The DREAMS Databases and Assessment Algorithm

During the DREAMS project, we collected a large amount of polysomnographic recordings (PSG) to tune, train and test our automatic detection algorithms.

These recordings were annotated in microevents or in sleep stages by several experts. They were acquired in a sleep laboratory of a Belgium hospital using a digital 32-channel polygraph (BrainnetTM System of MEDATEC, Brussels, Belgium). The standard European Data Format (EDF) was used for storing.

In order to facilitate future research and performance comparision, we decided to publish these data on Internet. Therefore, eight DREAMS databases are available according to the annotation carried out (click on the link to open):

- The DREAMS Subjects Database : 20 whole-night PSG recordings coming from healthy subjects, annotated in sleep stages according to both the Rechtschaffen and Kales criteria and the new standard of the American Academy of Sleep Medicine;
- The DREAMS Patients Database: 27 whole-night PSG recordings coming from patients with various pathologies, annotated in sleep stages according to both the Rechtschaffen and Kales criteria and the new standard of the American Academy of Sleep Medicine;
- The DREAMS Artifacts Database: 20 excerpts of 15 minutes of PSG recordings annotated in artifacts (cardiac interference, slow ondulations, muscle artifacts, failing electrode, 50/60Hz main interference, saturations, abrupt transitions, EOG interferences and artifacts in EOG) by an expert;
- The DREAMS Sleep Spindles Database: 8 excerpts of 30 minutes of central EEG channel (extracted from whole-night PSG recordings), annotated independently by two experts in sleep spindles;
- The DREAMS K-complexes Database: 5 excerpts of 30 minutes of central EEG channel (extracted from whole-night PSG recordings), annotated independently by two experts in K-complexes;
- The DREAMS REMs Database: 9 excerpts of 30 minutes of PSG recordings in which rapid eye movements were annotated by an expert;
- The DREAMS PLMs Database: 10 whole-night PSG recordings coming from patients in which one of the two tibialis EMG was annotated in periodic limb movements by an expert;
- The DREAMS Apnea Database: 12 whole-night PSG recordings coming from patients annotated in respiratory events (central, obstructive and mixed apnea and hypopnea) by an expert.

We also developed and tested several automatic procedures to detect micro-events such as sleep spindles, K-complexes, REMS, etc. and provide the source codes for them in the DREAMS Assessment Algorithm package.

All our publications on this subject can be found in : https://www.researchgate.net/scientific-contributions/35338616_S_Devuyst

The DREAMS Subjects Database

This Subjects database was collected during the DREAMS project, to tune, train and test our automatic sleep stages classification algorithms.

It consist of 20 whole-night PSG recordings coming from healthy subjects, annotated in sleep stages according to both the Rechtschaffen and Kales (R&K) criteria and the new standard of the American Academy of Sleep Medicine (AASM).

In order to facilitate future research and performance comparision, we decided to publish these data on Internet. Be simply aware that this DREAMS Subjects Database of University of MONS - TCTS Laboratory (Stéphanie Devuyst, Thierry Dutoit) and Université Libre de Bruxelles - CHU de Charleroi Sleep Laboratory (Myriam Kerkhofs) is under terms of the Attribution-NonCommercial-NoDerivs 3.0 Unported (CC BY-NC-ND 3.0) License. Each use of this database and/or its content must be attributed to University of MONS - TCTS Laboratory (Stéphanie Devuyst, Thierry Dutoit) and Université Libre de Bruxelles - CHU de Charleroi Sleep Laboratory (Myriam Kerkhofs). Any other additional authorisations may be asked to avre@umons.ac.be.

Database description

Data collected were acquired in a sleep laboratory of a belgium hospital using a digital 32-channel polygraph (BrainnetTM System of MEDATEC, Brussels, Belgium). They consist of 20 whole-night polysomnographic recordings, coming from 20 healthy subjects. At least two EOG channels (P8-A1, P18-A1), three EEG channels (CZ-A1 or C3-A1, FP1-A1 and O1-A1) and one submental EMG channel were recorded. The standard European Data Format (EDF) was used for storing. The sampling frequency was 200Hz.

These recordings have been specifically selected for their clarity (i.e. that they contain few artifacts) and come from persons, free of any medication, volunteers in other research projects, conducted in the sleep lab.

The sleep stage classification according to the Rechtschaffen and Kales (R&K) criteria has been made on the basis of epochs 20 seconds, while the scoring according to the American Academy of Sleep Medicine (AASM) criteria has been completed (nearly two years later) based on epochs of 30 seconds. Both annotations were produced visually by a single expert of the sleep laboratory.

Name	Sampling frequency	Age	Sex	Recording duration (hh.mm.ss)
subject1	200Hz	23	Woman	08:00:40
subject2	200Hz	47	Woman	08:12:30
subject3	200Hz	24	Woman	08:24:20

subject4	200Hz	48	Woman	08:46:30
subject5	200Hz	46	Woman	08:51:30
subject6	200Hz	65	Woman	08:18:40
subject7	200Hz	45	Woman	08:26:00
subject8	200Hz	22	Woman	08:05:00
subject9	200Hz	21	Woman	09:18:40
subject10	200Hz	20	Woman	08:36:20
subject11	200Hz	30	Woman	08:24:10
subject12	200Hz	54	Woman	08:00:40
subject13	200Hz	23	Woman	09:15:40
subject14	200Hz	57	Woman	08:22:10
subject15	200Hz	20	Woman	07:00:00
subject16	200Hz	27	Woman	08:03:50
subject17	200Hz	23	Man	08:18:30
subject18	200Hz	27	Man	08:30:40
subject19	200Hz	27	Man	08:36:50
subject20	200Hz	20	Man	09:32:30

File format

Three files are available per subject:

- subject.edf: corresponds to the polysomnographic recording in the European Data Format (EDF)
- HypnogramR&K_subject.txt: is a textual file containing, in first line, the name "[HypnogramR&K]" followed by one column of integer. These numerical values correspond to the sleep stage (one value per 5 sec) annotated by the expert according to the Rechtschaffen and Kales criteria.
  5=wake
  4=REM stage
  3=sleep stage S1
  2=sleep stage S2

1=sleep stage S3
0=sleep stage S4
-1=sleep stage movement
-2 or -3 =unknow sleep stage

- HypnogramAASM_subject.txt: is a textual file containing, in first line, the name "[HypnogramAASM]" followed by one column of integer. These numerical values correspond to the sleep stage (one value per 5 sec) annotated by the expert according to the American Academy of Sleep Medicine criteria.
  5=wake
  4=REM stage
  3=sleep stage N1
  2=sleep stage N2
  1=sleep stage N3
  0 or -1 or -2 or -3 =unknow sleep stage

The DREAMS Patients Database

This Patients database was collected during the DREAMS project, to tune, train and test our automatic sleep stages classification algorithms.

It consist of 27 whole-night PSG recordings coming from patients with various pathologies, annotated in sleep stages according to both the Rechtschaffen and Kales (R&K) criteria and the new standard of the American Academy of Sleep Medicine (AASM).

In order to facilitate future research and performance comparision, we decided to publish these data on Internet. Be simply aware that this DREAMS Patients Database of University of MONS - TCTS Laboratory (Stéphanie Devuyst, Thierry Dutoit) and Université Libre de Bruxelles - CHU de Charleroi Sleep Laboratory (Myriam Kerkhofs) is under terms of the Attribution-NonCommercial-NoDerivs 3.0 Unported (CC BY-NC-ND 3.0) License. Each use of this database and/or its content must be attributed to University of MONS - TCTS Laboratory (Stéphanie Devuyst, Thierry Dutoit) and Université Libre de Bruxelles - CHU de Charleroi Sleep Laboratory (Myriam Kerkhofs). Any other additional authorisations may be asked to avre@umons.ac.be.

Database description

Data collected were acquired in a sleep laboratory of a belgium hospital using a digital 32-channel polygraph (BrainnetTM System of MEDATEC, Brussels, Belgium). They consist of 27 whole-night polysomnographic recordings, coming from patients with various pathologies (diseases suffered by these patients are given in Table below).

At least two EOG channels (P8-A1, P18-A1), three EEG channels (CZ-A1 or C3-A1, FP1-A1 and O1-A1) and one submental EMG channel were recorded. The standard European Data Format (EDF) was used for storing. The sampling frequency was 200Hz. Corresponding physiological signals can be particularly contaminated by artifacts (notably due to the numerous movements of the sleeper during the night).

The sleep stage classification according to the Rechtschaffen and Kales (R&K) criteria has been made on the basis of epochs 20 seconds, while the scoring according to the American Academy of Sleep Medicine (AASM) criteria has been completed (nearly two years later) based on epochs of 30 seconds. Both annotations were produced visually by a single expert of the sleep laboratory.

Name	Sampling frequency	Age	Sex	Recording duration (hh.mm.ss)	Pathology PLMS= periodic limb movements sydrome SAHS =sleep apnea-hypopnea syndrome TST=total sleep time

patient1	200Hz	72	Man	08:01:40	Mixed apnea in the beginning of the night, no sleep spindles
patient2	200Hz	50	Woman	08:32:00	Dysomnia,fibromyalgia
patient3	200Hz	52	Woman	09:07:50	Dysomnia,PLMS at 12/h
patient4	200Hz	42	Man	08:41:10	SAHS, mixed apnea, periodic breathing in arousal
patient5	200Hz	40	Man	08:22:40	Dysomnia, somnolence
patient6	200Hz	74	Woman	08:21:20	SAHS, Cheyne-Stokes respiration
patient7	200Hz	52	Man	08:13:30	PLMS at 125/h, awakening+arousal index=25.8/h
patient8	200Hz	31	Man	09:30:30	PLMS at 25/h, insomnia: TST=256 min, awakening+arousal index=16.8/h
patient9	200Hz	53	Woman	08:26:50	SAHS at 23/h
patient10	200Hz	61	Woman	09:00:30	SAHS at 14/h, PLMS at 20/h
patient11	200Hz	73	Man	08:59:50	SAHS at 37/h
patient12	200Hz	47	Man	08:38:40	SAHS at 88/h
patient13	200Hz	38	Man	08:08:10	SAHS at 53/h
patient14	200Hz	48	Man	08:52:10	SAHS at 40/h
patient15	200Hz	53	Man	07:55:00	SAHS at 73/h, PLMS at 19/h
patient16	200Hz	45	Woman	09:32:40	Insomnia: TST=288 min
patient17	200Hz	57	Man	09:20:20	PLMS at 66/h
patient18	200Hz	52	Woman	10:25:20	SAHS at 13/h
patient19	200Hz	53	Woman	08:58:30	Snoring, dissomnia: TST=399 min, sleep latency :107min
patient20	200Hz	19	Man	08:13:50	Not specified
patient21	200Hz	44	Man	09:20:30	PLMS (index unknow)

patient22	200Hz	38	Man	09:12:40	PLMS at 16.2/h
patient23	200Hz	60	Man	08:07:30	PLMS at 116.9/h
patient24	200Hz	50	Man	07:43:30	PLMS at 30.5/h
patient25	200Hz	27	Woman	08:59:40	PLMS at 18.9/h
patient26	200Hz	71	Man	08:20:30	PLMS at 78.3/h
patient27	200Hz	69	Woman	08:54:10	PLMS at 133/h

