Paper companion notebook — Jones et al.

> **Auto-generated from `tutorial_notebook/notebook_paper.ipynb`.** Executed against the seaborn canvas so every figure is inline as a static PNG. Plotly-only cells are kept for context and marked as placeholders — for the interactive version, run the source notebook.

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ethoscopy & ethoscope-lab: a framework for behavioural analysis to lower entrance barrier and aid reproducibility

Figure 1

1. Loading the data

```
import ethoscopy as etho
import pandas as pd
```

```
# This tutorial required version 1.1.8 or greater
etho.__version__
```

```
'2.0.5'
```

One-time setup: fetch the tutorial datasets

The tutorial pickle files (~36 MB total, dominated by `overview_data.pkl`) are **not** bundled with the PyPI package, to keep `pip install ethoscopy` lean.

Run the cell below **once per environment** to download them into the installed package directory. Subsequent runs are idempotent (already-present files are skipped).

You can also fetch them manually from https://github.com/gilestrolab/ethoscopy/tree/main/src/ethoscopy/misc/tutorial_data.

```
# Idempotent: skips files that are already present.
import ethoscopy as etho
etho.download_tutorial_data()
```

```
  [skip] overview_data.pkl (already present)
  [skip] overview_meta.pkl (already present)
  [skip] circadian_data.pkl (already present)
  [skip] circadian_meta.pkl (already present)
  [skip] 4_states_F_WT.pkl (already present)
  [skip] 4_states_M_WT.pkl (already present)
Tutorial data ready in: /home/gg/.cache/ethoscopy/tutorial_data
```

```
PosixPath('/home/gg/.cache/ethoscopy/tutorial_data')
```

```
# import this function to get the tutorial dataset
from ethoscopy.misc.get_tutorials import get_tutorial
```

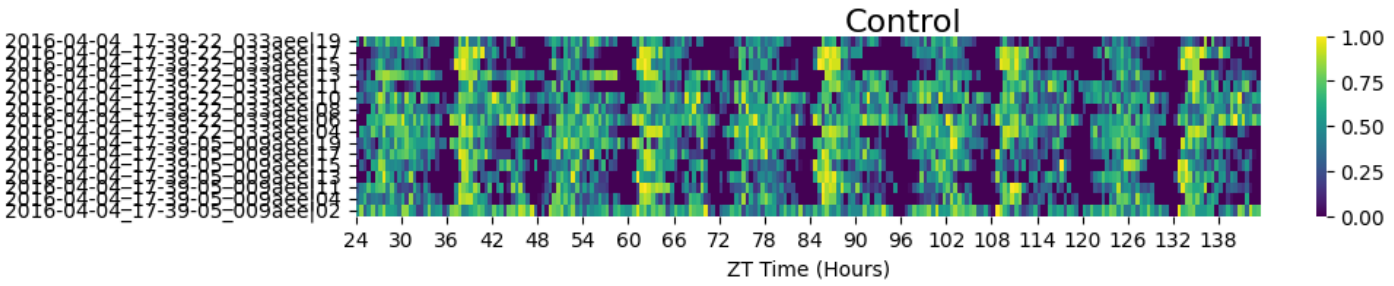
```
# We'll be using the same dataset as in the overview tutorial, so use the same function below
with the argument 'overview'
# Load the data and metadata, and then intialise it into a behavpy_HMM
data, metadata = get_tutorial('overview')
df = etho.behavpy(data, metadata, check = True)
```

```
df = df.t_filter(start_time = 24, end_time = 144)
```

(a)

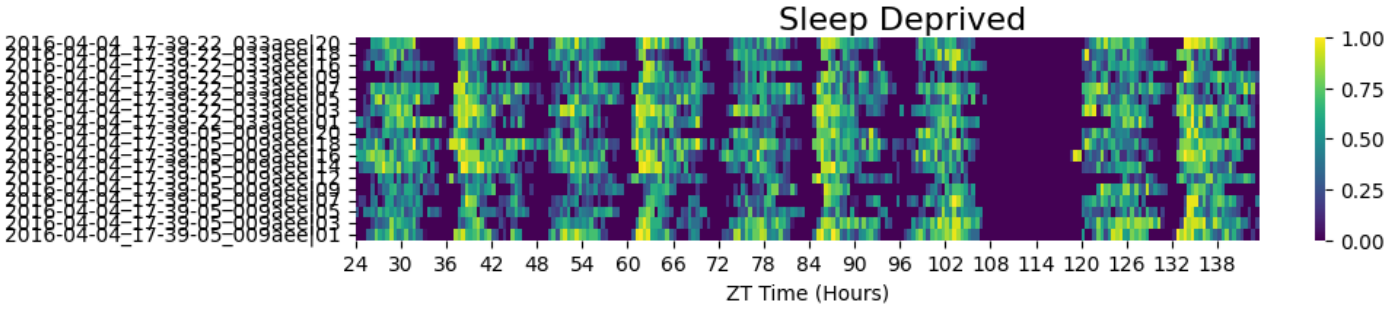
```
fig = df.xmv('sleep_deprived', False).heatmap(variable = 'asleep', title = 'Control')
fig.show()
```

```
/home/gg/Code/ethoscope_project/ethoscopy/src/ethoscopy/behavpy_core.py:1611: FutureWarning: DataFrameGroupBy.apply operated on the grouping columns. This behavior is deprecated, and in a future version of pandas the grouping columns will be excluded from the operation. Either pass `include_groups=False` to exclude the groupings or explicitly select the grouping columns after groupby to silence this warning.
  tdf.groupby("id", group_keys=False).apply(
/tmp/ipykernel_557712/1229634965.py:2: UserWarning: FigureCanvasAgg is non-interactive, and thus cannot be shown
  fig.show()
```




```
# As we saw in the overview tutorial the dataset we have has half the specimens sleep deprived later in the experiment
fig = df.xmv('sleep_deprived', True).heatmap(variable = 'asleep', title = 'Sleep Deprived')
fig.show()
```

