measurements over power spectral density of the [0.1; 0.2) band of the hEOG signal
13-18: statistical measurements over power spectral density of the [0.2; 0.3) band of the hEOG signal
19-24: statistical measurements over power spectral density of the [0.3; 0.4) band of the hEOG signal
25-30: statistical measurements over power spectral density of the [0.4; 0.6) band of the hEOG signal
31-36: statistical measurements over power spectral density of the [0.6; 1) band of the hEOG signal
37-42: statistical measurements over power spectral density of the [1; 1.5) band of the hEOG signal
43-48: statistical measurements over power spectral density of the [1.5; 2) band of the hEOG signal
49-54: statistical measurements over power spectral density of the [105; 115) band of the hEOG signal
55-60: statistical measurements over power spectral density of the [115; 130) band of the hEOG signal
61-66: statistical measurements over power spectral density of the [130; 145) band of the hEOG signal
Statistical measurements mean, std, skewness, kurtosis, %values>mean+std, %values<mean-std

Dt_FMU_Movie_Sorted.mat

This file contains a 3 dimensional matrix including the employed facial motion unit (FMU) features of **music** video clips in the classification tasks. The matrix name is FMUFeatures that is an NSx**NM**x72 matrix where 72 is the total number of FMU features employed for the classification tasks as explained in the paper.

Dt_FMU_Music_Sorted.mat

This file contains a 3 dimensional matrix including the employed facial motion unit (FMU) features of **music** video clips in the classification tasks. The matrix name is FMUFeatures that is an NSx**NM**x72 matrix where 72 is the total number of FMU features employed for the classification tasks as explained in the paper.

Given the angle of the NIR camera during the facial recordings, the visible faces are under the impact of about 30 degrees of head pitch and hence the initial frames for the tracker are not frontal. Given the head pitch factor along with the noise on the NIR channels, unfortunately, the tracker failed on some facial videos. The failure rate of the tracker on facial videos in response to movie video clips and music video clips is 15.5% and 19% respectively. The state of failure can be determined from the matrix entries. In case facial analysis is critical in your research on DECAF, we recommend using another method for facial tracking on the facial video clips instead of using the currently provided facial tracks.

* We will provide new sets of FMUs using other available trackers in soon future.

Both the "Dt_FMU_Movie_Sorted.mat" and the "Dt_FMU_Music_Sorted.mat" files also contain a 1xNS vector that indicates the number of videos per person for which the facial tracker failed. The tracker failed on 19% of facial videos for music video clips and 15.5% of facial videos for movie video clips.

Facial Motion Unit Features
01-06: statistical measurements over vertical deformation of the upper lip
07-12: statistical measurements over vertical deformation of the lower lip
13-18: statistical measurements over horizontal deformation of the left lip corner
19-24: statistical measurements over vertical deformation of left lip corner
25-30: statistical measurements over horizontal deformation of the right lip corner
31-36: statistical measurements over vertical deformation of the right lip corner
37-42: statistical measurements over deformation of the right eyebrow
43-48: statistical measurements over deformation of the left eyebrow
49-54: statistical measurements over deformation of the right cheek
55-60: statistical measurements over deformation of the left cheek
61-66: statistical measurements over deformation of the right lid
67-72: statistical measurements over deformation of the left lid
Statistical measurements: mean, std, skewness, kurtosis, %values>mean+std, %values<mean-std

Dt_MCA_Movie_Sorted.mat

This file contains a 2 dimensional matrix including the employed multimedia content analysis (MCA) features of **movie** video clips in the classification tasks. The matrix name is MCAFeatures that is an **NV**x105 matrix where 105 is the total number of MCA features employed for the classification tasks as explained in the paper.

Dt_MCA_Music_Sorted.mat

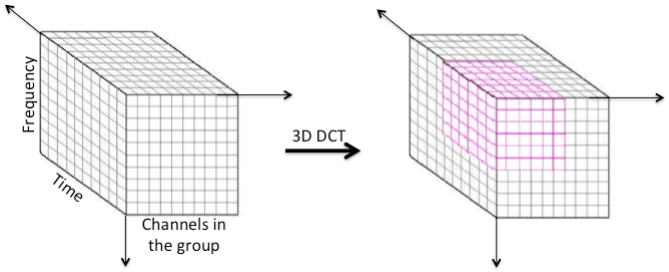
This file contains a 2 dimensional matrix including the employed multimedia content analysis (MCA) features of **music** video clips in the classification tasks. The matrix name is MCAFeatures that is an **NM**x105 matrix where 105 is the total number of MCA features employed for the classification tasks as explained in the paper.