File format

Three files are available per patient:

- patient.edf: corresponds to the polysomnographic recording in the European Data Format (EDF)
- HypnogramR&K_patient.txt: is a textual file containing, in first line, the name "[HypnogramR&K]" followed by one column of integer. These numerical values correspond to the sleep stage (one value per 5 sec) annotated by the expert according to the Rechtschaffen and Kales criteria.
  5=wake
  4=REM stage
  3=sleep stage S1
  2=sleep stage S2
  1=sleep stage S3
  0=sleep stage S4
  -1=sleep stage movement
  -2 or -3 =unknow sleep stage
- HypnogramAASM_patient.txt: is a textual file containing, in first line, the name "[HypnogramAASM]" followed by one column of integer. These numerical values correspond to the sleep stage (one value per 5 sec) annotated by the expert according to the American Academy of Sleep Medicine criteria.
  5=wake
  4=REM stage
  3=sleep stage N1
  2=sleep stage N2
  1=sleep stage N3
  0 or -1 or -2 or -3 =unknow sleep stage

The DREAMS Artifacts Database

This artifacts database was collected during the DREAMS project, to tune, train and test our automatic detection algorithms.

It consist of 20 excerpts of 15 minutes of PSG recordings (extracted from whole-nights), annotated by an expert in artifacts.

In order to facilitate future research and performance comparision, we decided to publish these data on Internet. Be simply aware that this DREAMS Artifacts Database of University of MONS - TCTS Laboratory (Stéphanie Devuyst, Thierry Dutoit) and Université Libre de Bruxelles - CHU de Charleroi Sleep Laboratory (Myriam Kerkhofs) is under terms of the Attribution-NonCommercial-NoDerivs 3.0 Unported (CC BY-NC-ND 3.0) License. Each use of this database and/or its content must be attributed to University of MONS - TCTS Laboratory (Stéphanie Devuyst, Thierry Dutoit) and Université Libre de Bruxelles - CHU de Charleroi Sleep Laboratory (Myriam Kerkhofs). Any other additional authorisations may be asked to avre@umons.ac.be.

Database description

Data collected were acquired in a sleep laboratory of a belgium hospital using a digital 32-channel polygraph (BrainnetTM System of MEDATEC, Brussels, Belgium). They consist of 20 polysomnographic recordings coming from patients with different pathologies (dysomnia, restless legs syndrome, insomnia, apnoea/hypopnoea syndrome). Two EOG channels (P8-A1, P18-A1), three EEG channels (CZ-A1 or C3-A1, FP1-A1 and O1-A1) and one submental EMG channel were recorded. The standard European Data Format (EDF) was used for storing. The sampling frequency was 200Hz, 100Hz or 50Hz. An excerpt of 15 minutes was extracted from each of these recordings to be annotated in artifacts by an expert. These excerpts were voluntarily withdrawn at various times of the night, in order to diversify the background of the physiological signals observed (depending on sleep stage considered). The corresponding whole-night recordings were also previously scored in sleep stages according to the Rechtschaffen and Kales criteria, but no note of these stages quotations was given to the scorers.

Name	Sampling frequency	Age	Sex	Time of the excerpt (from the begining of the recording)
excerpt1	50Hz	60	Woman	extracted from 00:20:00 to 00:35:00
excerpt2	50Hz	53	Man	extracted from 01:23:00 to 01:38:00
excerpt3	100Hz	50	Woman	extracted from 08:17:00 to 08:32:00
excerpt4	100Hz	51	Man	extracted from 00:14:00 to 00:29:00
excerpt5	200Hz	73	Man	extracted from 05:14:00 to 05:29:00

excerpt6	100Hz	42	Man	extracted from 03:45:00 to 04:00:00
excerpt7	50Hz	65	Man	extracted from 04:03:00 to 04:18:00
excerpt8	200Hz	53	Man	extracted from 07:38:00 to 07:53:00
excerpt9	50Hz	63	Man	extracted from 00:46:00 to 01:01:00
excerpt10	200Hz	72	Man	extracted from 03:15:00 to 03:30:00
excerpt11	200Hz	47	Man	extracted from 04:20:00 to 04:35:00
excerpt12	200Hz	31	Man	extracted from 00:17:00 to 00:32:00
excerpt13	200Hz	52	Woman	extracted from 01:50:00 to 02:05:00
excerpt14	200Hz	42	Man	extracted from 08:01:00 to 08:16:00
excerpt15	200Hz	40	Man	extracted from 08:04:00 to 08:19:00
excerpt16	200Hz	52	Man	extracted from 02:22:00 to 02:37:00
excerpt17	200Hz	53	Woman	extracted from 01:49:00 to 02:04:00
excerpt18	200Hz	61	Woman	extracted from 00:00:00 to 00:15:00
excerpt19	200Hz	73	Man	extracted from 05:39:00 to 05:54:00
excerpt20	200Hz	48	Man	extracted from 03:00:00 to 03:15:00

