Exploratory_Data_Analysis_and_Visualization

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1 EDA and Visualization

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[1]:
```
import gc
from IPython.display import Markdown
import matplotlib.pyplot as plt
import numpy as np
import pandas as pd
import seaborn as sns
import warnings
```

1.3 Exploratory Data Analysis (EDA)

[2]:
```
train_series = pd.read_parquet("../data/train_series.parquet")
train_events = pd.read_csv("../data/train_events.csv")
```

1.3.1 Train Series

[3]:
```
train_series.head()
```

[3]:

	series_id	step	timestamp	anglez	enmo
0	038441c925bb	0	2018-08-14T15:30:00-0400	2.6367	0.0217
1	038441c925bb	1	2018-08-14T15:30:05-0400	2.6368	0.0215
2	038441c925bb	2	2018-08-14T15:30:10-0400	2.6370	0.0216
3	038441c925bb	3	2018-08-14T15:30:15-0400	2.6368	0.0213
4	038441c925bb	4	2018-08-14T15:30:20-0400	2.6368	0.0215

[4]:
```
train_series.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 127946340 entries, 0 to 127946339
Data columns (total 5 columns):
 #   Column     Dtype
---  ------     -----
 0   series_id  object
 1   step       uint32
 2   timestamp  object
 3   anglez     float32
 4   enmo       float32
dtypes: float32(2), object(2), uint32(1)
memory usage: 3.3+ GB
```

[5]:
```
train_series.describe(include='all')
```

[5]:

	series_id	step	timestamp	anglez	enmo
count	127946340	1.279463e+08	127946340	1.279463e+08	1.279463e+08
unique	277	NaN	12159540	NaN	NaN
top	78569a801a38	NaN	2018-12-27T10:03:30-0500	NaN	NaN
freq	1433880	NaN	19	NaN	NaN
mean	NaN	2.548048e+05	NaN	-8.810453e+00	
std	NaN	1.778930e+05	NaN	3.552188e+01	
min	NaN	0.000000e+00	NaN	-9.000000e+01	
25%	NaN	1.158120e+05	NaN	-3.185890e+01	
50%	NaN	2.345190e+05	NaN	-9.597900e+00	
75%	NaN	3.571960e+05	NaN	1.130020e+01	
max	NaN	1.433879e+06	NaN	9.000000e+01	

```
unique           NaN
top              NaN
freq             NaN
mean    4.131503e-02
std     1.018289e-01
min     0.000000e+00
25%     1.300000e-03
50%     1.720000e-02
75%     4.370000e-02
max     1.143370e+01
```

[6]:
```
# Check null values
train_series.isnull().any()
```

[6]:
```
series_id    False
step         False
timestamp    False
anglez       False
enmo         False
dtype: bool
```

1.3.2 Train Events

[7]:
```
train_events.head()
```

[7]:

	series_id	night	event	step	timestamp
0	038441c925bb	1	onset	4992.0	2018-08-14T22:26:00-0400
1	038441c925bb	1	wakeup	10932.0	2018-08-15T06:41:00-0400
2	038441c925bb	2	onset	20244.0	2018-08-15T19:37:00-0400
3	038441c925bb	2	wakeup	27492.0	2018-08-16T05:41:00-0400
4	038441c925bb	3	onset	39996.0	2018-08-16T23:03:00-0400

[8]:
```
train_events.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 14508 entries, 0 to 14507
Data columns (total 5 columns):
 #   Column     Non-Null Count  Dtype
---  ------     --------------  -----
 0   series_id  14508 non-null  object
 1   night      14508 non-null  int64
 2   event      14508 non-null  object
 3   step       9585 non-null   float64
 4   timestamp  9585 non-null   object
dtypes: float64(1), int64(1), object(3)
memory usage: 566.8+ KB
```

