# HAAG Week 10 Report -Lizard Jaw Segmentation

## Shuyu Tian

## Time-Log

What did I do this week?

- I integrated ICP refinement based on suggestions of the last computational advisor meeting for refining registration
- As the webpage manager and meeting leader of my group, I updated the webpage of the Stroud group with a subpage for the Lizard Jaw Segmentation group's weekly reports and group meeting recording link.

- What I will do next week
  - I will get an updated from Philip on his non-rigid point matching results
  - I will compare non-rigid and rigid point matching results with Philip in our weekly meeting to then make a decision on what our next steps need to be.
- Blockers, things I want to flag, problems, etc.
  - Getting a plan of research progress for the rest of the semester due to my availability for the rest of the semester

## Abstract:

Animal biometrics is a challenging task. In the literature, many algorithms have been used, e.g. penguin chest recognition, elephant ears recognition and leopard stripes pattern recognition, but to use technology to a large extent in this area of research, still a lot of work has to be done. One important target in animal biometrics is to automate the segmentation process, so in this paper we propose a segmentation algorithm for extracting the spots of Diploglossus millepunctatus, an endangered lizard species. The automatic segmentation is achieved with a combination of preprocessing, active contours and morphology. The parameters of each stage of the segmentation algorithm are found using an optimization procedure, which is guided by the ground truth. The results show that automatic segmentation of spots is possible. A 78.37 % of correct segmentation in average is reached.

**Link:** https://arxiv.org/abs/1603.00841

**General summary:** The paper proposes an algorithm to automatically segment the spots of *Diploglossus millepunctatus*, an endangered lizard species. The methodology combines preprocessing steps, active contour models, and morphological operations, with parameters optimized based on ground truth data. The algorithm achieved an average correct segmentation rate of 78.37%, demonstrating the feasibility of automated spot segmentation in this context. This work contributes to the field of animal biometrics by providing a non-invasive technique for identifying individual lizards based on their unique spot patterns.

## What did you do and prove it

I took the approach to coarse point matching in a different way than last week. This time I took the following steps:

1. I refactored the code written previously that used Ransac for registration to now include ICP refinement.
2. I took data of how close the previous Ransac registration without ICP refinement ran by an average of 20 iterations for fitness and RMSE values to provide an evaluation of how well registration ran

```
def process(num_samples=20, max_iters=5):
    iternum = 0
    all_transformations = []

    while(iternum < num_samples):
        voxel_size = 3  # Reduced voxel size to keep more points

        source, target, source_down, target_down, source_fpfh, target_fpfh = prepare_dataset(
                        voxel_size, source_file, target_file)

        #If downsampled point clouds are empty, warn and break early
        if len(source_down.points) == 0 or len(target_down.points) == 0:
            print(f"Warning: Downsampled point cloud is empty for sample {iternum + 1}. Skipping...")
            continue

        result_ransac = execute_global_registration(source_down, target_down,
                                                    source_fpfh, target_fpfh,
                                                    voxel_size)

        all_transformations.append(result_ransac.transformation)
        print(f"Sample {iternum + 1}: Fitness - {result_ransac.fitness}, RMSE - {result_ransac.inlier_rmse}")
        iternum += 1

        # ICP refinement
        refined_transformation = refine_registration(source_down, target_down, result_ransac.transformation, voxel_size)

        all_transformations.append(refined_transformation)
        print(f"Sample {iternum + 1}: Fitness - {result_ransac.fitness}, RMSE - {result_ransac.inlier_rmse}")
        iternum += 1

    if all_transformations:
        avg_transformation = compute_average_transformations(all_transformations)
        print("Average Transformation Matrix:\n", avg_transformation)
        return avg_transformation
    else:
        raise RuntimeError("No valid transformations found. Check input point clouds.")
```