The artifacts asked to be identified in these excerpts were the following ones (click on link to see example):
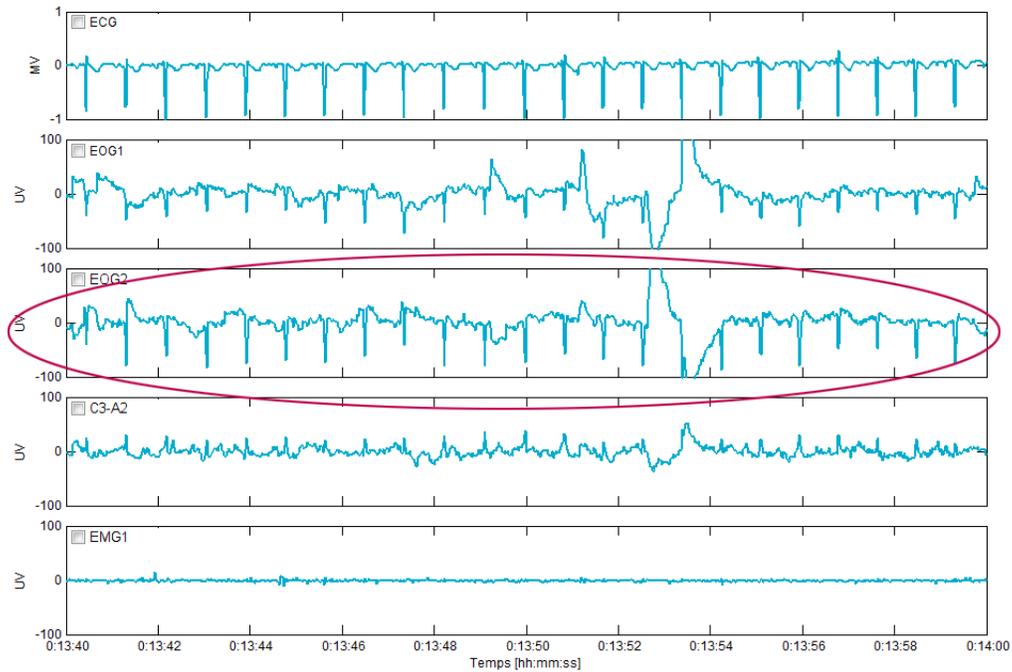
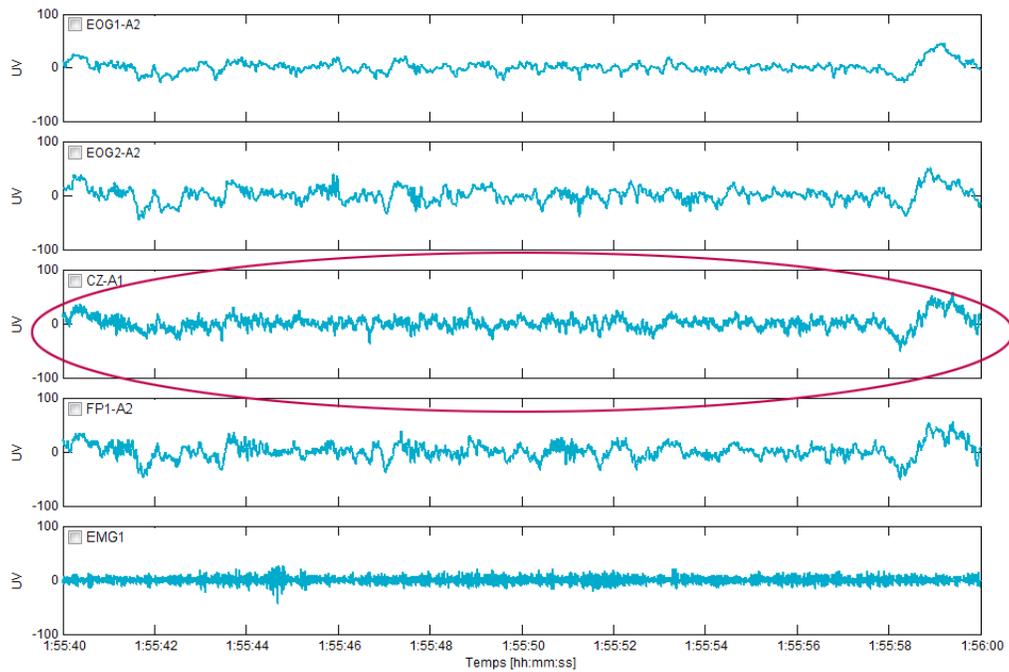- Slow ondulations on the central EEG (Atf_OndE);
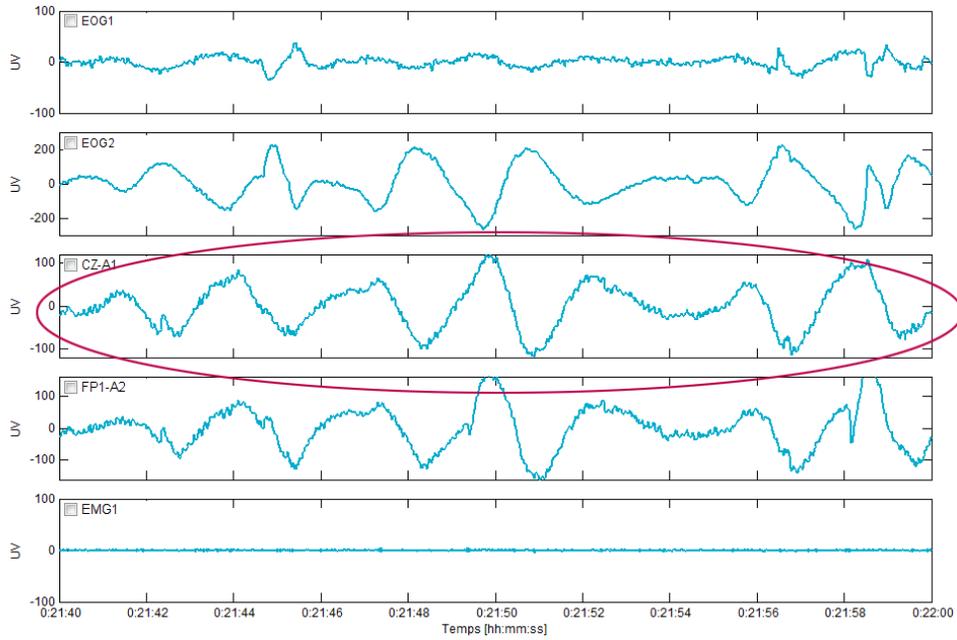
- Slow ondulations on at least one of the EOG (Atf_OndO);
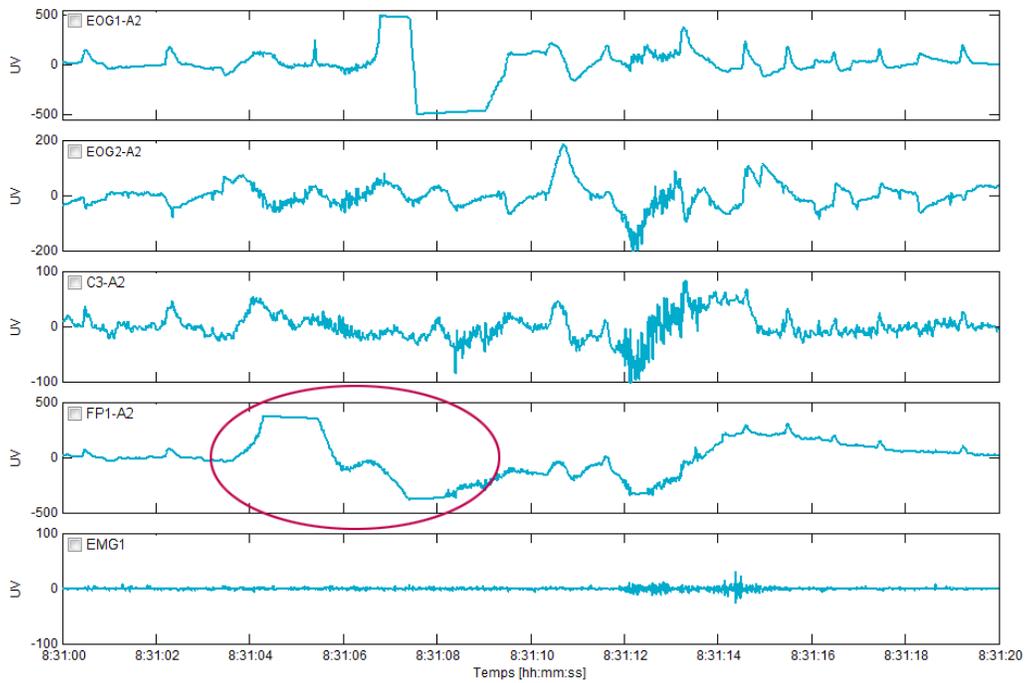- Cardiac interferences on the central EEG (Atf_cardE);
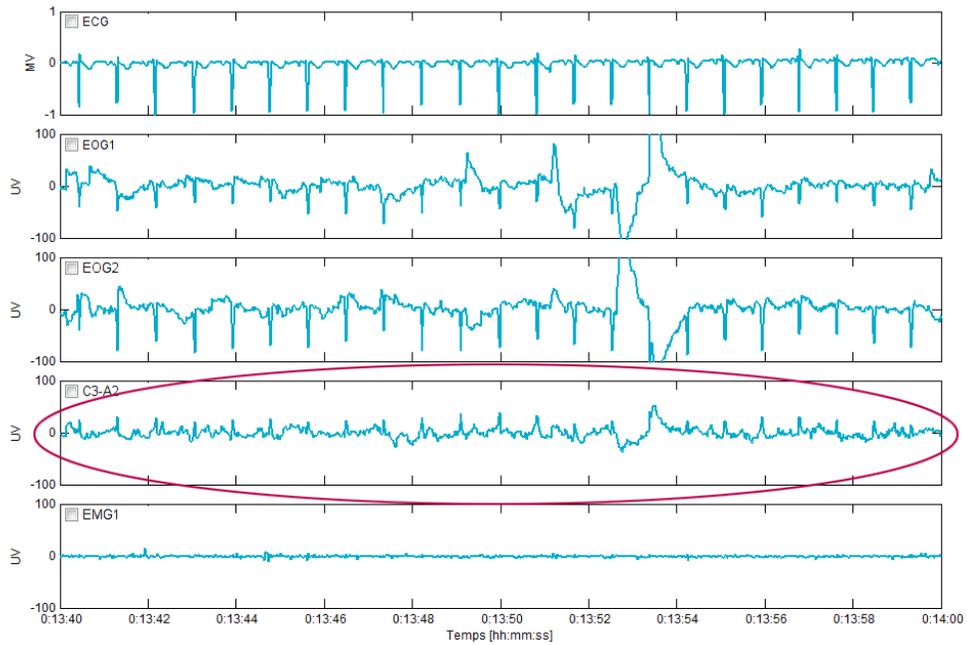
- Cardiac interferences on at least one of the EOG (Atf_cardO);
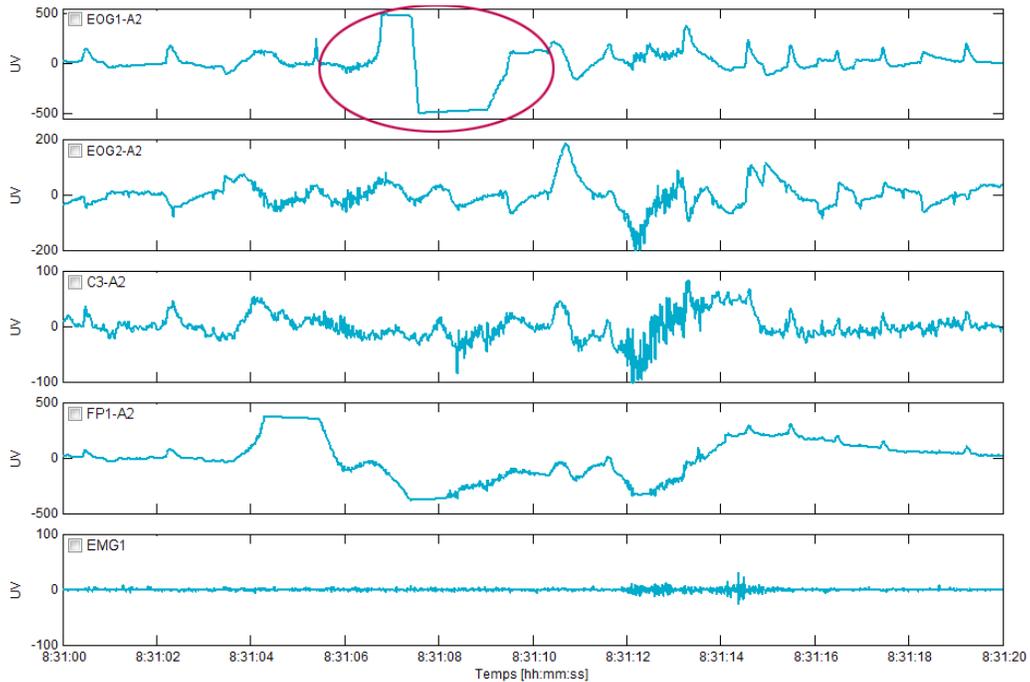
- Network interferences (50/60Hz) on the central EEG (Atf_50HzE);

- Network interferences (50/60Hz) on at least one of the EOG (Atf_50HzO);
- Network interferences (50/60Hz) on the submental EMG (Atf_50HzM);
- Saturations of the EEG (Atf_satE);

- Saturations of the EOG (Atf_satO);