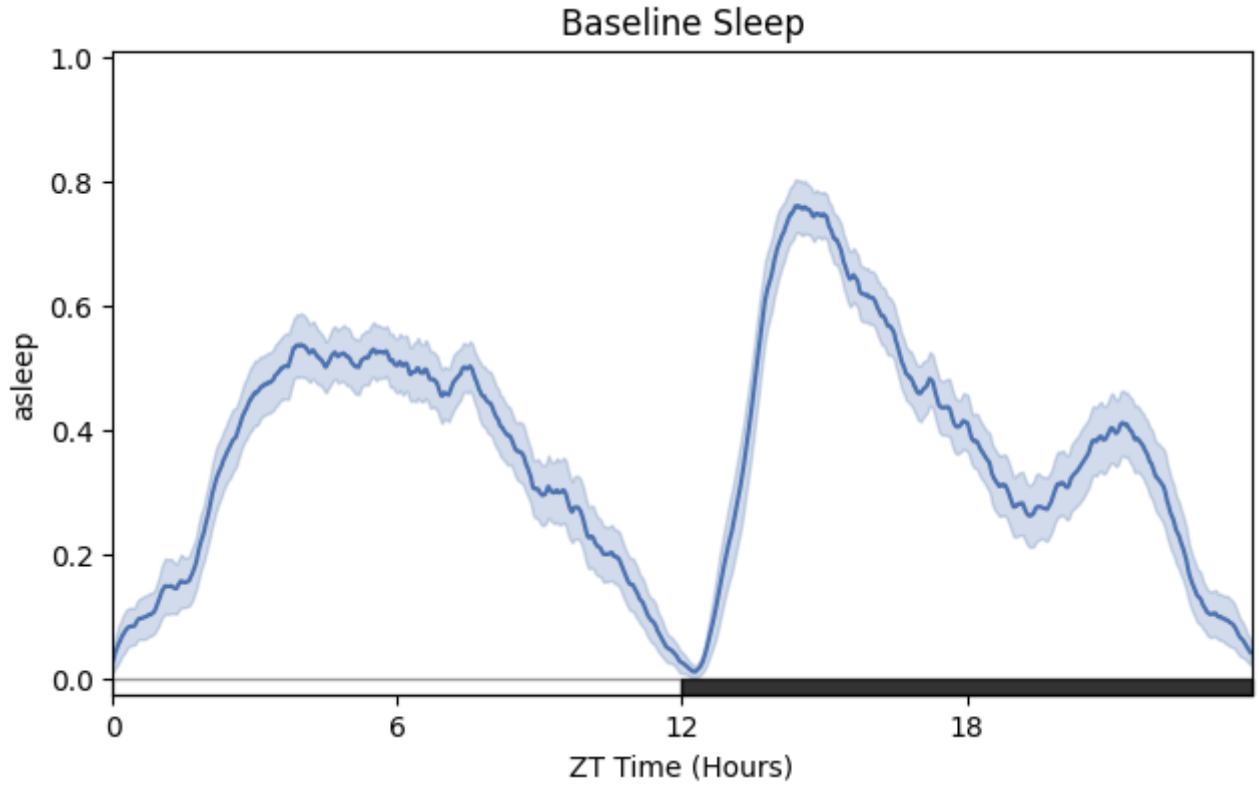
```
/home/gg/Code/ethoscope_project/ethoscopy/src/ethoscopy/behavpy_core.py:1611: FutureWarning: DataFrameGroupBy.apply operated on the grouping columns. This behavior is deprecated, and in a future version of pandas the grouping columns will be excluded from the operation. Either pass `include_groups=False` to exclude the groupings or explicitly select the grouping columns after groupby to silence this warning.
  tdf.groupby("id", group_keys=False).apply(
/tmp/ipykernel_557712/762731294.py:3: UserWarning: FigureCanvasAgg is non-interactive, and thus cannot be shown
  fig.show()
```



