
pyActigraphy, an open-source python package for actigraphy data visualisation and analysis

Hammad G.,¹ Reyt M.,^{1,2} Belyi N.,¹ Baillet M.,¹ Deantoni M.,¹ Lesoinne, A.,¹
Muto V.,¹ Schmidt C.^{1,2}

¹GIGA-Institute, Cyclotron Research Center/In Vivo Imaging, Sleep and Chronobiology Lab,
University of Liège, Liège, Belgium

²Psychology and Neuroscience of Cognition Research Unit, Faculty of Psychology and Educational
Sciences, University of Liège, Liège, Belgium

Introduction: Actigraphy consists in continuous 24-hour movement recordings using small watch-like accelerometers. As recordings can last several days or weeks, this technique is an adequate tool for the in-situ assessment of the locomotor activity and/or the study of rhythmic patterns and therefore has been used in the field of sleep and circadian rhythm studies for the past 40 years. However, the generalization of the findings is made difficult; researchers either develop home-made data processing pipeline and/or analysis scripts, which are time-consuming, error prone and make the reproducibility of the analyses difficult, or rely on commercial toolboxes that are not only costly but inherently biased and act as black boxes. In addition, cumbersome data preprocessing, such as cleaning, hampers large scale analyses, which are mandatory for reliable results.

Methods: The package consists in several modules and offers the following functionalities:

- unified way to read multiple actigraphy file formats;
- automatic cleaning and masking procedure for spurious periods of inactivity;
- actigraphy data visualisation, potentially overlaid with the different periods reported in a sleep agenda if available;
- usual rest-activity rhythm variables used to assess circadian integrity;
 - Interdaily stability (IS), Intradaily variability (IV), Relative Amplitude (RA) as well their variants (ISm, IVm)
 - transition probability from rest to activity (kRA) and from activity to rest (kAR)
 - sleep regularity index (SRI) and sleep mid-point
- automatic detection of the rest/activity periods (Cole-Kripke's, Sadeh's, Scripps', Oakley's, Crespo's and Roenneberg's algorithms);
- automatic detection of activity onset and offset times;
- signal modelling or decomposition techniques (Fourier or Singular Spectrum Analysis (SSA), Gaussian kernel smoothing, ...);
- advanced analysis (Cosinor, Detrended Fluctuation Analysis, Locomotor Inactivity During Sleep)

Results: The *pyActigraphy* toolbox, an open-source python package for actigraphy data visualisation and analysis, offers functionalities to automatise data pre-processing, read large file batches and implement various metrics and techniques for actigraphy data analysis.

Conclusions: By developing the *pyActigraphy* package, we not only hope to facilitate data analysis but also foster research using actimetry and drive a community effort to improve this open-source package and develop new variables and algorithms.