- Saturations of the EMG (Atf_satM);
- Unusual increases of the EEG amplitude (such as those caused by EOG interferences) (Atf_highE);
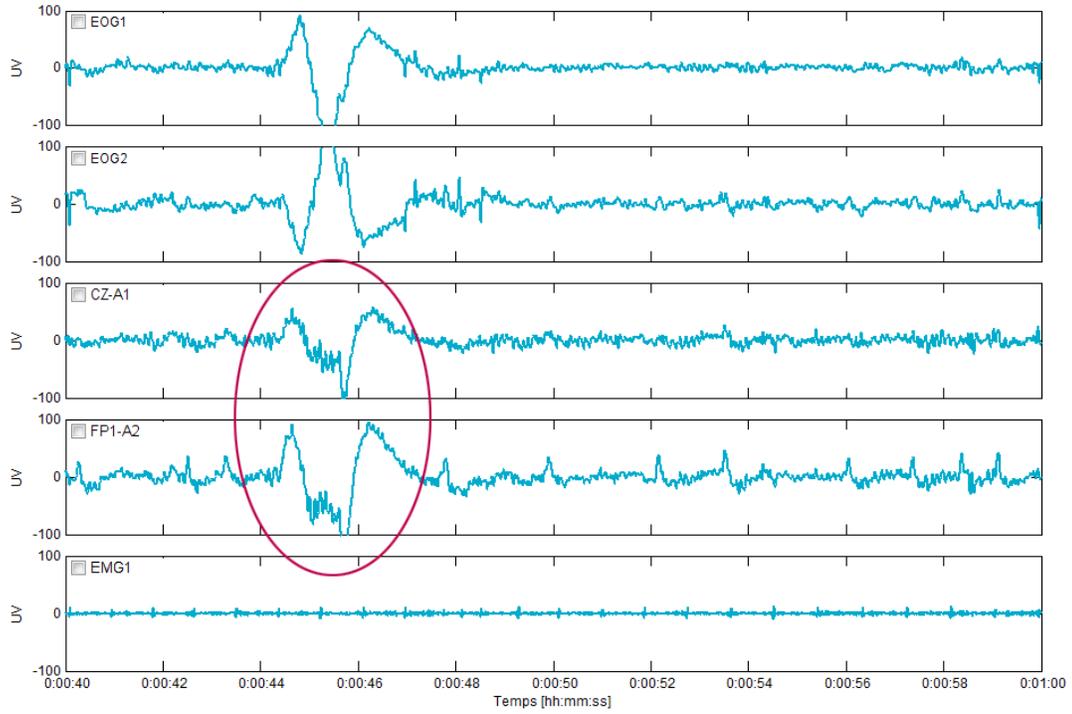
- Failing electrode on the EEG (Atf_noE);
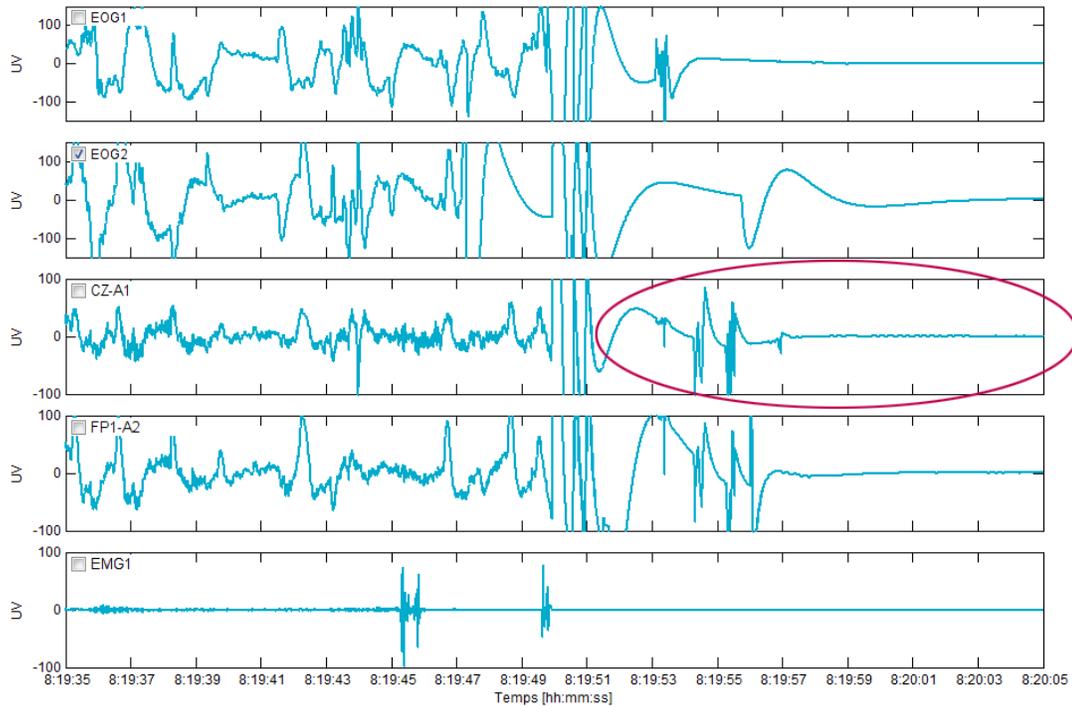
- Failing electrode on the EOG (Atf_noO);
- Abrupt transitions (electrode popping) on the EEG (Atf_transE);

- Muscle or movement artifacts on the EEG (Atf_mvtE);

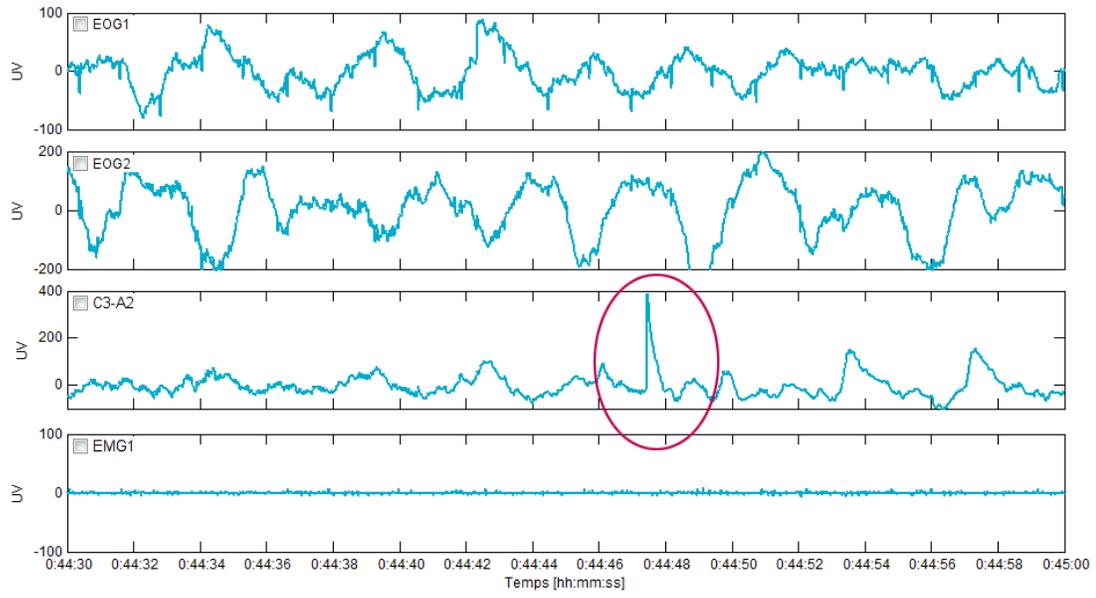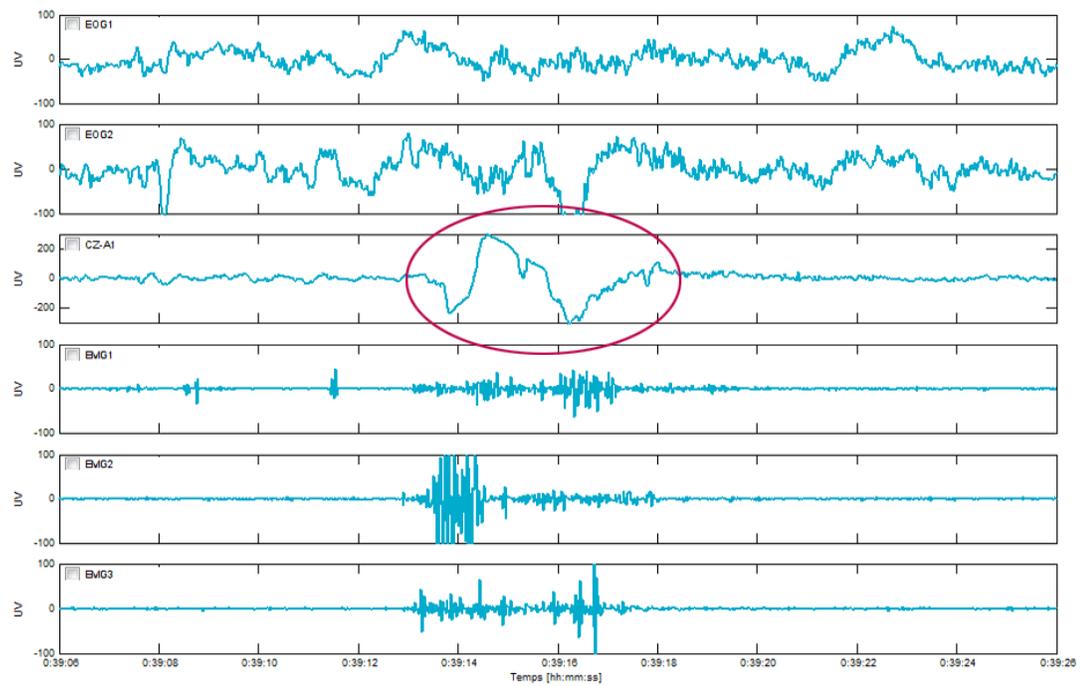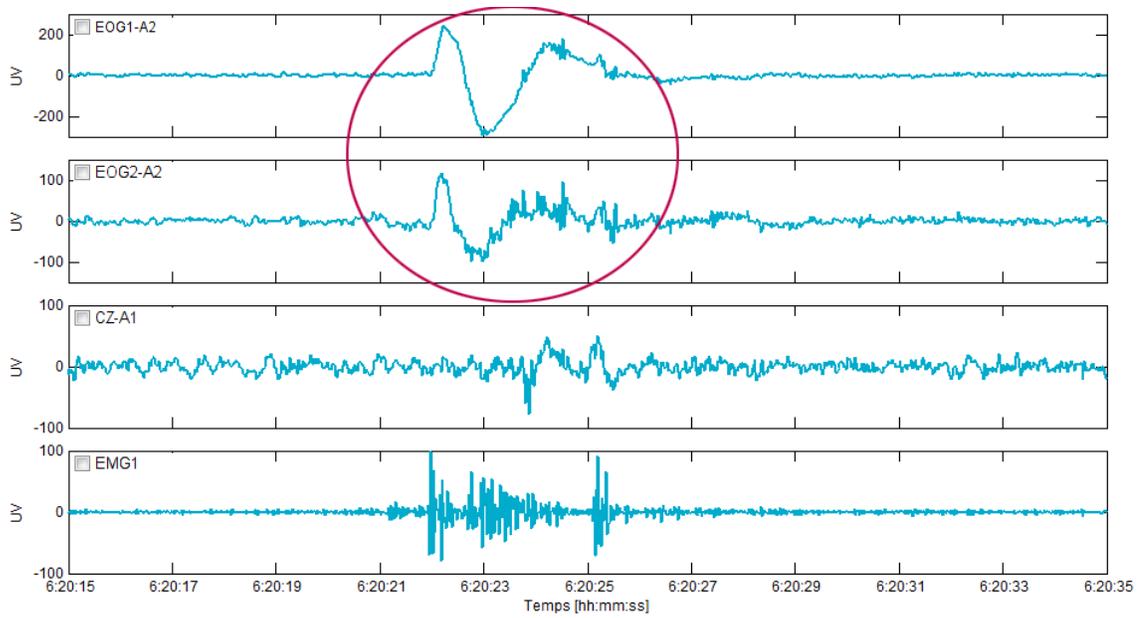- EOG artifacts constituted of in phase movements (Atf_phaseO);

- Other artifacts on the EEG (Atf_otherE);
- Other artifacts on the EOG (Atf_otherO).

