ASCERTAIN– The Description for the single-trial classification data

This Document belongs to the ASCERTAIN dataset documentations.

Dear user,

In this document we cover the description of the information that are used for Single-Trial Classifications 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 item:

1. ASCERTAIN_Features.zip
2. ASCERTAIN_raw.zip

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

• NS: Number of subjects that is equal to 58.
• NV: Number of movie video clips that is equal to 36.

Item 1: ASCERTAIN_Features.zip

Upon extracting the "ASCERTAIN_Features.zip" file, you will get a folder namely, "ASCERTAIN_Features" that contains the following files that will be explained below in more detail:

- Dt_EEGFeatures.mat
- Dt_ECGFeatures.mat
- Dt_GSRFeatures.mat
- Dt_EMOFeatures.mat
- Dt_SelfReports.mat
- Dt_Personality.mat
- Dt_Order_Movie.mat
- Data_Quality_Evaluation.xlsl
- Personality_Details.xlsl

Some of the extracted features include statistics about signal data. Whenever statistical measurements are mentioned below they include the following in the here-described order:

Columns	Statistical Measurements
01	mean
02	standard deviation (std)
03	skewness
04	kurtosis of the raw feature over time
05	% of times the feature value is above mean + std
06	% of times the feature value is below mean - std

Dt_ECGFeatures.mat

This file contains:

- **ECGFeatures**, an NSxNVx32 matrix where 32 is the total number of ECG features employed for the classification tasks as explained in the paper (see table below).
- **ECGFailures**, a 1-dimensional matrix that states for each of NS the ids of the videos for which a sensor failure occurred.

Columns	Electrocardiogram (ECG)
01-10	low frequency ([0-2.4] Hz) power spectral densities (PSDs)
11-14	four very slow response ([0-0.04] Hz) PSDs
15-20	Statistical measurements over inter beat intervals (IBI)
21-26	Statistical measurements over heart rate (HR)
27-32	Statistical measurements over heart rate variability (HRV)

Dt_EEGFeatures.mat

This file contains:

- **EEGFeatures**, an NSxNVx88 matrix where 88 is the total number of EEG features employed for the classification tasks as explained in the paper (see table below and statistical measurement description above).
- **EEGFailures**, a 1-dimensional matrix that states for each of NS the ids of the videos for which a sensor failure occurred.

Columns	Electroencephalography (EEG)
01-11	**NeuroSky EEG**
01	Average of first derivative,
02	proportion of negative differential samples,
03	mean number of peaks,
04	mean derivative of the inverse channel signal,
05	average number of peaks in the inverse signal,
06-11	Statistical measurements over the channel NeuroSky EEG
12-22	**Attention**
23-33	**Meditation**
34-44	**Alpha**
45-55	**Beta**
56-66	**Delta**
67-77	**Gamma**
78-88	**Theta**

Dt_GSRFeatures.mat

This file contains:

- **GSRFeatures**, an NSxNVx31 matrix where 31 is the total number of GSR features employed for the classification tasks as explained in the paper (see table below).
- **GSRFailures**, a 1-dimensional matrix that states for each of NS the ids of the videos for which a sensor failure occurred.

Columns	Galvanic Skin Response (GSR)
01	Mean skin resistance
02	Mean of first derivatives of skin resistance
03	Mean of absolute values of first derivatives of skin resistance
04	Mean first derivative for negative values only
05	Percentage of time with negative first derivative
06	Standard deviation of skin resistance
07	Average number of local minima in the skin conductance signal
08	Average rising time of the GSR signal
09-12	Log power density estimates; 4 sub-bands in the [0-0.4] Hz band
13	Standard deviation of skin conductance
14	Mean of first derivatives of skin conductance
15	Mean of absolute values of first derivatives of skin conductance
16	Mean of absolute values of second derivatives of skin conductance
17	Average number of local minima in the skin resistance signal
18-27	Log power density estimates; 10 sub-bands in the [0-2.4] Hz band
28	Zero crossing rate of skin conductance low response ([0-0.2] Hz)
29	Mean skin conductance low response peak magnitude
30	Zero crossing rate of skin conductance very slow response ([0-0.08] Hz)
31	Mean skin conductance very low response peak magnitude

Dt_EMOFeatures.mat

This file contains:

- **EMOFeatures**, an NSxNVx72 matrix where 72 is the total number of EMO features employed for the classification tasks as explained in the paper (see table below and statistical measurement description above).
- **EMOFailures**, a 1-dimensional matrix that states for each of NS the ids of the videos for which a sensor failure occurred.

Columns	Facial Motion Unit Features (EMO)
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

Dt_Selfreports.mat

Ratings includes 5 matrices for NSxNV for ratings from each subject for each video for the 5 rating types: Arousal, Valence, Engagement, Liking, Familiarity.

Dt_Personality.mat

Personality contains one NSx5 matrix that contains a value between 1 and 5 for each subject for the five personality traits in that order: Extraversion, Agreeableness, Conscientiousness, Emotional Stability and Openness.

Dt_Order_Movie.mat

This file contains a 2 dimensional matrix, namely **PermutationList**, with the size of NSxNV that includes the presentation order of the videos. Each row of the PermutationList is a random permutation of the video IDs from 1 to 36 that is originally used to select the order of the video presentation to the subject during the experiment.

Data_Quality_Evaluation.xlsl

This Microsoft Excel Document contains a description of how the evaluation was performed and classifies the data for each modality (EEG, ECG, GSR, EMO), video clip and person on a range from 1 (perfect data) to 6 (missing data).