(b)

```
fig = df.t_filter(start_time = 24, end_time = 96).plot_overtime(variable = 'asleep', wrapped = True, title = 'Baseline Sleep')
fig.show()
```

```
/tmp/ipykernel_557712/211641461.py:2: UserWarning: FigureCanvasAgg is non-interactive, and thus cannot be shown
  fig.show()
```



(c)

```
# Ethoscopy also has pretrained HMMs for both Male and Female CS Drosophila, trained on several days worth of data on hundreds of flies
```

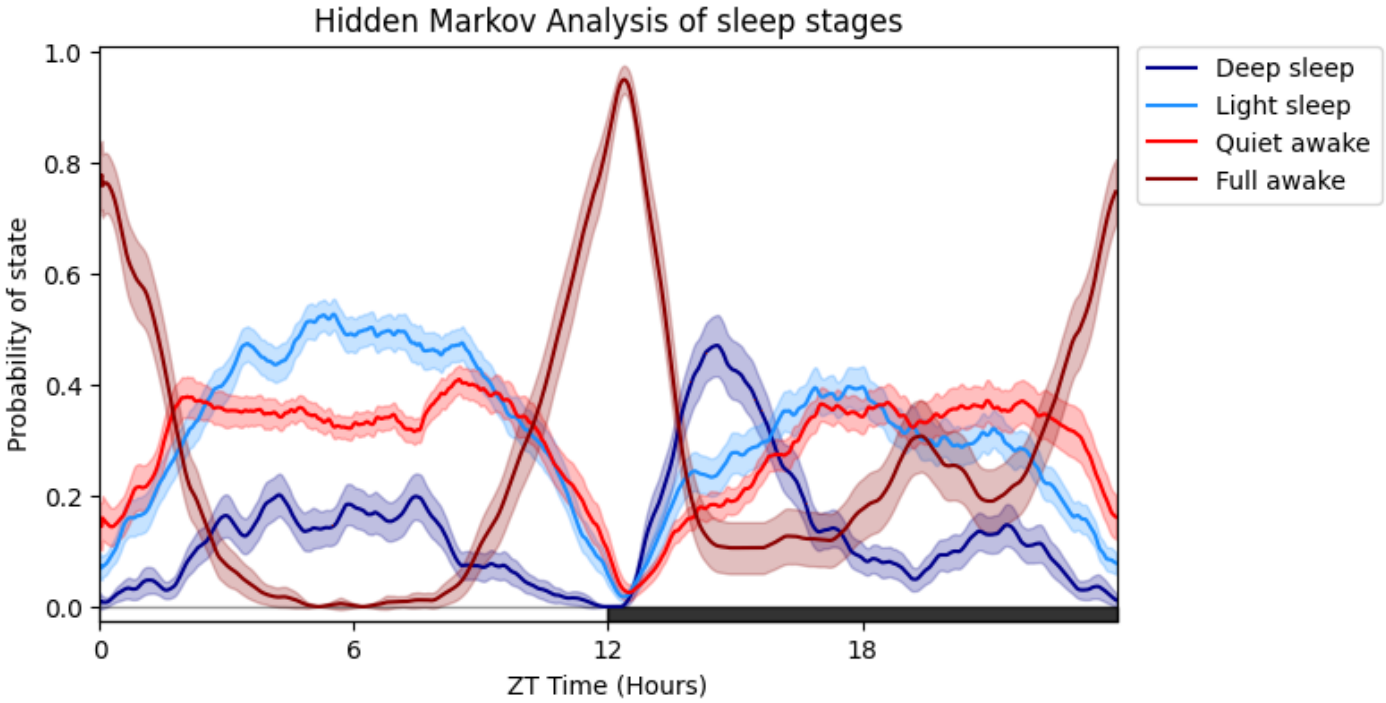
```
from ethoscopy.misc.get_HMM import get_HMM

# Have the argument as "M" or "F" for the male or female dataset respectively
h = get_HMM("M")
```

```
fig = df.plot_hmm_overtime(
            hmm = h,
            variable = 'moving',
            wrapped = True,
            labels = ['Deep sleep', 'Light sleep', 'Quiet awake', 'Full awake'],
            t_bin = 60,
            title = 'Hidden Markov Analysis of sleep stages'
            )
fig.show()
```

```
/home/gg/Code/ethoscope_project/ethoscopy/src/ethoscopy/behavpy_core.py:1611: FutureWarning: DataFrameGroupBy.apply operated on the grouping columns. This behavior is deprecated, and in a future version of pandas the grouping columns will be excluded from the operation. Either pass `include_groups=False` to exclude the groupings or explicitly select the grouping columns after groupby to silence this warning.
  tdf.groupby("id", group_keys=False).apply(


/tmp/ipykernel_557712/1927658757.py:9: UserWarning: FigureCanvasAgg is non-interactive, and thus cannot be shown
  fig.show()
```



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