EEG-Recorded Responses to Short Chord Progressions

Citation

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Abstract

This dataset contains scalp-recorded EEG responses from two human participants hearing short chord progressions with expected (tonic) and deviant (dominant, flatted supertonic, or silent) cadential events in keys of C Major, B Major, and F Major (12 chord progressions total). EEG data are published in Matlab (.mat) format, in two forms. First, two preprocessed data files (one per participant, each around 300MB), used as input to classification in the Kaneshiro et al. (2012) proceedings paper, each contain 108 epoched trials of response to the fifth chord (cadential event) for each of the 12 stimuli, for a total of 1296 trials of data per participant. Second, 24 minimally preprocessed EEG recordings (12 per participant, each between 650-811MB) each contain 54 tonic-ending progressions and 9 of each deviant-ending progression for every key, for a total of 648 tonic-ending progressions and 108 of each deviant-ending progression per key per participant. In addition to EEG data, this dataset includes audio files (.wav format) and a notated score of the stimuli, with mappings to stimulus triggers.

Related published work

Kaneshiro B, Berger J, Perreau Guimaraes M, and Suppes P (2012). An Exploration of Tonal Expectation Using Single-Trial EEG Classification. In Proceedings of the 12th International Conference on Music Perception and Cognition and the 8th Triennial Conference of the European Society for the Cognitive Sciences of Music, Thessaloniki, Greece.

Dataset Files

- **README.pdf** (this document)
  Informational document describing the dataset.
- **Stimuli_audio.zip**
  Set of 12 chord progressions used as stimuli for the experiment (.wav format).
- **Stimuli_score.pdf**
  Notated score of all 12 stimuli.
- **Stimuli_score_annotated.pdf**
  Notated score of all 12 stimuli, annotated with trigger numbers of each chord event.
- **P1_preprocessed.mat** and **P2_preprocessed.mat**
  Preprocessed data classified in the Kaneshiro et al. (2012) proceedings paper.
- **P1_a1.mat** through **P2_d3.mat**
  Set of 24 minimally preprocessed EEG recordings analyzed in the study.

Data acquisition and experimental paradigm

EEG data were recorded from 128 sensors using the Electrical Geodesics, Inc. (EGI) GES 300 system, sampled at 1 kHz with vertex reference. The experimental paradigm and details of data acquisition are described in the Kaneshiro et al. (2012) proceedings paper cited above.

Stimulus triggers

Each chord progression was presented as a single, continuous sound file. As a chord progression played, stimulus triggers were delivered at the onset times of beats 1-5 of the chord progression. See **Stimuli_score_annotated.pdf** for chord-to-trigger mappings.

NOTE: We have observed, in other experiments using the stimulus-delivery apparatus used here, a delay of approximately 67ms between the trigger timestamp and the onset of auditory stimulus playback. Thus, users of this dataset should be aware that the values in the **onsets** variable may need to advanced accordingly to account for such a delay. For the present data, the timing of subsequent triggers within a given chord progression appear to be correct relative to the timing of the first trigger, with 625 ms between triggers.

Preprocessed EEG files

Preprocessing of files **P1_preprocessed.mat** and **P2_preprocessed.mat** is as described in the Kaneshiro et al. (2012) proceedings paper. Only data corresponding to the fifth beat of each stimulus (the cadence events) were used for classification analysis. As described in the paper, a subset of the tonic-cadence responses was selected for classification so that the classification would involve a balanced number of trials for every stimulus. Trial epoching begins at stimulus onset (no prestimulus interval).

NOTE: Certain electrodes were excluded from classification analysis for the proceedings paper. Users are encouraged to identify and remove bad electrodes prior to performing classification.

Participant identifiers of the preprocessed .mat files correspond to identifiers used in the proceedings paper, and to identifiers used in the minimally preprocessed EEG files in this dataset.