56 Auditory Features	49 Visual Features
01-13: Mel-frequency cepstral coefficients (MFCC)	57: Mean Lightning Key
14-26: Delta MFCC (DMFCC)	58: Mean Color Variance
27-39: MFCC Auto-correlation (AMFCC)	59-78: 20 Histograms of Hue
40: Energy	79-98: 20 Histograms of Value
41-44: Formants	99: Shadow Proportion
45-46: mean and std of Spectral Flux	100: Median Lightness
47-48: mean and std of Spectral Centroids	101: Median Saturation
49-50: mean and std of Delta spectrum magnitude	102: Visual Details
51-52: mean and std of Band Energy Ratio	103: Grayness
53: Pitch	104: Visual Excitement
54-55: mean and std of Zero Crossing Rate	105: Motion
56: Silence Ratio	

Dt_MEGDCT_Movie_Sorted.mat

This file contains 2 cell vectors of size NS, one corresponds to gradiometers' data (SLDCT_GRADfeatures) and the other corresponds to the magnetometers' data (SLDCT_MAGfeatures). Each cell includes a 3 dimensional matrix of the size of 216xNVxNR where 216 is the total number of DCT features extracted from the MEG signals of specific group of channels in response to a specific video.

Calculation of the 216 DCT features: Upon preparing the output of MEG Time-Frequency Analysis (TFA), the TFA of the channels from a same group are put together before applying a 3-dimensional DCT. After applying the transformation, we took the first 6x6x6 coefficients to publish in the dataset (In the paper, we have used only the first 2x2x2 coefficients).



The entries of the 6x6x6 matrix are formed into a vector of the length of 216 to form the descriptor. Given the row-vector form of the descriptor (d), he MATLAB/Octave code to reshape the vector into a 6x6x6 matrix is as follows: reshape(d,6,6,6);

If you want to take the first 2x2x2 coefficients you can use the following code:

```
Tmp1 = reshape(1:216,6,6,6);

FeatureIDs = reshape(Tmp1(1:2,1:2,1:2),8,1);

TheFirst8Features = SLDCT_GRADfeatures{SubjectID}( FeatureIDs,:,:);
```

Dt_MEGDCT_Music_Sorted.mat

This file contains 2 cell vectors of size NS, one corresponds to gradiometers' data (SLDCT_GRADfeatures) and the other corresponds to the magnetometers' data (SLDCT_MAGfeatures). Each cell includes a 3 dimensional matrix of the size of 216xNMxNR where 216 is the total number of DCT features extracted from the MEG signals of specific group of channels in response to a specific video.

Dt_MEGDEAP_Movie_Sorted.mat

This file contains 2 cell arrays with the size of NSxNV, one corresponds to gradiometers' data (GRDFt) and the other corresponds to the magnetometers' data (MAGFt). Each cell includes a 2 dimensional matrix of the size of 150x4 where 4 is the related to the four bands of frequencies (theta, alpha, beta, gamma) and 150 is the total number of features per frequency band extracted from the MEG channels as explained in the paper.

Dt_MEGDEAP_Music_Sorted.mat

Same as above but the cell arrays have the size of NSxNM.

Dt_Order_Movie.mat

This file contains a 2 dimensional matrix, namely "PermutationList", with the size of NSxNV that includes the presentation order the videos. Each row of the PermutationList is a random permutation of the video IDs from 1 to 36 (according to the constraints explained in the paper) that is originally used to select the videos to be presented to the user during the experiment.

Dt_Order_Music.mat

Same as above but the "PermutationList" matrix has the size of NSxNM and the video IDs in each row range from 1 to 40.

Dt_SelfAssessments_Movie_Sorted.mat

This file contains a struct type of variable, namely "SelfAssessments" which includes the self-assessment of the users. The self-assessment of the user includes his/her level of Arousal/Valence/Dominance upon watching each videos and how much she/he knew the video in advance. The self-assessments are put into four NSxNV matrices:

SelfAssessments =

Arousal: [30x36 double]

Valence: [30x36 double]

Dominance: [30x36 double]

Familiarity: [30x36 double]

The rows correspond to the users and each row corresponds to the self-assessments of the user to the videos in their original order. In other words, the self-assessments are sorted according to the original video IDs and they **are not** according to presentation order.

Dt_SelfAssessments_Music_Sorted.mat

Same as above but the size of each matrix is NSxNV (30x40).

Item 2: DECAF-TCR-Features.zip

Upon extracting the contents of "DECAF-TCR-Features.zip" file, you will get four files:

- DtCont_ExpAnns_Movie_Sorted.mat
- DtCont_MEGDCT_Movie_Sorted.mat
- DtCont_Movie-MCA
- DtCont_Music-MCA

DtCont_ExpAnns_Movie_Sorted.mat

This file contains three parameters:

- AnnotatorsNum: 7
- K_Annotations: {7x2x36 cell}
- ClipsLength_Cropped: [1x36 double]

AnnotatorsNum is the number of experts who annotated the videos in terms of arousal and valence from the directors' point of view.