A summary of the recordings contents in artifacts is presented below. Unfortunately, no saturation has been reported by the expert in this database. We also note that only one period of EEG was annotated as corrupted by a network interference. However, this is hardly surprising given that the Medatec acquisition system already includes filters to eliminate these spurious frequencies.

	Atf_ondE	Atf_ondO	Atf_cardE	Atf_cardO	Atf_50HzE	Atf_50HzO	Atf_50HzM	Atf_satE	Atf_satO	Atf_satM	Atf_highE	Atf_noE	Atf_noO	Atf_tansE	Atf_mvtE	Atf_phaseO	Atf_otherE	Atf_otherO
excerpt1	X	X		X							X			X	X	X		
excerpt2	X	X									X				X	X		
excerpt3	X	X		X							X			X	X	X	X	
excerpt4	X	X		X										X	X	X		
excerpt5	X										X			X	X	X		

excerpt6	X	X		X							X			X	X	X	
excerpt7	X	X		X							X			X	X	X	X
excerpt8				X							X	X	X	X	X	X	X
excerpt9	X			X							X			X		X	
excerpt10				X							X				X		
excerpt11				X							X			X	X	X	
excerpt12											X			X	X		X
excerpt13	X			X							X				X	X	
excerpt14	X			X							X			X	X	X	
excerpt15			X	X	X						X				X	X	X
excerpt16	X			X							X				X	X	X
excerpt17				X							X				X	X	

excerpt18												X			X	X	X		
excerpt19	X			X								X				X	X		
excerpt20				X								X		X	X	X			X

File format

Four files are available per excerpt:

- excerpt.edf: corresponds to the polysomnographic recording in the European Data Format (EDF)
- Automatic_detection_excerpt.txt: is a textual file containing the result of our automatic procedures for artifacts detection. Each type of artifact detected and the concerned channel is indicated in brackets as follows: [Atf_mvtE/cz-A1]. Then two columns of numeric values are present: the first one indicating the start times (in second and from the beginning of the excerpt) of artifacts of this type, and the second one indicating their duration (in second).
- Visual_scoring1_excerpt.txt: is a textual file containing the result of the visual annotation in artifacts. Each type of artifact detected and the concerned channel is indicated in brackets as follows: [vis_Atf_mvtE/cz-A1]. Then two columns of numeric values are present: the first one indicating the start times (in second and from the beginning of the excerpt) of artifacts of this type scored by the expert, and the second one indicating their duration (in second).
- Hypnogram_excerpt.txt: is a textual file containing, in first line, the name "[hypnogram]" followed by one column of integer. These numerical values correspond to the sleep stage (one value per 5 sec) annotated by the expert according to the Rechtschaffen and Kales criteria.
  5=wake
  4=REM stage
  3=sleep stage S1
  2=sleep stage S2
  1=sleep stage S3
  0=sleep stage S4
  -1=sleep stage movement
  -2 or -3 =unknow sleep stage

More

Our main publication about our automatic procedures for artifacts processing can be found here :
https://www.researchgate.net/publication/225992683_Automatic_Processing_of_EEG-EOG-EMG_Artifacts_in_Sleep_Stage_Classification

The DREAMS Sleep Spindles Database

This Sleep Spindles database was collected during the DREAMS project, to tune, train and test our automatic detection algorithms.

It consist of 8 excerpts of 30 minutes of central EEG channel (extracted from whole-night PSG recordings), annotated independently by two experts in sleep spindles.

In order to facilitate future research and performance comparision, we decided to publish these data on Internet. Be simply aware that this DREAMS Spindles Database of University of MONS - TCTS Laboratory (Stéphanie Devuyst, Thierry Dutoit) and Université Libre de Bruxelles - CHU de Charleroi Sleep Laboratory (Myriam Kerkhofs) is under terms of the Attribution-NonCommercial-NoDerivs 3.0 Unported (CC BY-NC-ND 3.0) License. Each use of this database and/or its content must be attributed to University of MONS - TCTS Laboratory (Stéphanie Devuyst, Thierry Dutoit) and Université Libre de Bruxelles - CHU de Charleroi Sleep Laboratory (Myriam Kerkhofs). Any other additional authorisations may be asked to avre@umons.ac.be.

Database description

The data were acquired in a sleep laboratory of a belgium hospital using a digital 32-channel polygraph (BrainnetTM System of MEDATEC, Brussels, Belgium). They consist of height polysomnographic recordings coming from patients with different pathologies (dysomnia, restless legs syndrome, insomnia, apnoea/hypopnoea syndrome). Two EOG channels (P8-A1, P18-A1), three EEG channels (CZ-A1 or C3-A1, FP1-A1 and O1-A1) and one submental EMG channel were recorded. The standard European Data Format (EDF) was used for storing. The sampling frequency was 200Hz, 100Hz or 50Hz. A segment of 30 minutes of the central EEG channel was extracted from each whole-night recording for spindles scoring. No effort was made to select good spindle epochs or noise free epochs, in order to reflect reality as well as possible. These excerpts were given independently to two experts for sleep spindles scoring. The second expert only scored the 6 first excerpts. The corresponding whole night recordings were also previously scored in sleep stages according to the Rechtschaffen and Kales criteria,but no note of these stages quotations was given to the scorers.

Name	Sampling frequency	Age	Sex	Time of the excerpt (from the begining of the recording)	Annoted channel	Nr. of spindles scored by expert1	Nr. of spindles scored by expert2
excerpt1	100Hz	51	Woman	extracted from 03:15:00 to 03:45:00	C3-A1	52	115
excerpt2	200Hz	40	Man	extracted from 00:00:00 to 00:30:00	CZ-A1	60	52

excerpt3	50Hz	46	Man	extracted from 03:30:00 to 04:00:00	C3-A1	5	44
excerpt4	200Hz	31	Man	extracted from 01:55:00 to 02:25:00	CZ-A1	44	25
excerpt5	200Hz	53	Woman	extracted from 02:15:00 to 02:45:00	CZ-A1	56	86
excerpt6	200Hz	53	Woman	extracted from 03:00:00 to 03:30:00	CZ-A1	72	87
excerpt7	200Hz	41	Woman	extracted from 02:41:40 to 03:11:40	CZ-A1	18	/
excerpt8	200Hz	52	Man	extracted from 05:01:30 to 05:31:30	CZ-A1	48	/

File format

Six files are available per excerpt (except for the two last excerpts, for which visual scoring 2 is absent):

- excerpt.edf: corresponds to the polysomnographic recording in the European Data Format (EDF)
- excerpt.txt: is a textual file containing, in first line, the name of the signal extracted (the central EEG) and then 1 column with the values (amplitudes in microvolt) of its samples. The number of samples depends on the sampling rate corresponding to the excerpt (see Database description)
- Automatic_detection_excerpt.txt: is a textual file containing, in first line, the name of the detection and then 2 columns of numerical values. The first column contains time instants (in second) corresponding to the beginnings of the automatically detected micro-events (from the beginning of the excerpt), and the second one contains their durations (in second).
- Visual_scoring1_excerpt.txt: is a textual file containing, in the first line, the name of the detection and then, 2 columns of numerical values. The first column contains time instants (in second) corresponding to the beginnings of the micro-events scored by the expert 1 (from the beginning of the excerpt), and the second one contains their durations (in second).
- Visual_scoring2_excerpt.txt: is a textual file containing, in first line, the name of the detection and then 2 columns of numerical values. The first column contains time instants (in second) corresponding to the beginnings of the micro-events scored by the expert 2 (from the beginning of the excerpt), and the second one contains their durations (in second).
- Hypnogram_excerpt.txt: is a textual file containing, in first line, the name "[hypnogram]" followed by one column of integer. These numerical values correspond to the sleep stage (one value per 5 sec) annotated by the expert according to the Rechtschaffen and Kales criteria.
  5=wake
  4=REM stage

3=sleep stage S1
2=sleep stage S2
1=sleep stage S3
0=sleep stage S4
-1=sleep stage movement
-2 or -3 =unknow sleep stage

More

- See our assessment algorithm in this repository, which compares automatic and visual annotations can be found here.
- Our main publication about our automatic procedures for sleep spindles detection can be found here :
  https://www.researchgate.net/publication/221756528_Automatic_Sleep_Spindles_Detection_-_Overview_and_Development_of_a_Standard_Proposal_Assessment_Method

The DREAMS K-complexes Database

This K-complexes database was collected during the DREAMS project, to tune, train and test our automatic detection algorithms.

It consist of 10 excerpts of 30 minutes of central EEG channel (extracted from whole-night PSG recordings), annotated independently by two experts in K-complexes.

In order to facilitate future research and performance comparision, we decided to publish these data on Internet. Be simply aware that this DREAMS K-complexes Database of University of MONS - TCTS Laboratory (Stéphanie Devuyst, Thierry Dutoit) and Université Libre de Bruxelles - CHU de Charleroi Sleep Laboratory (Myriam Kerkhofs) is under terms of the Attribution-NonCommercial-NoDerivs 3.0 Unported (CC BY-NC-ND 3.0) License. Each use of this database and/or its content must be attributed to University of MONS - TCTS Laboratory (Stéphanie Devuyst, Thierry Dutoit) and Université Libre de Bruxelles - CHU de Charleroi Sleep Laboratory (Myriam Kerkhofs). Any other additional authorisations may be asked to avre@umons.ac.be.

