Assessing Stem Cell Therapeutics in Murine Models: Final Presentation

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Introduction

Sue and Bill Gross Stem Cell Research Center @ UCI School of Medicine

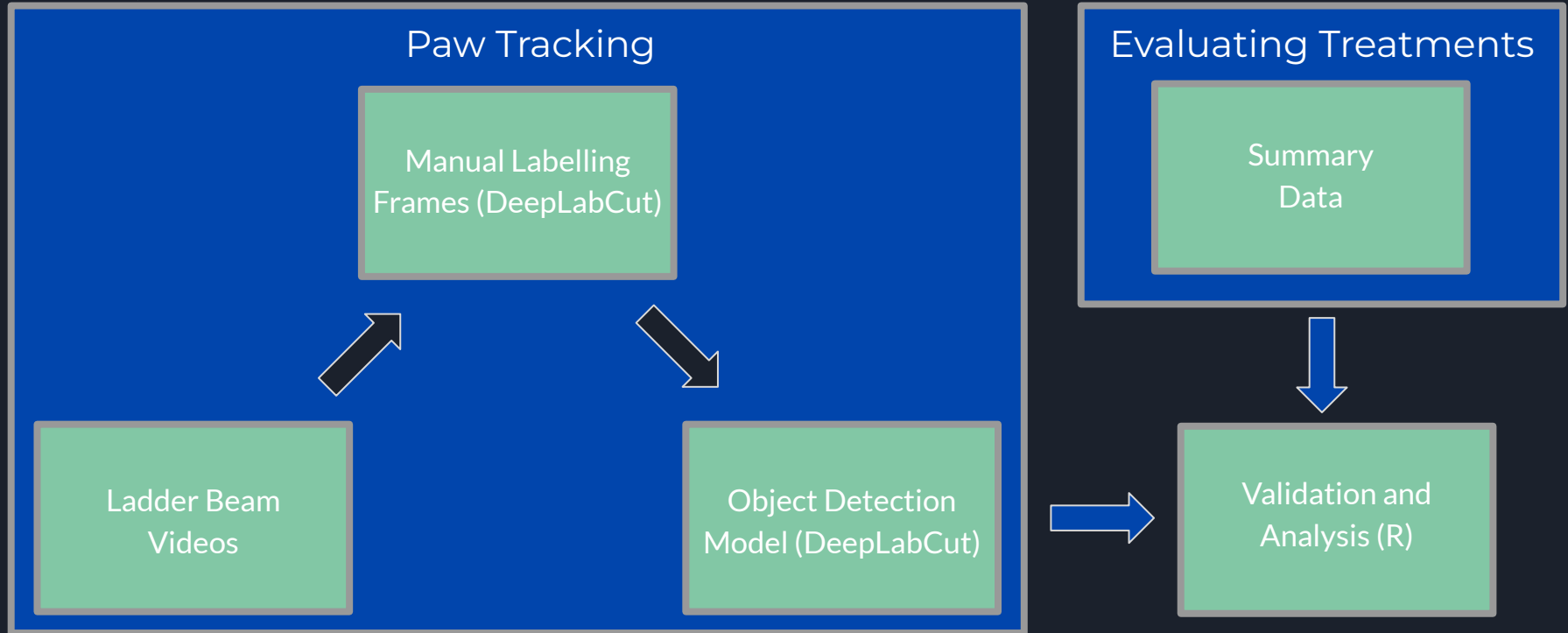- Spinal Cord Injury
- Ladder Beam
- Catwalk

Primary Objectives:

- Evaluate effectiveness of treatments for SCI
- Accurately track mice steps

Data Source:

- Ladder Beam Videos
- Summary Excel Sheets

Data Pipeline

Raw Data: Ladder Beam Clips

Summary Sheet Data

Animal ID	Total Good Steps	Total Bad Steps	Average Good Steps	Average Bad Steps	LB Score	Type
1	276	24	46.00	4.00	92.00	w
2	280	20	46.67	3.33	93.33	k
3	255	45	42.50	7.50	85.00	w
4	228	71	38.00	11.83	76.25	k
5	267	33	44.50	5.50	89.00	v
6	279	21	46.50	3.50	93.00	v
7	276	24	46.00	4.00	92.00	k
8	226	74	37.67	12.33	75.33	w
9	227	73	37.83	12.17	75.67	k
10	222	78	37.00	13.00	74.00	v

