A semi-automatic user-friendly tracking software (TrAQ) for animal models capable of automatic turning rotation behaviour characterization

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Background

Quantitative metrics of laboratory animals' locomotion are crucial tools in behavioural neuroscience studies.

We present a MATLAB-based semi-automatic user-friendly tracking software, TrAQ, not requiring massive user interaction, while providing quantitative data. We show TrAQ capability of automatic rotation behaviour measurement validated with a rat model.

Methods

- User-friendly GUI designed to set-up and review a study with minimal user intervention and video batch process function (Fig.1).
- Use of a probabilistic algorithm to calculate the reference background image (no ghosting from low activity animals).
- Absolute time identification for output comparison with behavioural features recorded by other software tools and techniques.
- Automatic identification of the animal as the largest moving pixel cluster (Fig. 2).
- Extremities (head/tail) defined from the main cluster shape with head-ahead motion condition (Fig. 2).
- Automatic body rotations counting (Fig. 3).
- Different graphical formats for the most common output data (Fig. 4).
- TrAQ validation with smartphone-recorded videoclips of hemi-parkinsonian rats [1] in a Open Field arena (50cmx50cm): centroid tracking against EthoVision XT [2] and apomorphine-induced body rotations against manual counting (Fig. 4).

Results

- Correlation within 1% between TrAQ and EthoVision XT (Fig. 3 A,B).
- TrAQ number of net body turns in agreement with human operator counting (3% maximum deviation, Fig. 3 C).

References

1. Ungerstedt, U. and Arbuthnott, G.W. Brain Research, 1970;24:485–493.
2. Noldus, L. P. J. J. et al. Behavior Research Methods, Instruments, and Computers, 2001;33:398–414.

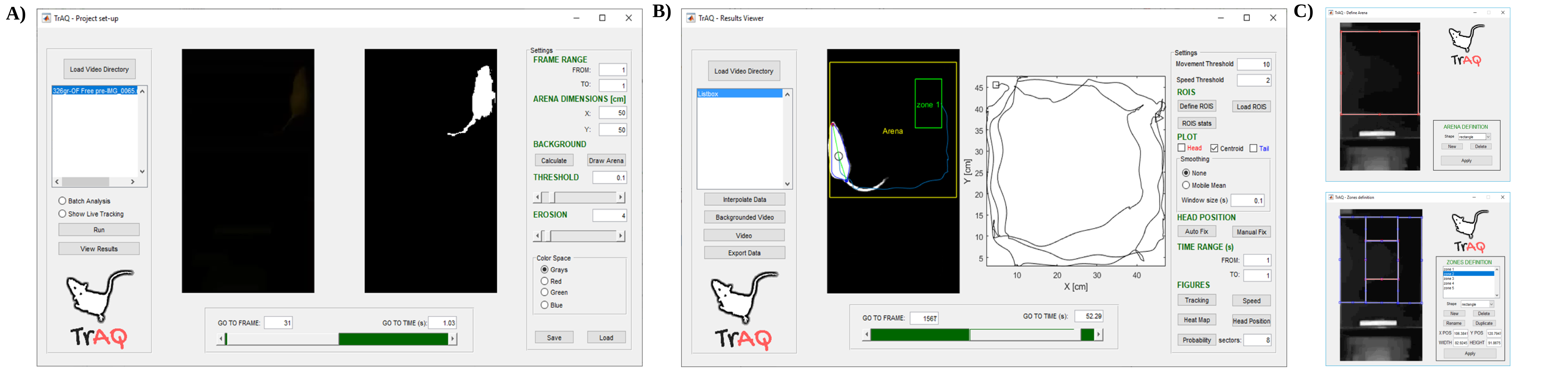

Figure 1: Graphical User Interface of the TrAQ software, (A) Project settings windows, (B) Results viewer and analyzer, (C) Window for Arena and Regions Of Interest definition