Personality_Details.xlsl

This Microsoft Excel Document contains the data acquired to calculate the 5 personality traits. It contains a matrix of A x NS where A are 50 adjectives subjects had to rate on how well they describe themselves on a Likert-scale from 1-7. Details on how the trait scores are retrieved are described in the file.

Item 2: ASCERTAIN_raw.zip

Upon extracting the content of the "**ASCERTAIN_raw.zip**" file, you will get a folder namely "**MovieDataSegments**" which includes four sub-folders with the following names:

- **EEGData**: Includes the electroencephalography (EEG) signals of the subjects.
- **ECGData**: Includes the electrocardiography (ECG) signals of the subjects.
- **GSRData**: Includes the Galvanic Skin Response (GSR) signals of the subjects.
- **EMOData**: Includes the facial tracks (EMO) of the subjects.
- **SDMData**: Includes the facial landmark tracks (SDM) of subjects.

Each of the 4 folders has 58 sub-folders in correspondence to the 58 subjects. The template name of the folders is "**Movie_P##**" where P stands for the word "**p**erson" and **##** is the subject-numeric-ID and ranges from 01 to 58. Each **Movie_P##** includes 58 files corresponding to the 58 video clips and end with a ".mat" extensions. The files can be loaded using Octave or MATLAB and include vectors or matrices of the relevant digital signals.

Important Note:
The clip-numeric-IDs that will be used in the description of this section are the original clip IDs. In other words, the files are already sorted according to the "*PermutationList"* variable in "*Dt_Order_Movie.mat*" file in the "*ASCERTAIN-Features.zip*" file and do **not** follow the order of the actual presentation.

EEGData

The files under each **Movie_P##** folder have a template name of "**EEG_Clip##.mat**" where **##** is the clip-numeric- ID and ranges from 01 to 36. Please consider the "Important Note" explained above.
Each variable "**ThsEEG**" is a matrix of the size of 8xL, where L is the length of the EEG signal in milliseconds.
The data was sampled at a rate of 32Hz.

ECGData

The files under each **Movie_P##** folder have a template name of "**ECG_Clip##.mat**" where **##** is the clip-numeric- ID and ranges from 01 to 36. Please consider the "Important Note" explained above.
Each file includes the variable "**Data_ECG**" which is a matrix of the size Lx6, where L is the length of the ECG signal in milliseconds. The first column includes the time stamp, the last two the ECG signal from the right and left arms respectively. Columns 2- 4 include the three directions of the accelerometer data. The data for the first 8 subjects only includes the columns 1, 5 and 6.
The data was sampled at a rate of 256Hz.

GSRData

The files under each **Movie_P##** folder have a template name of "**GSR_Clip##.mat**" where **##** is the clip-numeric- ID and ranges from 01 to 36. Please consider the "Important Note" explained above.
Each file includes a variable, namely, "**Data_GSR**" which is a matrix of the size Lx5, where L is the length of the GSR signal in milliseconds. The first column includes the time in ms, 2-4 contain the signal from the three directions of the accelerometer (X, Y, Z).
The data was sampled at a rate of 128Hz.

EMOData

The files under each **Movie_P##** folder have a template name of "**EMO_Clip##.mat**" where **##** is the clip-numeric- ID and ranges from 01 to 36. Please consider the "Important Note" explained above.
Each file includes the output of the facial tracker and facial expression analysis via a variable, namely, "**ThsEMO**" which is a matrix of the size of *NF*x22, where *NF* is the number of frames in the corresponding facial video clip. For the first 36 subjects the frame rate of the video streams is 20 fps and hence *NF* = 20 x L where L is the length of the video clip in seconds. For the subjects 37-58 the frame rate is 25fps, i.e. *NF* = 25 x L.
The labels for the 22 columns of **ThsEMO** are as follows:

01: Frame number	12: deformation of the right lid
02: vertical deformation of the upper lip	13: deformation of the left lid
03: vertical deformation of the lower lip	14: neutral state assuming a neutral frontal initial frame
04: horizontal deformation of the left lip corner	15: happy state assuming a neutral frontal initial frame
05: vertical deformation of left lip corner	16: surprised state assuming a neutral frontal initial frame
06: horizontal deformation of the right lip corner	17: angry state assuming a neutral frontal initial frame
07: vertical deformation of the right lip corner	18: disgusted state assuming a neutral frontal initial frame
08: deformation of the right eyebrow	19: fearful state assuming a neutral frontal initial frame
09: deformation of the left eyebrow	20: sad state assuming a neutral frontal initial frame
10: deformation of the right cheek	21: x dimension of the head pose
11: deformation of the left cheek	22: y dimension of the head pose

SDMData

The files in the folder have a template name of "**Movie_User##.mat**" where ## is the subject-numeric- ID and ranges from 01 to 58. Please consider the "Important Note" explained above. Each file includes the facial landmark tracks in response to the 36 video samples for one subject. The content is sorted for videos in the form TrackResults[1, **##**], where **##** is the clip-numeric- ID and ranges from 01 to 36.

The track information is in a cell-array under the same structure namely 'Data'.

The tracks are slightly longer than the video length, i.e. recording started before the start of the video. The frame-rate is 20fps (25fps for subjects 37-58), hence users of the dataset are advised to use the data corresponding to the LAST L*20 (or 25) cells where L is the length of the video clip in seconds. The framerate, duration of the presentation, and the height and width are shown in 'Info'.

For each frame [pred] includes the x and y coordinates of the 49 landmarks that are provided by the SDM and [pose] includes rotation and angle values for estimating the head-pose.