Database description

Data were acquired in a sleep laboratory of a belgium hospital using a digital 32-channel polygraph (BrainnetTM System of MEDATEC, Brussels, Belgium). They consist of 10 polysomnographic recordings coming from healthy subjects. Two EOG channels (P8-A1, P18-A1), three EEG channels (CZ-A1 or C3-A1, FP1-A1 and O1-A1) and one submental EMG channel were recorded. The standard European Data Format (EDF) was used for storing. The sampling frequency was 200Hz. A segment of 30 minutes of the central EEG channel was extracted from each whole-night recording for K-complexes scoring. These excerpts were given independently to two experts with the following recommendation regarding this annotation:
- K-complex must be a biphasic wave composed of a first negative sharp wave immediately followed by a slower positive component.
- It can occur isolated or by pair.
- It can be associated with spindles (before, after, or on it).
- Its duration should be at least 0.5s and no more than 1.5s.
- Its amplitude should be at least twice as high as the EEG background.
- The amplitude of the negative component should be at least 50% of the positive amplitude component.
- The minimum interval between successive K-complexes in slow wave sleep should be greater than 2s.
The corresponding whole night recordings were also previously scored in sleep stages according to the Rechtschaffen and Kales criteria, but no note of these stages quotations was given to the scorers. Unfortunately, the second expert has only annotated the first five excerpts.

Name	Sampling frequency	Age	Sex	Time of the excerpt (from the begining of the recording)	Annoted channel	Nr. of K-complexes scored by expert1	Nr. of K-complexes scored by expert2

excerpt1	200Hz	20	Man	extracted from 02:00:00 to 02:30:00	CZ-A1	34	19
excerpt2	200Hz	23	Woman	extracted from 05:00:30 to 05:30:30	CZ-A1	45	8
excerpt3	200Hz	47	Woman	extracted from 06:06:00 to 06:36:00	CZ-A1	12	3
excerpt4	200Hz	24	Woman	extracted from 01:16:00 to 01:46:00	CZ-A1	78	14
excerpt5	200Hz	23	Woman	extracted from 07:15:00 to 07:45:00	CZ-A1	39	20
excerpt6	200Hz	23	Man	extracted from 00:10:00 to 00:40:00	CZ-A1	28	/
excerpt7	200Hz	27	Man	extracted from 02:20:00 to 02:50:00	CZ-A1	11	/
excerpt8	200Hz	46	Woman	extracted from 04:50:00 to 05:20:00	CZ-A1	4	/
excerpt9	200Hz	27	Man	extracted from 05:30:00 to 06:00:00	CZ-A1	5	/
excerpt10	200Hz	21	Woman	extracted from 02:30:00 to 03:00:00	CZ-A1	16	/

File format

Six files are available per excerpt (except for the five last excerpts, for which visual scoring 2 is absent):

- excerpt.edf: corresponds to the polysomnographic recording in the European Data Format (EDF)
- excerpt.txt: is a textual file containing, in first line, the name of the signal extracted (the central EEG) and then 1 column with the values (amplitudes in microvolt) of its samples. The number of samples depends on the sampling rate corresponding to the excerpt (see Database description)
- Automatic_detection_excerpt.txt: is a textual file containing, in first line, the name of the detection and then 2 columns of numerical values. The first column contains time instants (in second) corresponding to the beginnings of the automatically detected micro-events (from the beginning of the excerpt), and the second one contains their durations (in second).
- Visual_scoring1_excerpt.txt: is a textual file containing, in the first line, the name of the detection and then, 2 columns of numerical values. The first column contains time instants (in

second) corresponding to the beginnings of the micro-events scored by the expert 1 (from the beginning of the excerpt), and the second one contains their durations (in second).

- Visual_scoring2_excerpt.txt: is a textual file containing, in first line, the name of the detection and then 2 columns of numerical values. The first column contains time instants (in second) corresponding to the beginnings of the micro-events scored by the expert 2 (from the beginning of the excerpt), and the second one contains their durations (in second).
- Hypnogram_excerpt.txt: is a textual file containing, in first line, the name "[hypnogram]" followed by one column of integer. These numerical values correspond to the sleep stage (one value per 5 sec) annotated by the expert according to the Rechtschaffen and Kales criteria.
  5=wake
  4=REM stage
  3=sleep stage S1
  2=sleep stage S2
  1=sleep stage S3
  0=sleep stage S4
  -1=sleep stage movement
  -2 or -3 =unknow sleep stage

More

- See our assessment algorithm in the same repository, which compares automatic and visual annotations can be found here.
- Our main publication about our automatic procedures for K-complexes detection can be found here : https://www.researchgate.net/publication/49627435_Automatic_K-complexes_Detection_in_Sleep_EEG_Recordings_using_Likelihood_Thresholds

The DREAMS REMs Database

This REMs database was collected during the DREAMS project, to tune, train and test our automatic detection algorithms.

It consist of 9 excerpts of 30 minutes of PSG recordings in which rapid eye movements (REMs) were annotated by an experts.

In order to facilitate future research and performance comparision, we decided to publish these data on Internet. Be simply aware that this DREAMS REMs Database of University of MONS - TCTS Laboratory (Stéphanie Devuyst, Thierry Dutoit) and Université Libre de Bruxelles - CHU de Charleroi Sleep Laboratory (Myriam Kerkhofs) is under terms of the Attribution-NonCommercial-NoDerivs 3.0 Unported (CC BY-NC-ND 3.0) License. Each use of this database and/or its content must be attributed to University of MONS - TCTS Laboratory (Stéphanie Devuyst, Thierry Dutoit) and Université Libre de Bruxelles - CHU de Charleroi Sleep Laboratory (Myriam Kerkhofs). Any other additional authorisations may be asked to avre@umons.ac.be.

Database description

Data collected were acquired in a sleep laboratory of a belgium hospital using a digital 32-channel polygraph (BrainnetTM System of MEDATEC, Brussels, Belgium). They consist of 9 excerpts of PSG recordings, coming from 5 healthy subjects. Two EOG channels (P8-A1, P18-A1), three EEG channels (CZ-A1 or C3-A1, FP1-A1 and O1-A1) and one submental EMG channel were recorded. The standard European Data Format (EDF) was used for storing. The sampling frequency was 200Hz. These excerpts of 30 minutes were extracted from whole-night recordings. No care was provided to select epochs free of artifacts, but a special effort was provided to cover all sleep stages. (Indeed, sleep stages were previously scored according to the Rechtschaffen and Kales criteria, but no note of this stages cotation was provided to the scorer during the annotation in REMs).

Name	Sampling frequency	Age	Sex	Time of the excerpt (from the begining of the recording)	Nr. of REMs scored by the expert
excerpt1	200Hz	20	Man	extracted from 00:35:30 to 01:05:30	157
excerpt2	200Hz	20	Man	extracted from 01:55:00 to 02:25:00	3
excerpt3	200Hz	23	Woman	extracted from 03:30:00 to 04:00:00	165
excerpt4	200Hz	23	Woman	extracted from 07:16:30 to 07:46:30	66

excerpt5	200Hz	27	Man	extracted from 07:30:00 to 08:00:00	108
excerpt6	200Hz	27	Man	extracted from 01:32:30 to 02:02:30	14
excerpt7	200Hz	24	Woman	extracted from 02:45:00 to 03:15:00	131
excerpt8	200Hz	24	Woman	extracted from 00:14:58 to 00:44:58	162
excerpt9	200Hz	46	Woman	extracted from 05:15:00 to 05:45:00	41

File format

Four files are available per excerpt:

- excerpt.edf: corresponds to the polysomnographic recording in the European Data Format (EDF)
- Automatic_detection_excerpt.txt: is a textual file containing, in first line, the name of the detection and then 2 columns of numerical values. The first column contains time instants (in second) corresponding to the beginnings of the automatically detected micro-events (from the beginning of the excerpt), and the second one contains their durations (in second).
- Visual_scoring1_excerpt.txt: is a textual file containing, in the first line, the name of the detection and then, 2 columns of numerical values. The first column contains time instants (in second) corresponding to the beginnings of the micro-events scored by the expert (from the beginning of the excerpt), and the second one contains their durations (in second).
- Hypnogram_excerpt.txt: is a textual file containing, in first line, the name "[hypnogram]" followed by one column of integer. These numerical values correspond to the sleep stage (one value per 5 sec) annotated by the expert according to the Rechtschaffen and Kales criteria.
  5=wake
  4=REM stage
  3=sleep stage S1
  2=sleep stage S2
  1=sleep stage S3
  0=sleep stage S4
  -1=sleep stage movement
  -2 or -3 =unknow sleep stage

The DREAMS PLMs Database

This PLMs database was collected during the DREAMS project, to tune, train and test our automatic detection algorithms.

It consist of 10 whole-night PSG recordings coming from patients, in which one of the two tibialis EMG was annotated in periodic limb movements (PLMs) by an experts.

In order to facilitate future research and performance comparision, we decided to publish these data on Internet. Be simply aware that this DREAMS PLMs Database of University of MONS - TCTS Laboratory (Stéphanie Devuyst, Thierry Dutoit) and Université Libre de Bruxelles - CHU de Charleroi Sleep Laboratory (Myriam Kerkhofs) is under terms of the Attribution-NonCommercial-NoDerivs 3.0 Unported (CC BY-NC-ND 3.0) License. Each use of this database and/or its content must be attributed to University of MONS - TCTS Laboratory (Stéphanie Devuyst, Thierry Dutoit) and Université Libre de Bruxelles - CHU de Charleroi Sleep Laboratory (Myriam Kerkhofs). Any other additional authorisations may be asked to avre@umons.ac.be.

Database description

Data collected were acquired in a sleep laboratory of a belgium hospital using a digital 32-channel polygraph (BrainnetTM System of MEDATEC, Brussels, Belgium). They consist of 10 whole-night polysomnographic recordings coming from patients with Periodic limb movement disorder. Two EOG channels (P8-A1, P18-A1), three EEG channels (CZ-A1 or C3-A1, FP1-A1 and O1-A1), one submental EMG channel and two EMG of the anterior tibialis muscle were recorded. The standard European Data Format (EDF) was used for storing. The sampling frequency was 200Hz or 50Hz. On each of these recordings, all leg movements of one of the two tibialis EMG were annotated by an expert. The criteria used were those of the American Sleep Disorder Association (ASDA), Without taking into account the periodic aspect and the distinction between awaking movement or not. The recordings were also previously scored in sleep stages according to the Rechtschaffen and Kales criteria, but no note of these stages cotations was given to the scorer during the PLMS annotation.