Each preprocessed .mat file contains the following variables:

- **fs**: Sampling rate in Hz. For both recordings, fs=62.5.
- **sessionID**: Identifier of the data recording. sessionID is always the same as the .mat filename, minus the file extension.
- **N**: Number of time samples used for each trial. For both recordings, N=39.
- **Triggers**: 1 x 1296 vector containing the labels of trials used for classification.
- **y**: Trial-space data matrix containing the trials selected for classification. *This is the data matrix that is ready for input to a classifier.* Rows of **y** correspond to trials, and columns correspond to concatenated electrodes. Thus, data from trial 1 are found in row 1, from trial 2 are found in row 2, etc.; data from electrode 1 are found in columns 1:N, from electrode 2 are found in columns (N+1):2N, etc. This matrix has 1296 rows (corresponding to elements in the **Triggers** vector) and 4836 (124*39) columns.
- **x**: Channel-space data matrix of trials selected for classification. Rows of **x** correspond to electrodes, and columns correspond to epoched, concatenated trials. Thus, data from electrode 1 are found in row 1, from electrode 2 are found in row 2, etc.; data from trial 1 are found in columns 1:N, from trial 2 are in columns (N+1):2N, etc. This matrix has 124 rows and 50544 (1296*39) columns. This matrix corresponds to the elements in the **Triggers** vector.
- **TS**: 2 x 2920 matrix. The first row contains all of the chord 5 event labels, in the order they were presented during experimental sessions; the second row specifies whether each event was selected for classification, as in order to present a balanced number of

trials for classification, only one tonic-progression ending per block was used for analysis. The **Triggers** vector can be derived from this matrix.

- **yAll**: Trial-space data matrix of all trials. This data matrix can be used as input to a classifier, but it does not contain a balanced number of trials for every stimulus. The rows of **yAll** correspond to trials, and columns correspond to concatenated electrodes. Thus, data from trial 1 are found in row 1, from trial 2 are found in row 2, etc.; data from electrode 1 are found in columns 1:N, from electrode 2 are found in columns (N+1):2N, etc. This matrix has 2920 rows (corresponding to all elements in the first row of the **TS** matrix) and 4836 (124*39) columns.
- **xAll**: Channel-space data matrix of all trials. Rows of **xAll** correspond to electrodes, and columns correspond to epoched, concatenated time samples. Thus, data from trial 1 are found in columns 1:N, from trial 2 are in columns (N+1):2N, etc. The data matrix has 124 rows and 113880 (2920*39) columns. This matrix corresponds to all elements in the first row of the **TS** matrix.

Minimally preprocessed EEG files

Preprocessing of files **P1_a1.mat** through **P2_d3.mat** differs from the procedure described in the 2012 Kaneshiro et al. proceedings paper. For minimally preprocessed data, the following steps were performed using EGI's Net Station software:

- Data frames were band-pass filtered between 0.3-50 Hz.
- Filtered data were exported to Matlab cell arrays.

Following this, using Matlab we extracted stimulus triggers and onset times, and anonymized the data. No artifact rejection or re-referencing has been performed on these data files. All 129 channels of data are retained, including the zero-valued channel 129 representing the vertex reference electrode.

Each .mat file is coded as follows:

- **{participant identifier}_{session}{recording}.mat**
- **Participant identifier** is P1 or P2 and corresponds to the identifiers used in the Kaneshiro et al. (2012) proceedings paper.
- **Session** refers to the day. Recordings were taken over four separate days. Session dates for P1 spanned 17 days, and for P2 spanned nine days.
- **Recording** refers to the block in the session. Each session comprised three consecutive blocks.
- Example: **P1_b3.mat** is participant 1 (P1), second session (b), third block (3).

Every .mat file contains the following variables:

- **fs**: Sampling rate in Hz. For all recordings, fs=1000.
- **sessionID**: Identifier of the data recording. sessionID is always the same as the .mat filename, minus the file extension.
- **xContinuous**: Continuous (non-epoched) data frame. xContinuous is a 2D matrix with 129 rows and variable number of columns (channels x total time).
- **triggers**: Vector of stimulus numbers, in the order they occurred in the recording. Always a column vector of length 1215.
- **onsets**: Vector of onset times of triggers, in ms (or time samples, since fs=1000). Always a column vector of length 1215.