Introduction

RBDConverter is a software package that converts Polysomnography data from the format adopted by the Canadian working group to the format suitable for use with RBDtector (see pubmed article on RBDtector and its github repository).

Input comes as two files: raw time series in EDF format and XML file with metadata. Data processing is configurable via config.ini file, so RBDConverter can be used in a wide variety of scenarios.

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Input

1) EDF file

Arbitrary-named EDF file with muscular activity. Muscles are labeled with the following labels:

EMG EMG1
EMG TAGl
EMG TAD
EMG FSDG
EMG FSDD

2) Sleep profile

XML file named “sleep_profile.xml” that contains the following information:

EpochLength – sleep stage sampling period, in seconds.

ScoredEvents – a list of events with following properties:

- Name – event name, one of the following:
    "Annotation" – artifacts (arousals, etc.)
    "Position du corps" – body movements?
    "DetecteMJ_TAG" – periodic limb movements (left leg)

"DetecteMJ_TAD" – periodic limb movements (right leg)
"TCSP_Phasique" – phasic mentalis EMG activity
"TCSP_Tonique" – tonic mentalis EMG activity (whole epoch)
"ÉVÉNEMENTS RESPIRATOIRES" – respiratory artefacts
"Biocalibration" – some kind of calibration, irrelevant for our application

- Start – event start time, in seconds, relative to EDB start time
- Duration – duration of the event, in seconds

SleepStages – a list of sleep stage codes, sampled every EpochLength seconds. SleepStage code is an one-digit integer number:

0 – Awake (Wake)
1 – NREM 1 (N1)
2 – NREM 2 (N2)
3 – SWS
5 – REM
9 – Artefact (A)

Sleep profile example:

```
<CMPStudyConfig>
   <EpochLength>30</EpochLength>
   <ScoredEvents>
      <ScoredEvent>
         <Name>DetecteMJ_TAD</Name>
         <Start>851.587891</Start>
         <Duration>8.480469</Duration>
         <Input>EMG TAD</Input>
         <EventName>MJ</EventName>
         <ChannelName>TAD</ChannelName>
      </ScoredEvent>
      <ScoredEvent>
         <Name>ÉVÉNEMENTS RESPIRATOIRES</Name>
         <Start>5757.169922</Start>
         <Duration>12.478516</Duration>
         <Input>CANULE</Input>
         <EventName>HYPOPNÉE</EventName>
      </ScoredEvent>
   </ScoredEvents>
   <SleepStages>
      <SleepStage>9</SleepStage>
      <SleepStage>9</SleepStage>
      <SleepStage>0</SleepStage>
      <SleepStage>0</SleepStage>
      <SleepStage>0</SleepStage>
      <SleepStage>1</SleepStage>
      <SleepStage>2</SleepStage>
      <SleepStage>2</SleepStage>
  </SleepStages>
</CMPStudyConfig>
```

Output

1) Converted EDF file

Copy of input EDF file with names of the channels mapped as follows:

```
"EMG1" ⇒ "EMG"
"TAG"  ⇒ "PLM l"
"TAD"  ⇒ "PLM r"
"FSDG" ⇒ "Akti."
"FSDD" ⇒ "AUX"
```

I decided to make this mapping configurable, so my converter will be more flexible and future-proof, see Configuration chapter.

We might also need to introduce some filtering of signal data as well – **clarification needed**.

2) Sleep profile

TXT file named “Sleep profile.txt” with mappings between time points and sleep stages/wake activity. Example:

```
Signal ID: SchlafProfil\profil
Start Time: 02.08.2020 21:44:30
Unit:
Signal Type: Discret
Events list: N4,N3,N2,N1,REM,Wake,Movement
Rate: 30 s

02:04:00,000; A
02:04:30,000; Wake
02:05:00,000; Wake
02:05:30,000; Wake
02:06:00,000; Wake
02:06:30,000; Wake
02:07:00,000; Wake
02:07:30,000; N1
02:08:00,000; N1
02:08:30,000; N2
02:09:00,000; N2
02:09:30,000; N2
```

Sleep stage codes:

- REM – rapid eye movements stage
- N1, N2, N3, N4 – other sleep stages
- A – artifacts
- Wake – patient is awake

3) Flow events

TXT file named “Flow Events.txt” with mappings between time intervals and breathing disorders, like hypopnea.

```
Signal ID: FlowD\flow
Start Time: 02.08.2020 21:44:53
Unit: s
Signal Type: Impuls

21:46:22,937-21:46:31,938; 9;Obstructive Apnea
21:48:39,937-21:48:54,688; 15;Obstructive Apnea
23:03:26,246-23:04:01,246; 35;Hypopnea
23:06:18,938-23:06:40,312; 21;Obstructive Apnea
23:10:03,246-23:10:20,246; 17;Hypopnea
23:41:25,938-23:41:36,937; 11;Obstructive Apnea
23:43:24,937-23:43:50,562; 26;Obstructive Apnea
23:47:40,938-23:47:51,688; 11;Obstructive Apnea
00:40:31,674-00:40:49,249; 18;Hypopnea
00:43:37,938-00:43:58,938; 21;Obstructive Apnea
00:48:13,660-00:48:33,268; 20;Hypopnea
```

Line format: `[startTime]-[endTime]; [duration];[event]`
Where:

duration – interval duration rounded to whole seconds.
event – one of the following:

- "Hypopnea"
- "Obstructive Apnea"
- "Mixed Apnea"
- "Body event"

4) Classification Arousals

TXT file named “Classification Arousals.txt”. Currently I just generate an empty file (with appropriate header, of course).

Configuration

Behavior of RBDconvertor is completely controlled by the configuration provided in the “config.ini” file:

```
# Controls how channels in EDF file are renamed, e.g. EMG1 => EMG
[edf_channel_map]
EMG1 = EMG
TAG = PLM l
TAD = PLM r
FSDG = Akti.
FSDD = AUX
```

```
# Controls how SleepStage codes from "sleep_profile.xml" are converted to
# SleepStage codes in "Sleep profile.txt", e.g. "0" is mapped to "Wake"
[sleep_stage_map]
0 = Wake
1 = N1
2 = N2
3 = N3
4 = N4
5 = REM
6 = Movement
7 = Tech
8 = Undefined
9 = A

# Controls how ScoredEvents from "sleep_profile.xml" are converted to events
# in "Flow Events.txt", e.g. "HYPOPNÉE" is mapped to "Hypopnea".
# Please note that you can use both ScoredEvent.Name and
# ScoredEvent.EventName as a mapping key.
[flow_event_map]
HYPOPNÉE = Hypopnea
```