EasieRR:

Open-source software for HRV analysis and artefact processing in non-restrained animals

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Background

The assessment of heart rate (HR) and heart rate variability (HRV) is considered a good proxy for stress in a wide range of animal species. However, acquiring ECG in unrestrained animals may result in artefacts, caused by technical (i.e. bad electrode skin contact) or physiological (i.e. ectopic beats, non-cardiac muscle potentials) sources which may disrupt the ECG signal. Thus, the process of visual inspection of the ECG and tachogram to detect and subsequently correct these artefacts is essential. Most of the commercially available software are not freely available, and/or require intensive training and are time-consuming.

Methods and Results

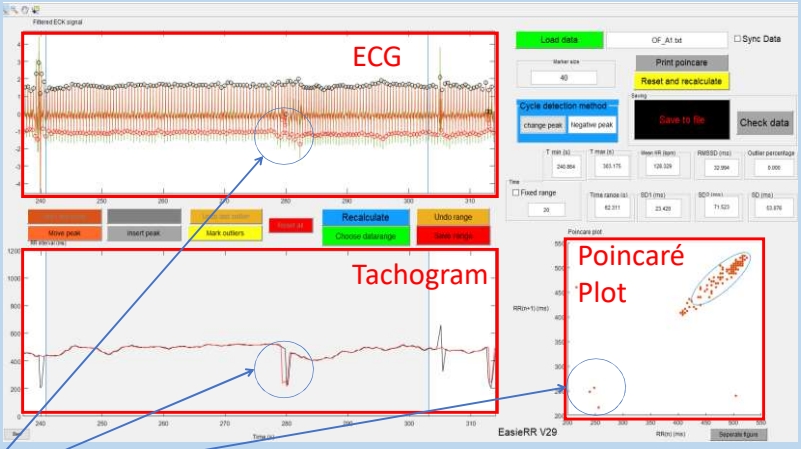
The intuitive graphical user interface and the visualisation of ECG, tachogram und Poincaré plot eases the validation of correct heart cycle interval detection and minimises work for the user. The software automatically detects the prominent peaks and apparent artefacts which, in addition, can then be manually corrected in the ECG. Corrections are instantly visible in the tachogram and Poincaré plot. The analysis report can be exported using many common formats. A special feature is the possibility to synchronise ECG data with videos in order to link cardiac responses to specific behavioural responses.

Conclusion

EasieRR is a user-friendly software for efficient processing and HRV analysis of ECG data of non-restrained animals.

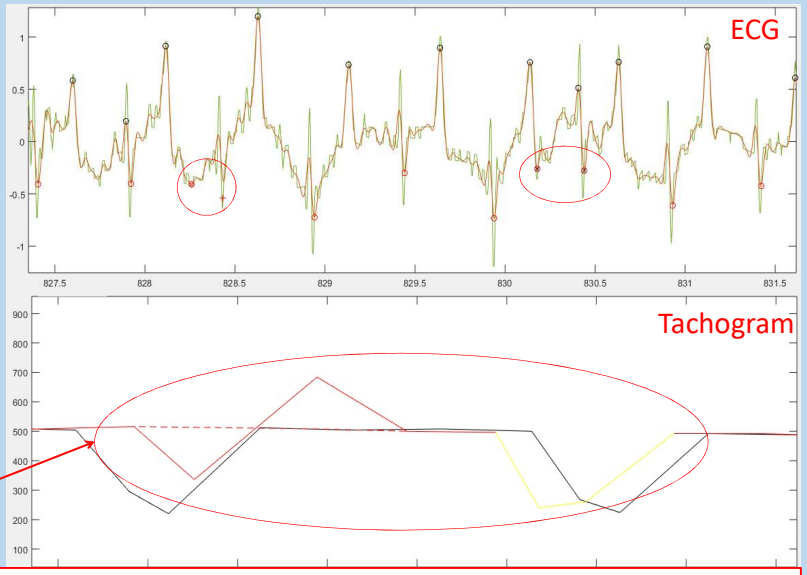
1. INPUT

2. PROCESSING



Artefacts caused by i.e. high activity.

3. ARTEFACT CORRECTION



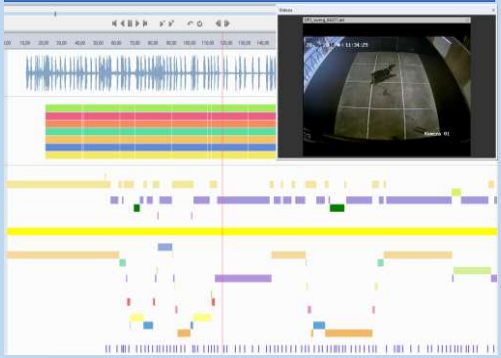
Manual corrections are visible in the ECG (as red crosses) as well as in the tachogram (as yellow lines = deleted intervals and red dotted lines = corrected intervals).

4. RESULTS

Example: Analysis report of several 20-sec sequences

N	xrange	SD1	SD2	meanHR	SD	RMSSD
50	20	5.9659	17.1044	157.0353	13.0467	8.3523
54	20	9.4170	27.1198	185.5713	20.4747	13.2106
67	20	8.4299	21.3051	209.8546	16.2085	11.8398
66	20	5.6951	38.2240	206.1110	27.5306	8.0754
58	20	6.2433	16.1641	185.0870	12.2010	8.7573
61	20	5.3388	35.0791	191.0540	25.4687	7.6136
57	20	6.6491	24.8077	175.7666	18.3844	9.3584
49	20	8.9489	36.0037	155.6068	26.0738	12.5325
53	20	8.8769	50.3820	166.1340	36.2748	12.5172

5. INTEGRATION IN OTHER SOFTWARE



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DFG Deutsche Forschungsgemeinschaft

FNSNF Schweizerischer Nationalfonds zur Förderung der wissenschaftlichen Forschung

Software Access:

Publication:

Agroscope