# Performance Statistics

| Sample | Fitness | RMSE |
|---|---|---|
| 1 | 0.2545 | 2.5186 |
| 2 | 0.2113 | 2.4763 |
| 3 | 0.3699 | 2.4796 |
| 4 | 0.4279 | 2.5106 |
| 5 | 0.2353 | 2.5783 |
| 6 | 0.3062 | 2.4984 |
| 7 | 0.3403 | 2.4496 |
| 8 | 0.1157 | 2.6008 |
| 9 | 0.3321 | 2.4122 |
| 10 | 0.2581 | 2.5437 |
| 11 | 0.3492 | 2.4352 |
| 12 | 0.2744 | 2.4436 |
| 13 | 0.315 | 2.4155 |
| 14 | 0.398 | 2.4046 |
| 15 | 0.3046 | 2.4875 |
| 16 | 0.3307 | 2.3829 |
| 17 | 0.3358 | 2.2382 |
| 18 | 0.2582 | 2.3918 |
| 19 | 0.2801 | 2.5271 |
| 20 | 0.3676 | 2.4297 |

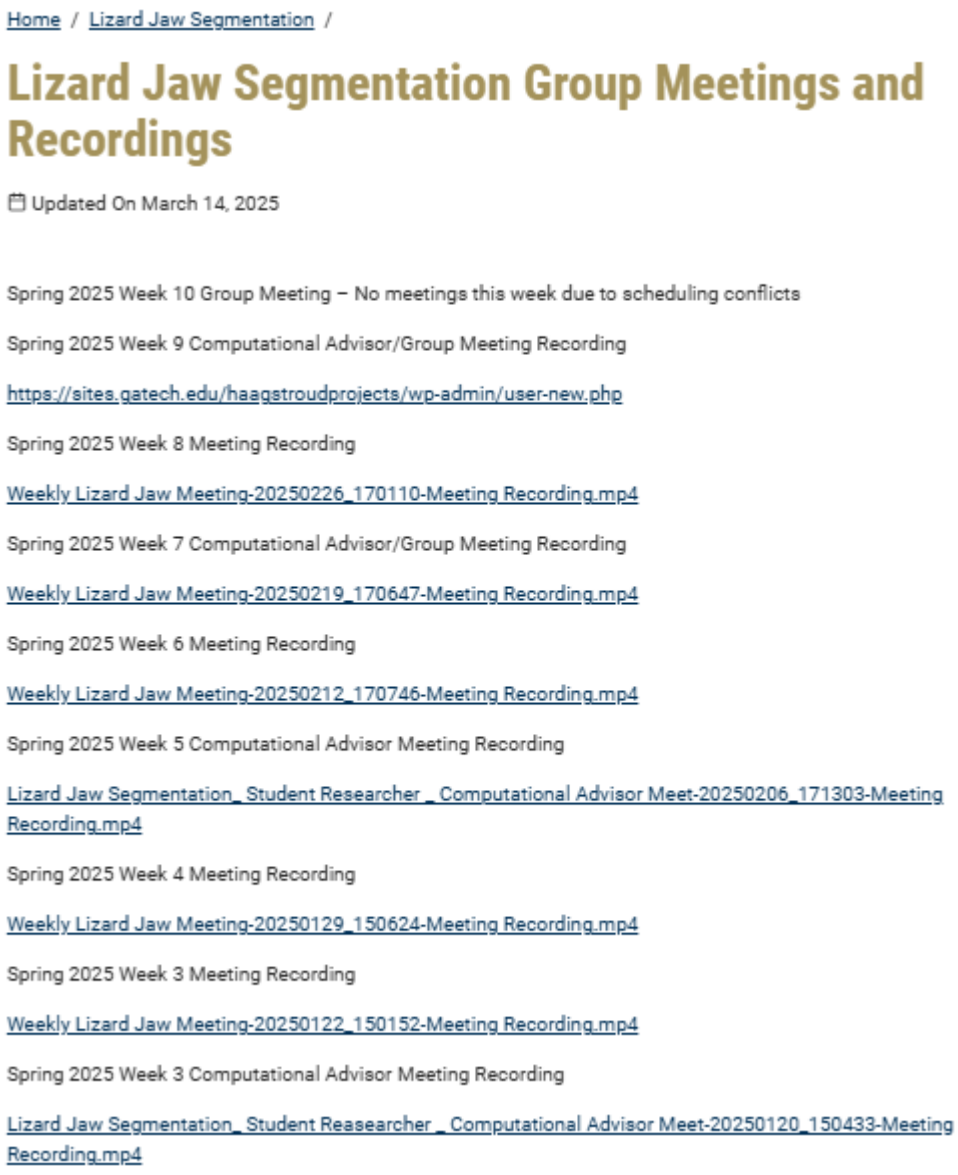
# Performance Statistics

- Fitness score range of 0.1557 to 0.4279, with an average of 0.3032
- RMSE range of 2.2382 to 2.6008, with an average of 2.4612

- Relatively low fitness score (closer to 0) with a relatively high RMSE indicate poor registration

- Perhaps a non-rigid registration method would be needed

Additionally, I updated the Stroud lab webpage with my group's relevant information up to week 9 of this semester (see images below).



