Bonsai

Project Title: Evaluation of SCI Recovery in Rodent Models
Client: Dr. Hassan Ali, Ali Lab, University of Miami Miller School of Medicine
Project Manager: Nikhita Guhan

1. Background

Spinal cord injury (SCI) is a major cause of disability, making it essential to quantify recovery under experimental therapies. The Ali Lab has collected gait data from wildtype rats, SCI rats, and SCI rats with therapeutic intervention ("rescue"), measured across multiple timepoints. Data consist of frame-by-frame .csv files of joint and limb positions during locomotion.

2. Objectives

- Identify kinematic features most impacted by SCI and rescue therapy.
- Build an automated pipeline to process raw data into clear, interpretable figures.
- Define and benchmark metrics to compare gait profiles across groups and timepoints.

3. Project Scope

3.1 Feature Analysis

- Perform dimensionality reduction (e.g., PCA, t-SNE) to identify high-variance features.
- Apply feature importance methods (e.g., random forest importance, permutation testing) to determine which features are most affected by SCI and therapy.

3.2 Visualization Pipeline Development

- Create figures that highlight differences in gait profiles across WT, SCI, and rescue.
- Visualizations may include:
    - PCA/UMAP projections showing group separations.
    - Recovery curves across timepoints (1 dpi, 2 dpi, etc.).
    - Bar plots of recovery metrics (see **3.3**).

- Automate pipeline so raw data can be processed with minimal manual intervention.

3.3 Metric Exploration and Implementation

- Define and evaluate composite gait similarity measures, including:
    - Composite walking score (CWS).
    - Cosine similarity of gait vectors.
    - Other statistical or ML-based similarity measures.
- Benchmark metrics across groups and timepoints to quantify how sensitively they partition groups.

4. Deliverables

- Report on feature importance.
- Automated figure-generation pipeline.
- Evaluation report on gait similarity metrics.

5. Roles and Responsibilities

5.1 Bonsai Applied Computations Group

- Conduct computational analysis and pipeline development.
- Prepare interim progress updates and final deliverables.

5.2 Ali Lab

- Provide access to datasets and domain-specific context for SCI and therapy.
- Offer feedback on preliminary results and guide scientific interpretation.

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