Training Data

Video	Frame	Bodypart	X	Y
20230112_145948	img0528.png	front_left_paw	1152	173
20230112_145948	img0528.png	front_right_paw	NA	NA
20230112_145948	img0528.png	front_mid	1525	117
20230112_145948	img0528.png	back_left_paw	NA	NA
20230112_145948	img0528.png	back_right_paw	NA	NA
20230112_145948	img0528.png	back_mid	NA	NA
20230112_145948	img0528.png	nose	1525	257
20230112_145948	img0528.png	tail	NA	NA
20230112_145948	img0614.png	front_left_paw	1521	320
20230112_145948	img0614.png	front_right_paw	1580	166

ANOVA Model and Kruskal Wallis Test

Distribution of Ladder Beam Performance Across Mice Groups

Normal Q-Q Plot
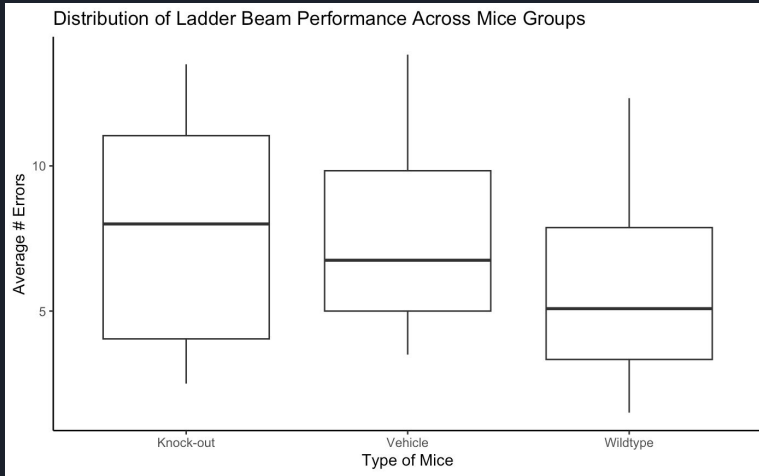
ANOVA Results:

- Average number of errors is not significantly different among the three types of mice after treatment (p-value = 0.543)
- Normality Assumption Violation
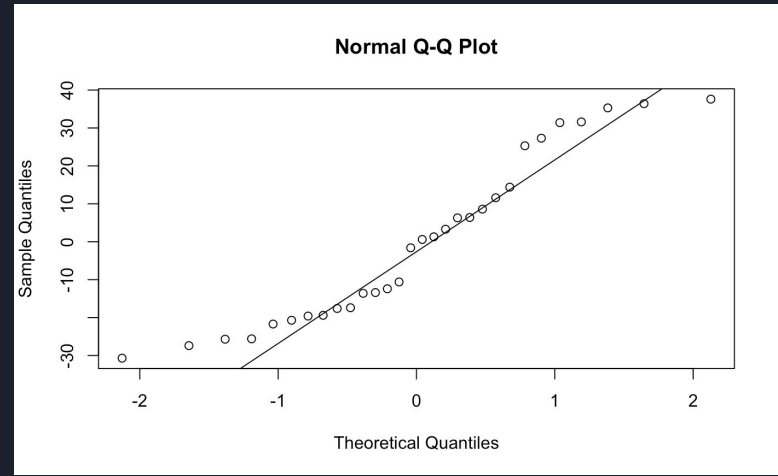
Kruskal Wallis Results:

- Median number of errors is not significantly different among the three types of mice after treatment (p-value = 0.402)

CNN Model

DeepLabCut:

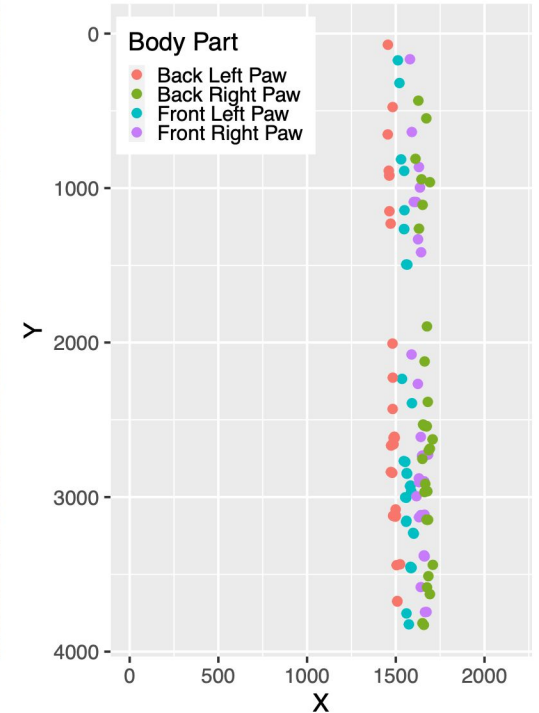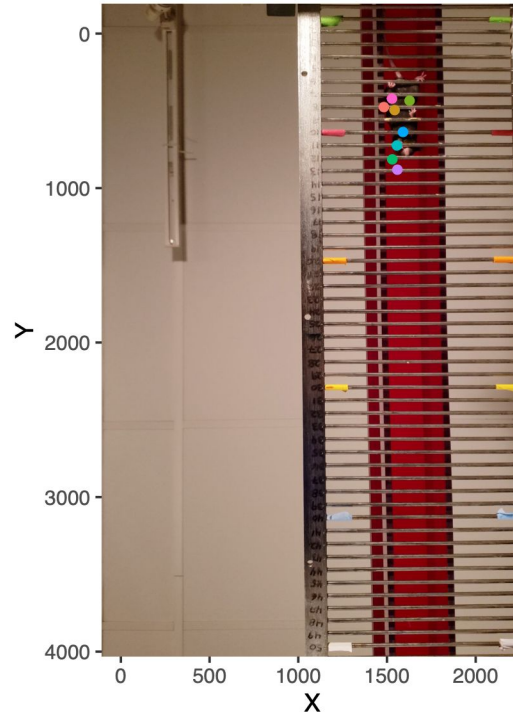   Made for Pose Estimation

    Label Frames of Videos

    Train Neural Network

Justification:

    CNN for object detection and image recognition
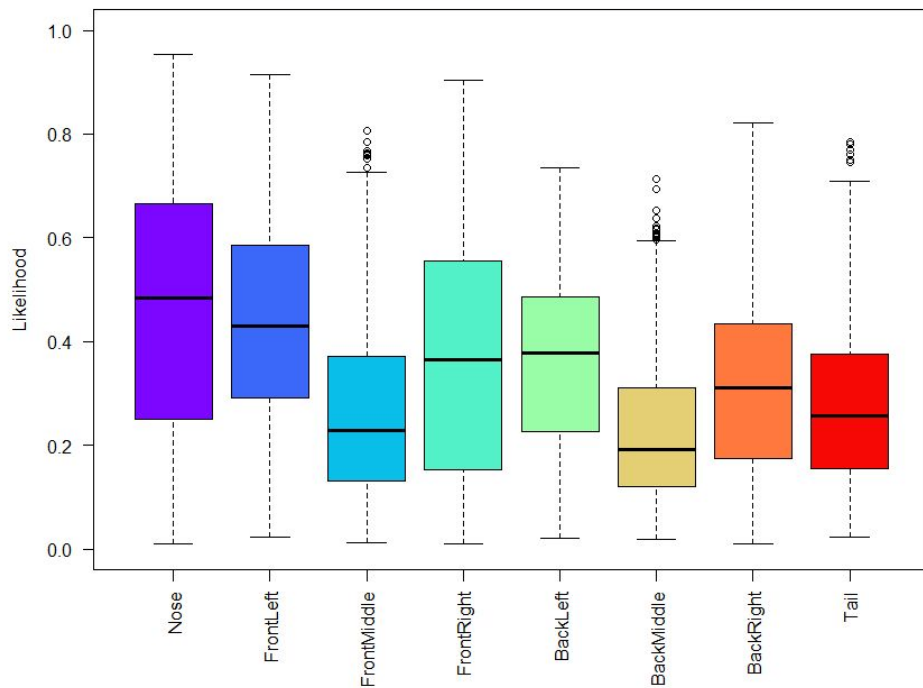
    Previous related work
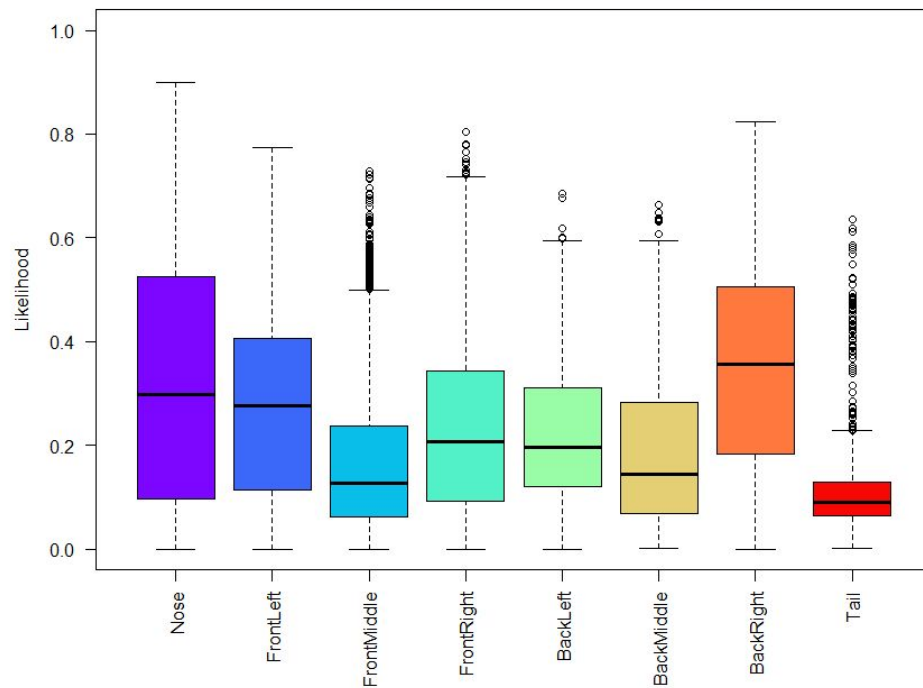
Example of Labeled Video