[9]:
```
train_events.describe(include='all')
```

[9]:
```
            series_id         night  event           step  \
count           14508  14508.000000  14508    9585.000000
unique            277           NaN      2            NaN
top     78569a801a38           NaN  onset            NaN
freq              168           NaN   7254            NaN
mean              NaN     15.120072    NaN  214352.123944
std               NaN     10.286758    NaN  141268.408192
min               NaN      1.000000    NaN     936.000000
25%               NaN      7.000000    NaN   95436.000000
50%               NaN     14.000000    NaN  200604.000000
75%               NaN     21.000000    NaN  317520.000000
max               NaN     84.000000    NaN  739392.000000

                          timestamp
count                          9585
unique                         9360
top     2017-11-27T21:37:00-0500
freq                              3
mean                            NaN
std                             NaN
min                             NaN
25%                             NaN
50%                             NaN
75%                             NaN
max                             NaN
```

[10]:
```
# Check null values
train_events.isnull().any()
```

[10]:
```
series_id    False
night        False
event        False
step          True
timestamp     True
dtype: bool
```

1.4 Pre-processing of Data

[11]:
```
train_events = train_events.dropna(axis=0, ignore_index=True)
train_events.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 9585 entries, 0 to 9584
Data columns (total 5 columns):
 #   Column     Non-Null Count  Dtype
---  ------     --------------  -----
 0   series_id  9585 non-null   object
 1   night      9585 non-null   int64
```

```
 2   event      9585 non-null   object
 3   step       9585 non-null   float64
 4   timestamp  9585 non-null   object
dtypes: float64(1), int64(1), object(3)
memory usage: 374.5+ KB
```

1.4.1 Invalid events

Search for occurrences of "bad nights," which refers to any nights deviating from a single onset/wakeup pattern.

[12]:
```
bad_nights = train_events[['series_id', 'night', 'event']].
 ↪groupby(by=['series_id', 'night']).count()
bad_nights[bad_nights['event']!=2]
```

[12]:

		event
series_id	night	
0ce74d6d2106	20	1
154fe824ed87	30	1
44a41bba1ee7	10	1
efbfc4526d58	7	1
f8a8da8bdd00	17	1

Removing problematic Data

[13]:
```
train_events = train_events[~(((train_events['series_id']=='0ce74d6d2106') &␣
 ↪(train_events['night']==20)) |
                              ((train_events['series_id']=='154fe824ed87') &␣
 ↪(train_events['night']==30)) |
                              ((train_events['series_id']=='44a41bba1ee7') &␣
 ↪(train_events['night']==10)) |
                              ((train_events['series_id']=='efbfc4526d58') &␣
 ↪(train_events['night']==7)) |
                              ((train_events['series_id']=='f8a8da8bdd00') &␣
 ↪(train_events['night']==17)))].reset_index(drop=True)

train_events.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 9580 entries, 0 to 9579
Data columns (total 5 columns):
 #   Column     Non-Null Count  Dtype
---  ------     --------------  -----
 0   series_id  9580 non-null   object
 1   night      9580 non-null   int64
 2   event      9580 non-null   object
 3   step       9580 non-null   float64
 4   timestamp  9580 non-null   object
```

```
dtypes: float64(1), int64(1), object(3)
memory usage: 374.3+ KB
```

[14]:
```
series_ID_list = list(train_events['series_id'].unique())
print('Total number of valid series in training dataset: '+␣
 ↪str(len(series_ID_list)))
```

```
Total number of valid series in training dataset: 269
```

[15]:
```
# Update train_series dataset with final set of series
train_series = train_series[train_series['series_id'].isin(series_ID_list)].
 ↪reset_index(drop=True)

# Check for nulls
train_series.isnull().any()
```

[15]:
```
series_id    False
step         False
timestamp    False
anglez       False
enmo         False
dtype: bool
```