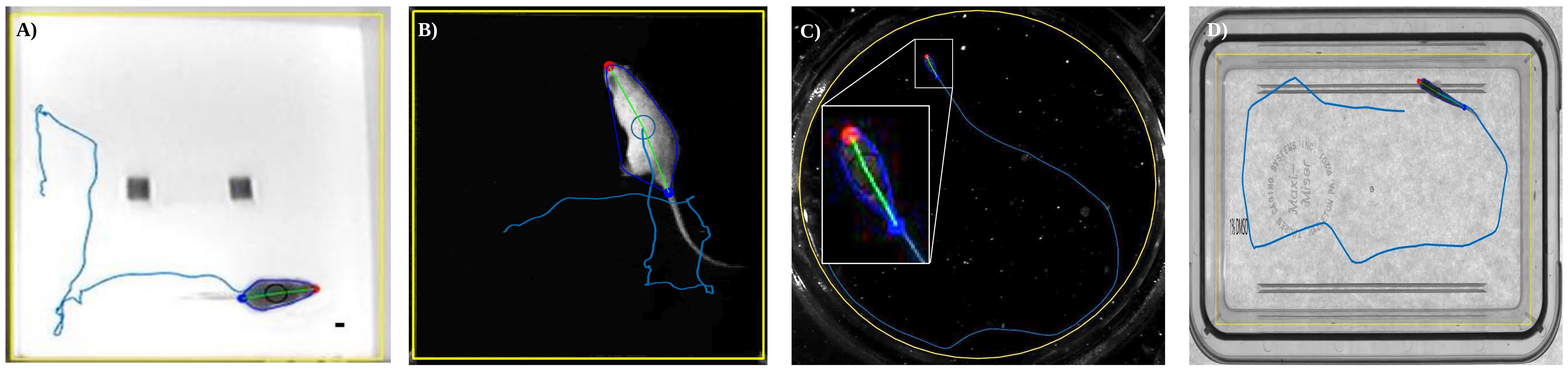

Figure 2: Different species tracked with TrAQ: (A) mouse, (B) rat, (C) copepod *D. Belgicus*, (D) zebrafish.

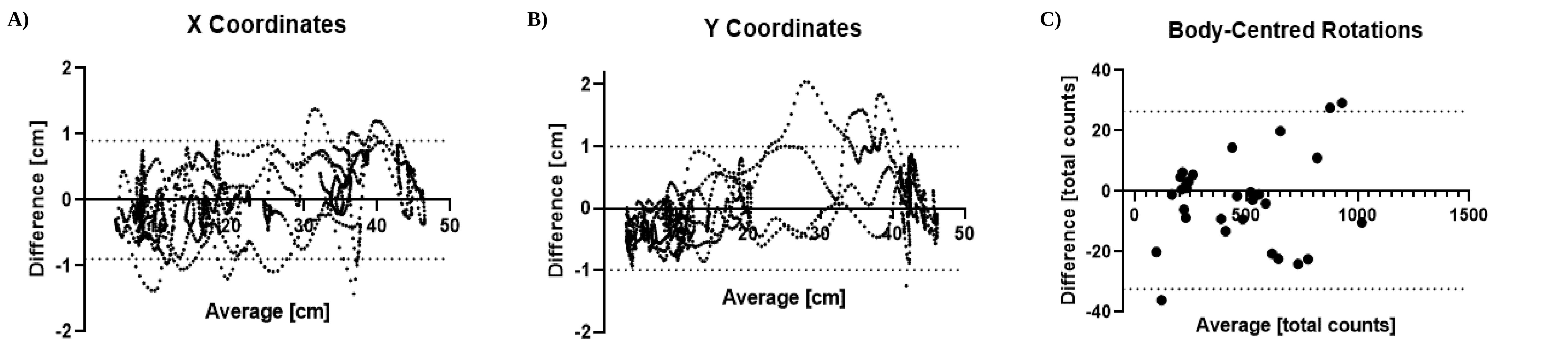

Figure 3: Bland-Altman plots for TrAQ and Ethovision XT comparison: centroid x (A) and y (B) coordinates, and (C) TrAQ and manual annotation of rat net number of body centered rotations (hemi-parkinsonian rat model in apomorphine-induced condition).

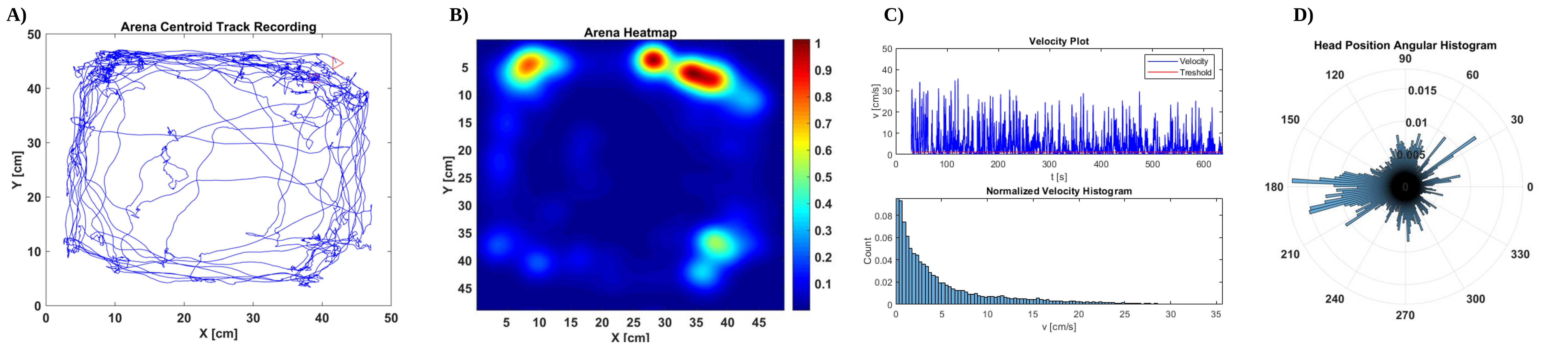

Figure 4: TrAQ data output: (A) centroid positions, (B) Arena heatmap (C) Instantaneous velocity (upper panel) and its probability distribution (lower panel), (D) Body angle distribution (orientation of centroid-head segment with respect to the horizontal axis).

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