Video analysis of social interactions in mice: an integrated solution

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Prior to any analysis, the entry point for a behavioral study is the tracking of one or several animals. One of the main issues when dealing with more than one animal is the fact that they do have frequent contact and are difficult to individualize.

To recognize the identity of each animal, several methods can be used such as shaving or painting the animals. In both cases, this may bias the experiment because of either the social meaning of being shaved (stress or dominance) or the smell of the painting. In our solution[1], we chose as a constraint not to change the appearance of animals.

In the described method, we introduce physical models, built by assembling basic physical primitive links together by articulations (i.e. degrees of freedom) created by either elastic wires or physical joints (rotation, sliders). To perform the tracking[2], the physical model is adjusted to the underlying image data thanks to forces that are computed from the image data and are then applied to the virtual model in order to adjust it to the location of the animal. The added robustness given by the model allows the tracking of several mice, and provides the location of the head, the belly, and the beginning of the tail for each animal.

We created a repertoire of events based on behaviorist's knowledge which describes each event in a mathematical manner, thus making the labeling reproducible.

Different kinds of event can be measured: Single frame events such as 'head-head contact', or events occurring on a number of successive frames as it is the case for pursuits. The repertoire also introduces the labelling of complex temporal sequences of events which represent the combination of several simpler events such as 'Mouse A comes to mouse B, contact, and then the contact is stopped by Mouse B.' Thanks to the tracking and the repertoire, video sequences are automatically analyzed and events are labeled[3].

The software implementation allows one to watch and browse the entire chronogram of events. The user can seek in the video and see information in overlay at the same time: 1. The quality of the tracking, as the head, belly and beginning of the tail are displayed. 2. The field of vision of the mice. 3. The different events that are occurring at the current frame.

The final part of the software[4] allows one to compile chronograms to create statistical transition graphs, which describe what are the predecessor and successor of each event. Those graphs are compiled for each strain and sum up all the data in a single view.

All the software[2-4] is free and open source, it can be downloaded through the software Icy[5]. A complete video showing how to use the software is also available[6].

Ethical statement

The mice were treated according to the ethical standards defined by the Centre National de la Recherche Scientifique for animal health and care in strict compliance with the EEC recommendations (86/609).

References

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