1.4.2 Sample encoding and merge data

[16]:
```
train_events["step"]  = train_events["step"].astype("int")
train_events["awake"] = train_events["event"].replace({"onset":1,"wakeup":0})

train_data = pd.merge(train_series, train_events[['step','awake']], on='step',␣
 ↪how='left')
train_data["awake"] = train_data["awake"].bfill(axis ='rows')
train_data['awake'] = train_data['awake'].fillna(1) # awake
train_data["awake"] = train_data["awake"].astype("int")
```

[17]:
```
train_data.sample(10)
```

[17]:

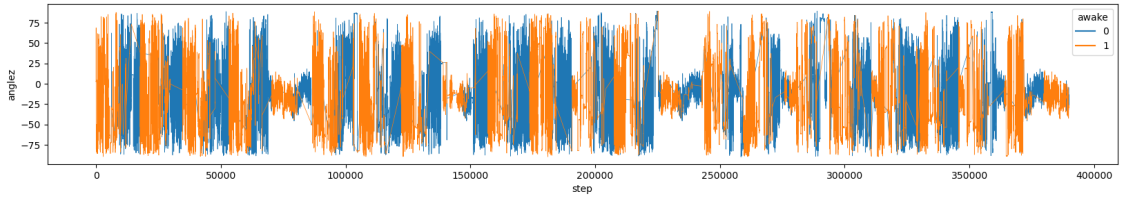
	series_id	step	timestamp	anglez	enmo	\
122483019	fa149c3c4bde	96695	2018-09-05T09:17:55-0400	-35.084999	0.0153	
78153839	aa81faa78747	173071	2018-03-09T17:22:35-0500	-21.054701	0.0504	
72679565	9c91c546e095	325646	2018-06-12T08:47:10-0400	-15.501500	0.0261	
45231413	601559e1777d	94646	2019-03-27T22:57:10-0400	5.609400	0.0000	
14889984	188d4b7cd28b	353126	2017-11-29T02:42:10-0500	-37.105000	0.0158	
87987116	c289c8a823e0	596500	2018-07-11T22:58:20-0400	-25.187000	0.0085	
1435520	0402a003dae9	315686	2019-01-05T19:12:10-0500	-22.354099	0.0235	
88812131	c38707ef76df	321529	2018-06-03T01:04:05-0400	-5.172600	0.1138	
81075524	b7188813d58a	125675	2018-10-11T18:32:55-0400	26.743799	0.0016	
115373893	ece2561f07e9	424534	2017-09-02T01:52:50-0400	-68.697403	0.0000	

```
           awake
122483019      0
78153839       0
72679565       0
45231413       1
14889984       0
87987116       0
1435520        1
88812131       0
81075524       1
115373893      0
```

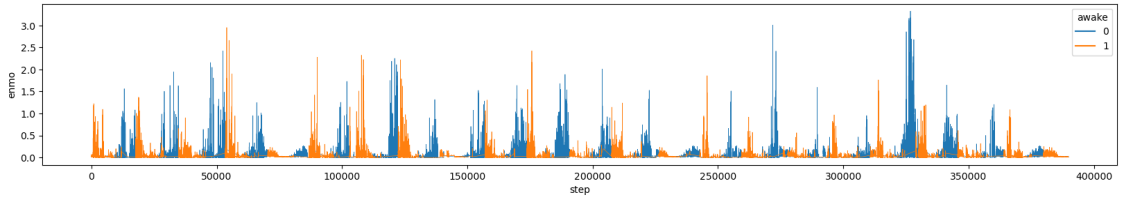
1.5 Visualization

[18]:
```
with warnings.catch_warnings():
    warnings.simplefilter("ignore")

    counter = 0  # Initialize the counter

    for series_ID in series_ID_list:
        train_series_sample = train_data[train_data['series_id'] == series_ID]

        # Plotting anglez
        display(Markdown('###  anglez for series ' + str(series_ID)))
        fig, ax = plt.subplots(figsize=(20, 3))
        sns.lineplot(data=train_series_sample, x="step", y="anglez",␣
↪hue="awake", linewidth=0.5)
        plt.show()

        # Plotting enmo
        display(Markdown('###  enmo for series ' + str(series_ID)))
        fig, ax = plt.subplots(figsize=(20, 3))
        sns.lineplot(data=train_series_sample, x="step", y="enmo", hue="awake",␣
↪linewidth=0.5)
        plt.show()

        # Memory cleanup
        del train_series_sample
        gc.collect()

        counter += 1  # Increment the counter after each iteration

        if counter == 5:
            break  # Break the loop when the counter equals 5
```