Name	Sampling frequency	Age	Sex	PLMS index	Recording duration (hh.mm.ss)	Annotated channel	Nr. of PLMs scored by the expert
excerpt1	200Hz	44	Man	unknow	09:20:30	EMG3 (left)	254
excerpt2	50Hz	53	Man	38.1/h	07:52:30	EMG3 (left)	321
excerpt3	200Hz	38	Man	16.2/h	09:12:40	EMG3 (left)	243
excerpt4	50Hz	71	Woman	36.8/h	08:01:40	EMG3 (left)	245

excerpt5	200Hz	60	Man	116.9/h	08:07:30	EMG3 (left)	968
excerpt6	200Hz	50	Man	30.5/h	07:43:30	EMG3 (left)	409
excerpt7	200Hz	27	Woman	18.9/h	08:59:40	EMG2 (right)	314
excerpt8	200Hz	71	Man	78.3/h	08:20:30	EMG2 (right)	496
excerpt9	200Hz	71	Man	78.3/h	08:20:30	EMG3 (left)	447
excerpt10	200Hz	69	Woman	133/h	08:54:10	EMG2 (right)	724

File format

Four files are available per excerpt:

- excerpt.edf: corresponds to the polysomnographic recording in the European Data Format (EDF)
- Automatic_detection_excerpt.txt: is a textual file containing, in first line, the name of the detection and then 2 columns of numerical values. The first column contains time instants (in second) corresponding to the beginnings of the automatically detected movements (from the beginning of the excerpt), and the second one contains their durations (in second).
- Visual_scoring1_excerpt.txt: is a textual file containing, in the first line, the name of the detection and then, 2 columns of numerical values. The first column contains time instants (in second) corresponding to the beginnings of the movements scored by the expert (from the beginning of the excerpt), and the second one contains their durations (in second).
- Hypnogram_excerpt.txt: is a textual file containing, in first line, the name "[hypnogram]" followed by one column of integer. These numerical values correspond to the sleep stage (one value per 5 sec) annotated by the expert according to the Rechtschaffen and Kales criteria.
  5=wake
  4=REM stage
  3=sleep stage S1
  2=sleep stage S2
  1=sleep stage S3
  0=sleep stage S4
  -1=sleep stage movement
  -2 or -3 =unknow sleep stage

The DREAMS Apnea Database

This apnea database was collected during the DREAMS project, to tune, train and test our automatic detection algorithms.

It consist of 12 whole-night PSG recordings coming from patients with sleep apnea syndrome and annoted by an expert in respiratory events (central, obstructive and mixed apnea and hypopnea).

In order to facilitate future research and performance comparision, we decided to publish these data on Internet. Be simply aware that this DREAMS Apnea Database of University of MONS - TCTS Laboratory (Stéphanie Devuyst, Thierry Dutoit) and Université Libre de Bruxelles - CHU de Charleroi Sleep Laboratory (Myriam Kerkhofs) is under terms of the Attribution-NonCommercial-NoDerivs 3.0 Unported (CC BY-NC-ND 3.0) License. Each use of this database and/or its content must be attributed to University of MONS - TCTS Laboratory (Stéphanie Devuyst, Thierry Dutoit) and Université Libre de Bruxelles - CHU de Charleroi Sleep Laboratory (Myriam Kerkhofs). Any other additional authorisations may be asked to avre@umons.ac.be.

Database description

Data collected were acquired in a sleep laboratory of a belgium hospital using a digital 32-channel polygraph (BrainnetTM System of MEDATEC, Brussels, Belgium). They consist of 12 polysomnographic recordings coming from patients with sleep apnea syndrome. Two EOG channels (P8-A1, P18-A1), three EEG channels (CZ-A1 or C3-A1, FP1-A1 and O1-A1), the submental EMG, the ECG , the nasal air flow (NAF) and the abdominal (VAB) and thoracic (VTH) inductive plethysmography were recorded. The standard European Data Format (EDF) was used for storing. The sampling frequency was 200Hz. These excerpts were annotated in respiratory events (central, obstructive and mixed apnea and hypopnea) by an expert. Criteria used were those of the American Academy of Sleep Medicine (AASM). The corresponding whole-night recordings were also previously scored in sleep stages according to the Rechtschaffen and Kales criteria.

Name	Sampling frequency	Age	apnea/hypopnea index	Recording duration (hh.mm.ss)	Nr. of hypopnea scored by the expert	Nr. of obstructive apnea scored by the expert	Nr. of central apnea scored by the expert	Nr. of mixed apnea scored by the expert
excerpt1	200Hz	51	50.9/h	09:32:00	249	194	3	6
excerpt2	200Hz	64	16.1/h	08:27:20	47	66	0	1
excerpt3	200Hz	70	49.3/h	09:33:40	38	340	0	0

excerpt4	200Hz	50	95/h	08:36:00	333	389	0	1
excerpt5	200Hz	41	80.9/h	09:22:40	189	350	17	144
excerpt6	200Hz	54	25.1/h	09:12:30	151	66	0	0
excerpt7	200Hz	60	51/h	07:32:00	113	209	1	9
excerpt8	200Hz	50	7.4/h	09:05:20	12	39	0	0
excerpt9	200Hz	54	21.2/h	08:35:20	37	128	0	0
excerpt10	200Hz	51	55.5/h	08:00:00	62	131	69	108
excerpt11	200Hz	51	46.7/h	08:02:40	172	116	1	0
excerpt12	200Hz	51	59.1/h	08:02:00	37	51	43	136

File format

Three files are available per excerpt:

- excerpt.edf: corresponds to the polysomnographic recording in the European Data Format (EDF)
- Visual_scoring1_excerpt.txt: is a textual file containing the result of the visual annotation in respiratory events. Each type of respiratory events detected is indicated in brackets as follows: [vis_hypopnea/PSG]. Then two columns of numeric values are present: the first one indicating the start times (in second and from the beginning of the excerpt) of the event of this type scored by the expert, and the second one indicating their duration (in second).
- Hypnogram_excerpt.txt: is a textual file containing, in first line, the name "[hypnogram]" followed by one column of integer. These numerical values correspond to the sleep stage (one value per 5 sec) annotated by the expert according to the Rechtschaffen and Kales criteria.
  5=wake
  4=REM stage
  3=sleep stage S1
  2=sleep stage S2
  1=sleep stage S3
  0=sleep stage S4
  -1=sleep stage movement
  -2 or -3 =unknow sleep stage

The DREAMS Assessment algorithm

During the DREAMS project, we developped and tested several automatic procedures to detect micro-events such as sleep spindles, K-complexes, REMS, etc.

Unfortunately, we observed that perfomances completed in the same field by other authors were hardly comparable because their methodology, their databases and their assessment methods were radically different.

To solve this problem and allow evaluation and comparison between other future works, we made our database, our visual scorings and our automatic scorings freely available on the web. In addition, we proposed a unique assessment method using a well defined terminology and from which it is possible to establish all the desired confusion matrices. This assessment method is presented below and the corresponding algorithm, implemented under Matlab, can be downloaded in this repository.

Assessment method

Our assessment algorithm can take into account the visual scoring of one or two experts.

Knowing the start time and duration of the annotated micro-events (on one hand, visually and on the other hand, by the automatic algorithm), it identifies the quantity of each possible covering as illustrated on Fig. 1. These various possible configurations are gathered in 4 categories: type T1 (A, B, or C) corresponds to a correct automatic detection since at least one of the two experts has scored the event like such; type T2 corresponds to a false detection; type T3 (A, B, C, or D) corresponds to a missing detection with respect to one or both experts; and type T5 (A, B, or C) corresponds to multiple coverings implying automatic detection.
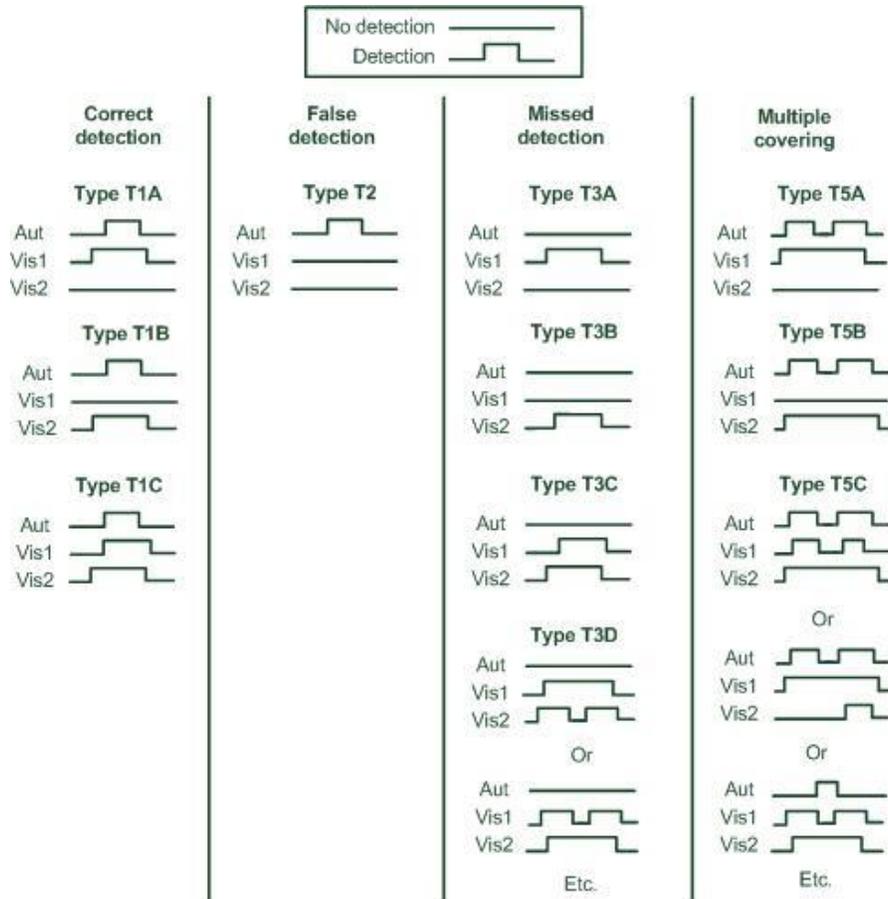
Fig. 1. Illustration of the various possible coverings between the diverse micro-events scored by expert 1 (Vis1), scored by expert 2 (Vis2) and automatically detected (Aut).

Once the number of these various types is known, it is easy to deduce the number of true positive (#TP), the number of false positive (#FP) and the number of false negative (#FN) of the different confusion matrixes (see table I). Moreover, the number of true negative (#TN) can be aproximate by (the total duration of the excerpt/the average duration of the micro-event) - (number of true positives + number of false positives + number of false negatives).