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# Lizard Jaw Segmentation Group Meetings and Recordings

Updated On March 14, 2025

Spring 2025 Week 10 Group Meeting – No meetings this week due to scheduling conflicts

Spring 2025 Week 9 Computational Advisor/Group Meeting Recording

https://sites.gatech.edu/haagstroudprojects/wp-admin/user-new.php

Spring 2025 Week 8 Meeting Recording

Weekly Lizard Jaw Meeting-20250226_170110-Meeting Recording.mp4

Spring 2025 Week 7 Computational Advisor/Group Meeting Recording

Weekly Lizard Jaw Meeting-20250219_170647-Meeting Recording.mp4

Spring 2025 Week 6 Meeting Recording

Weekly Lizard Jaw Meeting-20250212_170746-Meeting Recording.mp4

Spring 2025 Week 5 Computational Advisor Meeting Recording

Lizard Jaw Segmentation_ Student Researcher _ Computational Advisor Meet-20250206_171303-Meeting Recording.mp4

Spring 2025 Week 4 Meeting Recording

Weekly Lizard Jaw Meeting-20250129_150624-Meeting Recording.mp4

Spring 2025 Week 3 Meeting Recording

Weekly Lizard Jaw Meeting-20250122_150152-Meeting Recording.mp4

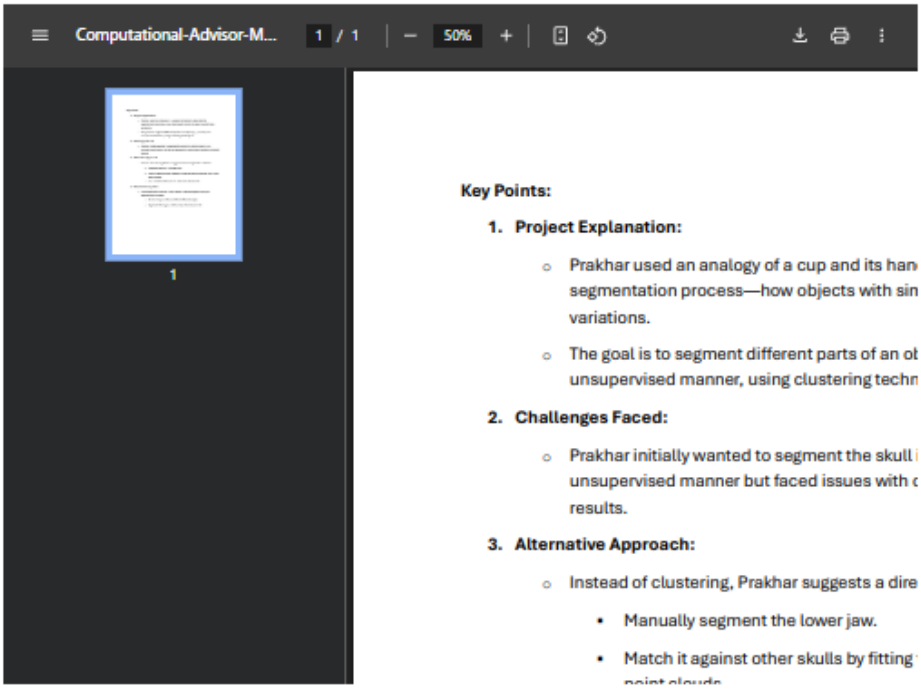
Spring 2025 Week 3 Computational Advisor Meeting Recording

Lizard Jaw Segmentation_ Student Reasearcher _ Computational Advisor Meet-20250120_150433-Meeting Recording.mp4

# Lizard Jaw Segmentation Weekly Submissions

Updated On March 14, 2025

Week 9 Computational Advisor Meeting




Computational Advisor Meeting Week 9 DOWNLOAD

Week 9 Weekly Report