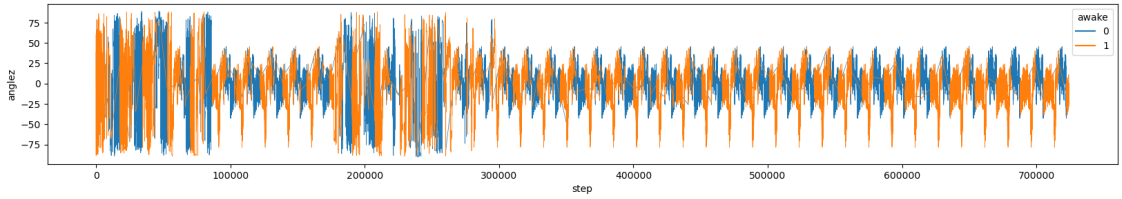
1.5.1 anglez for series 038441c925bb



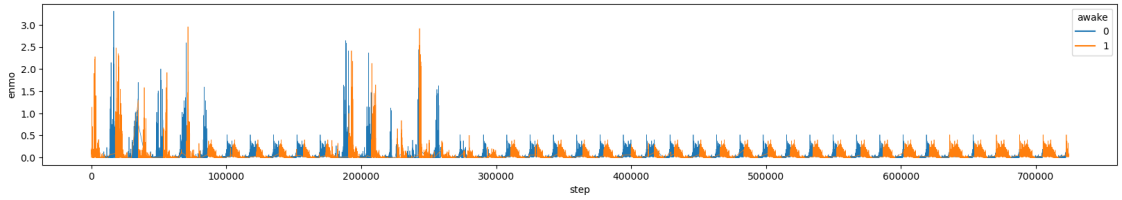
1.5.2 enmo for series 038441c925bb



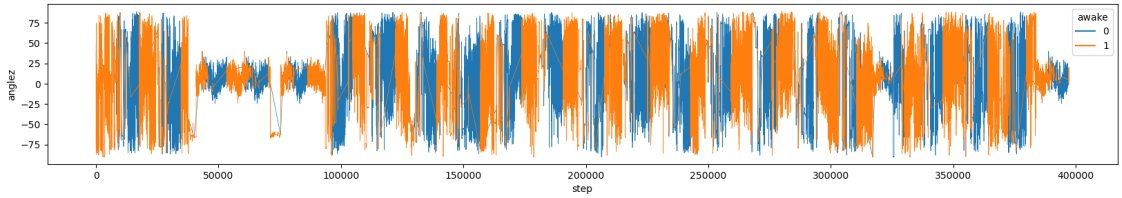
1.5.3 anglez for series 03d92c9f6f8a



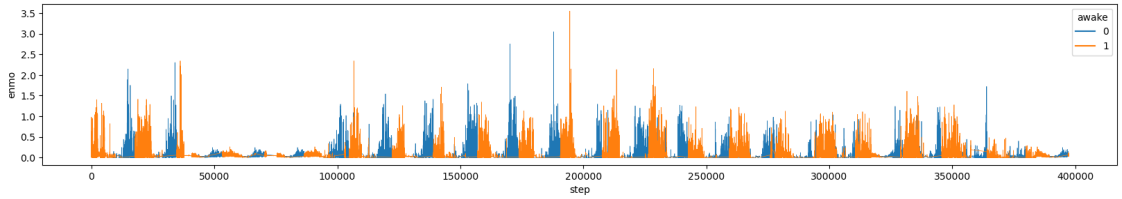
1.5.4 enmo for series 03d92c9f6f8a



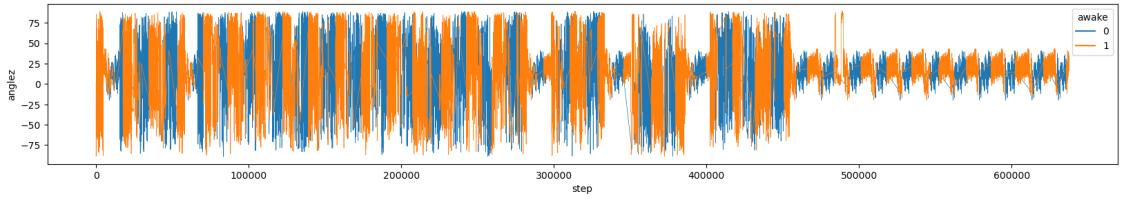