K_Annotations is a 7x2x36 cell array and includes the annotations provided by the experts where 7 is the number of the experts and 36 are the number of movie video clips. The correspondence to the video ids is according to the original video IDs. The second dimension of the matrix determines whether the annotation relates to the level of arousal (1) or to the level of valence (2) of the video. Each cell contains the annotation of the corresponding video with a row vector of length L (1xL) where L is the length of the video in seconds.

ClipsLength_Cropped is a 1x36 row vector including the Length of the original videos in seconds.

DtCont_MEGDCT_Movie_Sorted.mat

This file contains three parameters:

- AllFeatures: {30x36 cell}
- AllTargetsA: {1x36 cell}
- AllTargetsV: {1x36 cell}

AllFeatures is a 30x36 cell array that includes the MEG DCT feature used for time-continuous predictions where 30 corresponds to the number of subjects (NS) and 36 corresponds to the number of movie video clips (in their original order). Each cell contains a 2 dimensional matrix of the size of L x 540 where L is the length of the corresponding video in seconds and 540 is the total number of extracted MEG DCT features for each second as explained in the paper.

AllTargetsA is a 1x36 cell array where "36" is the number of movie video clips. The cells correspond to the videos according to their original order. Each cell is a 1 x L row vector that includes the aggregation of the experts' arousal annotations for the corresponding video.

AllTargetsV is a 1x36 cell array where "36" is the number of movie video clips. The cells correspond to the videos according to their original order. Each cell is a 1 x L row vector that includes the aggregation of the experts' valence annotations for the corresponding video.

DtCont_Movie-MCA.zip

Upon extracting the content of "DtCont_Movie-MCA.zip" you will get the "Movie-ContMCA" folder. The folder includes 72 mat files, 36 files contain the audio content analysis of the 36 videos and the other 36 videos contain the video content analysis of the same videos.

The audio content analysis files have the template name of "AudFt_##.mat" where ## is the corresponding video ID according to the original IDs.

The video content analysis files have the template name of "VidFt_##.mat" where ## is the corresponding video ID according to the original IDs.

AudFt_##.mat

Each "AudFt_##.mat" contains two matrices corresponding to two sets of features:

- AudioFeaturesDEAP: [Lx56 double]
- AudioFeaturesPlus: [Lx55 double] (not employed in the DECAF paper)

AudioFeaturesDEAP is a two dimensional matrix of the size of L x 56 where L is the length of the video and 56 is the number of features that are extracted following the DEAP paper.

AudioFeaturesPlus is a two dimensional matrix of the size of L x 55 where L is the length of the video and 55 is the number of features that are not included among the AudioFeaturesDEAP data.

The 56 Features in AudioFeaturesDEAP	The 55 Features in AudioFeaturesPlus
01-13: Mel-frequency cepstral coefficients (MFCC) 14-26: Delta MFCC (DMFCC) 27-39: MFCC Auto-correlation (AMFCC) 40: Energy 41-44: Formants 45-46: mean and std of Spectral Flux 47-48: mean and std of Spectral Centroids 49-50: mean and std of Delta spectrum magnitude 51-52: mean and std of Band Energy Ratio 53: Pitch 54-55: mean and std of Zero Crossing Rate 56: Silence Ratio	01: High zero-crossing rate ratio (HZCRR) 02-14: 13 Linear predictive coefficient (LPC) 15-27: 13 Delta LPC (DLPC) 28-51: mean and std of Spectral Pitch Chroma 52-53: mean and std of Spectral Roll Off 54-55: mean and std of The Band Width feature

The 49 Features in VideoFeatures	The 8 Features in VideoFeatures2
01: Mean Lightning Key 02: Mean Color Variance 03-22: 20 Histograms of Hue 23-42: 20 Histograms of Value 43: Shadow Proportion 44: Median Lightness 45: Median Saturation 46: Visual Details 47: Grayness 48: Visual Excitement 49: Motion	01: std of Lightning Key 02: std of Color Variance 03: std of Shadow Proportion 04: std of Median Lightness 05: std of Median Saturation 06: std of Visual Details 07: std of Grayness 08: std of Motion

VidFt_##.mat

Each "VidFt_##.mat" contains two matrices corresponding to two sets of features:

- VideoFeatures: [Lx49 single]
- VideoFeatures2: [Lx8 single] (not employed in the DECAF paper)

VideoFeatures is a two dimensional matrix of the size of L x 49 where L is the length of the video and 49 is the number of features that are extracted following the DEAP paper.

VideoFeatures2 is a two dimensional matrix of the size of L x 8 where L is the length of the video and 5 is the number of features that are not included among the VideoFeatures data.

DtCont_Music-MCA.zip

The same as above but everything is for “Music” instead of “Movie”. The length of videos, L, is equal to 60 for all the clips.