CNN Model Results

Likelihood Distribution By Skeletal Structure (Training)

Likelihood Distribution By Skeletal Structure (Testing)

CNN Model Results

Trained Neural Network Error Rate
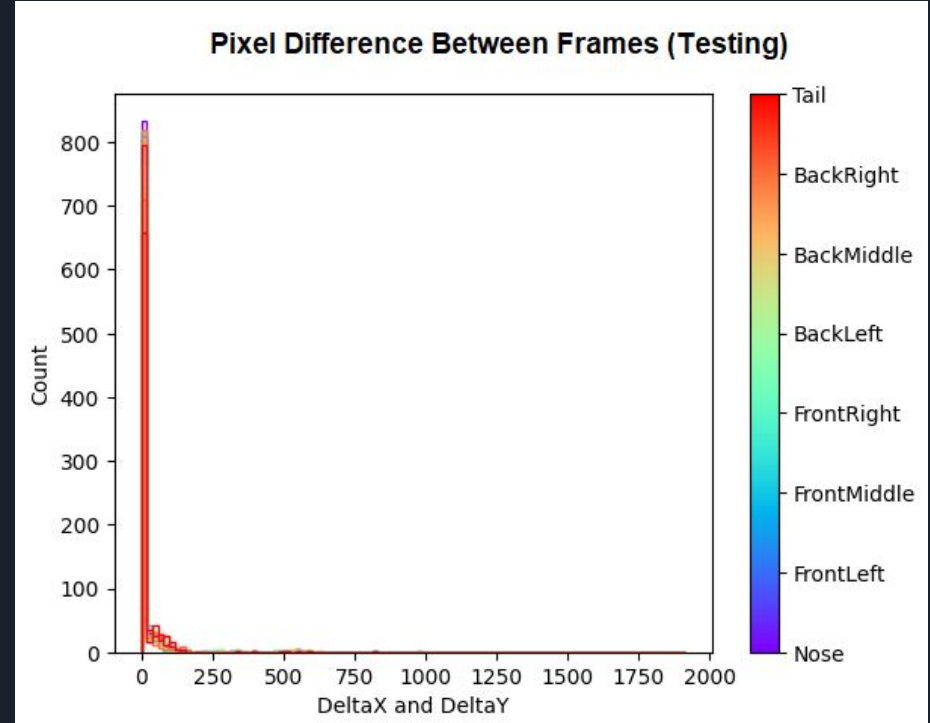
    10 Iterations: 34.955%

    10,000 Iterations: 0.3%

    166,570 Iterations: 0.096%

Mean Euclidean Distance

    Training Error: 105.05 pixels

    Testing Error: 44.17 pixels

    Likelihood > 0.6: 17 pixels

Pixel Difference Between Frames (Testing)

Limitations and Future Plans

Limits

- Computational Power
- Increasing Model Accuracy
    - Ladder rung obstructions
    - Non-uniform video conditions
    - Inconsistent performance of mice

Future Plans

- Obtain videos with more camera angles
- Leveraging RCIC GPUs for modeling
- Transitioning from tracking model to classifying model
- Analyze trend in missteps over time

Questions?