TABLE I
CONFUSION MATRIXES

CONFUSION MATRIX AUTOMATIC/VISUAL 1

	Yes Vis1	No Vis1
Yes aut	#TP = #T1A + #T1C+#T5A+#T5C	#FP = #T2 + #T1B+#T5B
No aut	#FN = #T3A + #T3C + #T3D	~#TN = TotalDuration/EventDuration - #FP -#TP-#FN

CONFUSION MATRIX AUTOMATIC/VISUAL 2

	Yes Vis2	No Vis2
Yes aut	#TP = #T1B + #T1C+#T5B+#T5C	#FP = #T2 + #T1A+#T5A
No aut	#FN = #T3B + #T3C + #T3D	~#TN = TotalDuration/EventDuration - #FP -#TP-#FN

CONFUSION MATRIX AUTOMATIC/(VISUAL 1 ∪ VISUAL 2)

	Yes Vis1∪Vis2	No Vis1∪Vis2
Yes aut	#TP = #T1A + #T1B + #T1C+#T5A+#T5B+#T5C	#FP = #T2
No aut	#FN = #T3A + #T3B + #T3C + #T3D	~#TN = TotalDuration/EventDuration - #FP -#TP-#FN

CONFUSION MATRIX AUTOMATIC/(VISUAL 1 ∩ VISUAL 2)

	Yes Vis1∩ Vis2	No Vis1∩ Vis2
Yes aut	#TP = #T1C+#T5C	#FP = #T2+ #T1A + #T1B
No aut	#FN = #T3C + #T3D+#T5A+#T5B	~#TN = TotalDuration/EventDuration - #FP -#TP-#FN

CONFUSION MATRIX VISUAL 1/VISUAL 2

	Yes Vis2	No Vis2
Yes Vis1	#TP = #T1C + #T3C + #T3D+#T5C	#FP = #T1A + #T3A+#T5A+#T5A
No Vis1	#FN = #T1B + #T3B+#T5B	~#TN = TotalDuration/EventDuration - #FP -#TP-#FN

Table. 1. Confusion matrices (where "EventDuration" is the average duration of the micro-event and "TotalDuration" is the total duration of the analyzed excerpt).

Finally, it is easy to deduce from these confusion matrices, the parameters commonly used in literature namely:

- The total agreement rate:

$$agreement\ rate = \frac{(\#TP + \#TN)}{(\#TP + \#TN + \#FP + \#FN)}$$

- The sensitivity, representing the probability that the automatic detection algorithm gives a positive result in the presence of a reference annotation:

$$sensitivity = TPrate = \frac{\#TP}{(\#TP + \#FN)}$$

- The specificity, representing the probability the automatic detection algorithm gives negative result in absence of any reference annotation:

$$specificity = \frac{\#TN}{(\#FP + \#TN)}$$

- The false positive rate:

$$FPrate = 1 - specificity = \frac{\#FP}{(\#FP + \#TN)}$$

- The proportion of false detections compared to the actual number of micro-events (according to the expert):

$$FPproportion = \frac{\#FP}{(\#TP + \#FN)}$$

- The amount of false alarms among all automatic detections:

$$FPamount = \frac{\#FP}{(\#TP + \#FP)}$$

Algorithms inputs and outputs

Algorithms for the assessment method has been developped under Matlab.

- Function assessmentMethod.m compare the automatic and visual annotations of one type of micro-event, carried out on one exerpt.

  Inputs:
  Function assessmentMethod.m uses as inputs files whose format is the same as those proposed in our public databases :
  * filename_edf : filename of the polysomnographic recording (in the European Data Format) from which the annoted channel is extracted.
  * filename_Automatic_detection : filename of a textual file containing, in the first line, the name

of the detection and then, 2 columns with the beginnings (first column) and durations (second column) of the automatically detected micro-events (in second).
* filename_Visual_scoring1 : filename of a textual file containing, in the first line, the name of the detection and then, 2 columns with the beginnings (first column) and durations (second column) of the visually scored micro-events by expert 1 (in second).
* filename_Visual_scoring2 : filename of a textual file containing, in the first line, the name of the detection and then, 2 columns with the beginnings (first column) and durations (second column) of the visually scored micro-events by expert 2 (in second). If this second annotation is not available, use filename_Visual_scoring2=''.
* filename_Hypnogram: filename of a textual file containing from the second line the hypnogram information, with one value per 5 sec.

5=wake
4=REM stage

3=sleep stage S1

2=sleep stage S2

1=sleep stage S3

0=sleep stage S4

-1=sleep stage movement

-2 or -3 =unknow sleep stage
If this Hypnogram is not available, use filename_Hypnogram=''.
*duration_event: is the average duration (in second) of the micro-event detected (for the approximation of the True Negative number #TN) in confusion matrixes.

Outputs:
Function assessmentMethod.m returns a structure "nbr_types" with the following fields:
* nbr_types.nbrtot_scored_by_system = total number of events scored by the automatic system, in each stages (wake,REM,S1,S2,S3,S4), and in total (=> vector with 7 values).
* nbr_types.nbrtot_scored_by_visual1 = total number of events scored by the expert 1, in each stages (wake,REM,S1,S2,S3,S4), and in total.
* nbr_types.nbrtot_scored_by_visual2 = total number of events scored by the expert 2, in each stages (wake,REM,S1,S2,S3,S4), and in total.
* nbr_types.nbr_scored_only_by_sys__type2 = number of coverings scored by only system (of type T2), in each stages (wake,REM,S1,S2,S3,S4), and in total.
* nbr_types.nbr_scored_only_by_vis1__type3A = number of coverings scored by only scorer #1 (of type T 3A), in each stages (wake,REM,S1,S2,S3,S4), and in total.
* nbr_types.nbr_scored_only_by_vis2__type3B = number of coverings scored by only scorer #2 (of type T3B), in each stages (wake,REM,S1,S2,S3,S4), and in total.
* nbr_types.nbr_scored_only_by_systEvis1__type1A = number of coverings scored by only system & scorer #1(of type T1A), in each stages (wake,REM,S1,S2,S3,S4), and in total.
* nbr_types.nbr_scored_only_by_systEvis2__type1B = number of coverings scored by only system & scorer #2 (of type T1B), in each stages (wake,REM,S1,S2,S3,S4), and in total.

* nbr_types.nbr_scored_only_by_vis1Evis2__type3C = number of coverings scored by only scorer #1 & scorer #2 (of type T3C), in each stages (wake,REM,S1,S2,S3,S4), and in total.
* nbr_types.nbr_scored_by_vis1Evis2Esyst__type1C = number of coverings scored by system & scorer #1 & #2 (of type T1C), in each stages (wake,REM,S1,S2,S3,S4), and in total.
* nbr_types.type3D = number of coverings of type T3D, in each stages (wake,REM,S1,S2,S3,S4), and in total.
* nbr_types.type5A = number of coverings of type T5A, in each stages (wake,REM,S1,S2,S3,S4), and in total..
* nbr_types.type5B = number of coverings of type T5B, in each stages (wake,REM,S1,S2,S3,S4), and in total.
* nbr_types.type5C = number of coverings of type T5C, in each stages (wake,REM,S1,S2,S3,S4), and in total.
* nbr_types.nbr_aut_multiple = number of automatic quotation implied in a multiple covering (3D, 5A,5B or 5C), in each stages (wake,REM,S1,S2,S3,S4), and in total.
* nbr_types.nbr_vis1_multiple = number of quotation of scorer 1 implied in a multiple covering (3D, 5A,5B or 5C), in each stages (wake,REM,S1,S2,S3,S4), and in total.
* nbr_types.nbr_vis2_multiple = number of quotation of scorer 2 implied in a multiple covering (3D, 5A,5B or 5C), in each stages (wake,REM,S1,S2,S3,S4), and in total.

It also returns the different possible confusion matrices:
* confusion_matrix_aut_Vis1 = confusion matrix of the automatic detection compared to the expert 1 scoring.
* confusion_matrix_aut_Vis2 = confusion matrix of the automatic detection compared to the expert 2 scoring.
* confusion_matrix_Vis1_Vis2 = confusion matrix of the expert 1 scoring compared to the expert 2 scoring.
* confusion_matrix_Vis2_Vis1 = confusion matrix of the expert 2 scoring compared to the expert 1 scoring.
* confusion_matrix_aut_Vis1uVis2= confusion matrix of the automatic detection compared to the union of the expert 1 scoring and the expert 2 scoring.
* confusion_matrix_aut_Vis1nVis2= confusion matrix of the automatic detection compared to the intersection of the expert 1 scoring and the expert 2 scoring (i.e. when a micro-event is considered as real when both scorers marked it as such).

Example (Matlab code):
filename_edf='C:\DEVUYST\DataBaseSpindles\excerpt1.edf';
filename_Automatic_detection='C:\DEVUYST\DataBaseSpindles\Automatic_detection_excerpt1.txt';
filename_Visual_scoring1='C:\DEVUYST\DataBaseSpindles\Visual_scoring1_excerpt1.txt';
filename_Visual_scoring2='C:\DEVUYST\DataBaseSpindles\Visual_scoring2_excerpt1.txt';
filename_Hypnogram='C:\DEVUYST\DataBaseSpindles\Hypnogram_excerpt1.txt';
duration_event=1;%in second

[nbr_types, confusion_matrix_aut_Vis1, confusion_matrix_aut_Vis2, confusion_matrix_Vis1_Vis2, confusion_matrix_Vis2_Vis1, confusion_matrix_aut_Vis1uVis2,

confusion_matrix_aut_Vis1nVis2]=assessmentMethod(filename_edf, filename_Automatic_detection, filename_Visual_scoring1, filename_Visual_scoring2, filename_Hypnogram, duration_event)

- Function global_assessmentMethod compute the global results of the assessmentMethod applied to a set of excerpts.

  Inputs:
  Function global_assessmentMethod used as input:
  * filepath: pathway of the files of the database.
  * indice_excerpts: vector with the index of the considered excerpts.
  * duration_event: the average duration (in second) of the microevent detected (for the approximation of the True Negative number #TN).

  Outputs:
  Function global_assessmentMethod returns the same outputs as the function assessmentMethod.m (but where the values were summed over all exerpts).

  Example (Matlab code):
  filepath='C:\DEVUYST\DataBaseSpindles\';
  indice_excerpts=[1:6];% excerpts for the test
  duration_event=1;% in second
  global_assessmentMethod (filepath,indice_excerpts,duration_event)

More

A publication that illustrates and legitimates this assessment method (by applying it on an automatic procedures for sleep spindles detection) can be found here :
https://www.researchgate.net/publication/221756528_Automatic_Sleep_Spindles_Detection_-_Overview_and_Development_of_a_Standard_Proposal_Assessment_Method