1.5.5 anglez for series 0402a003dae9



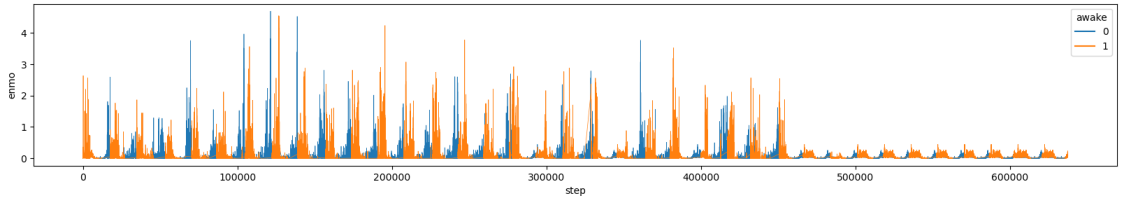
1.5.6 enmo for series 0402a003dae9



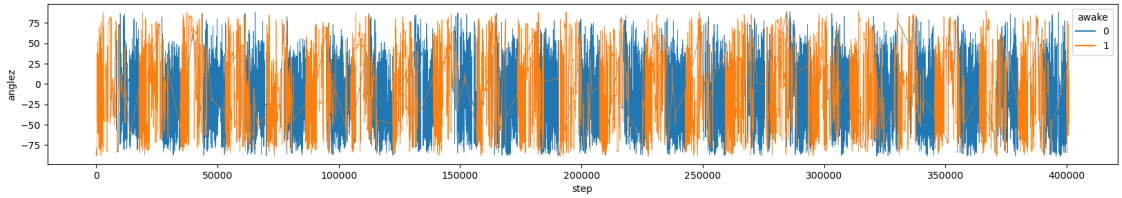
1.5.7 anglez for series 04f547b8017d



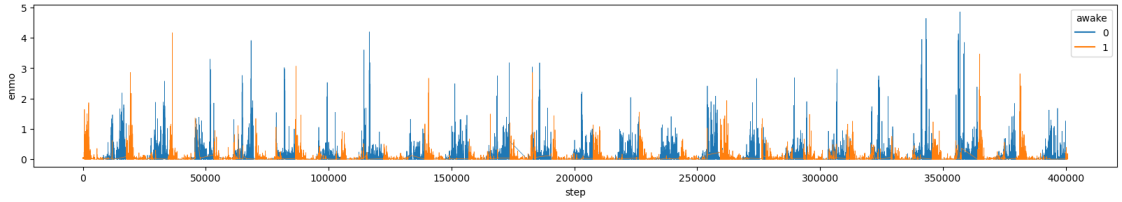
1.5.8 enmo for series 04f547b8017d



1.5.9 anglez for series 05e1944c3818



1.5.10 enmo for series 05e1944c3818



[ ]: