Panorama Stitching System - Technical Report

Visual Computing Assignment 1

Feature Detection, Matching, and Panorama Stitching

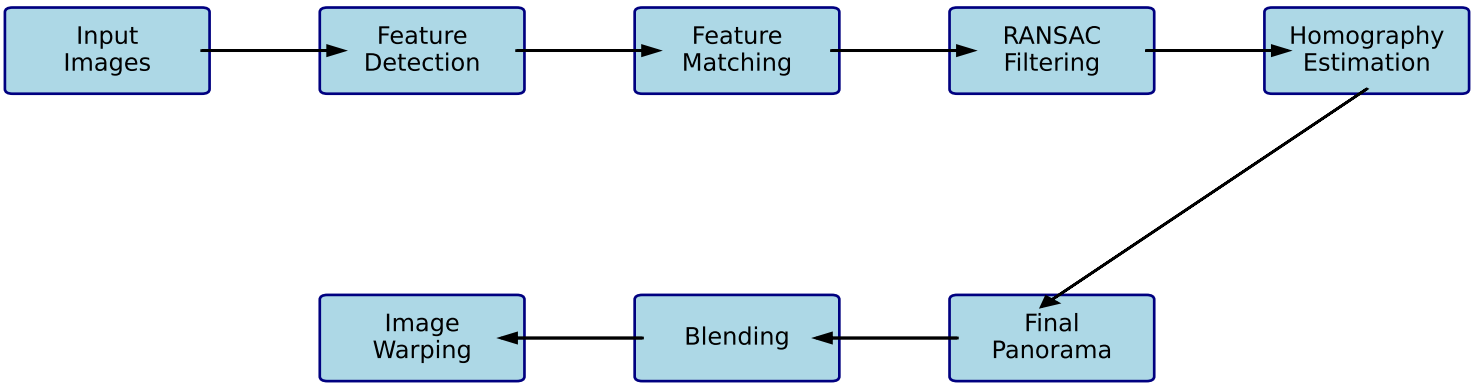
Date: September 15, 2025

Aarhus University

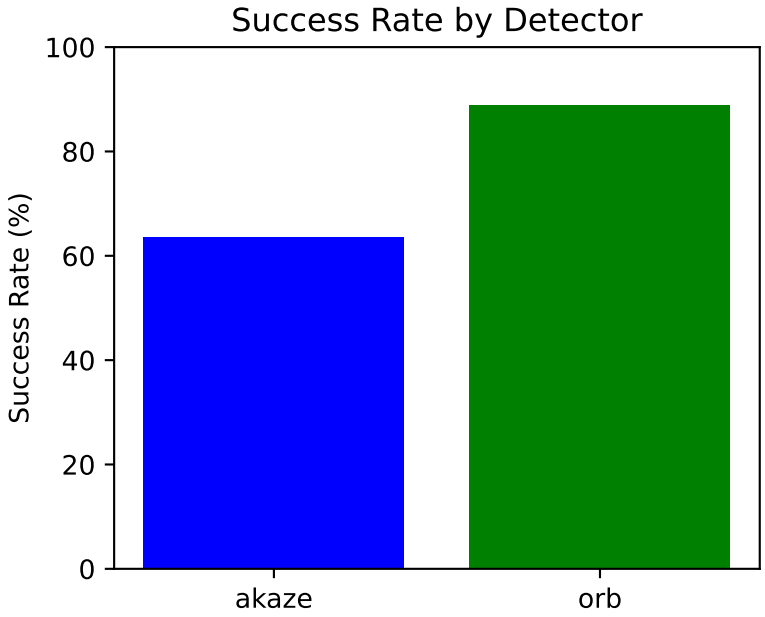
Method Overview

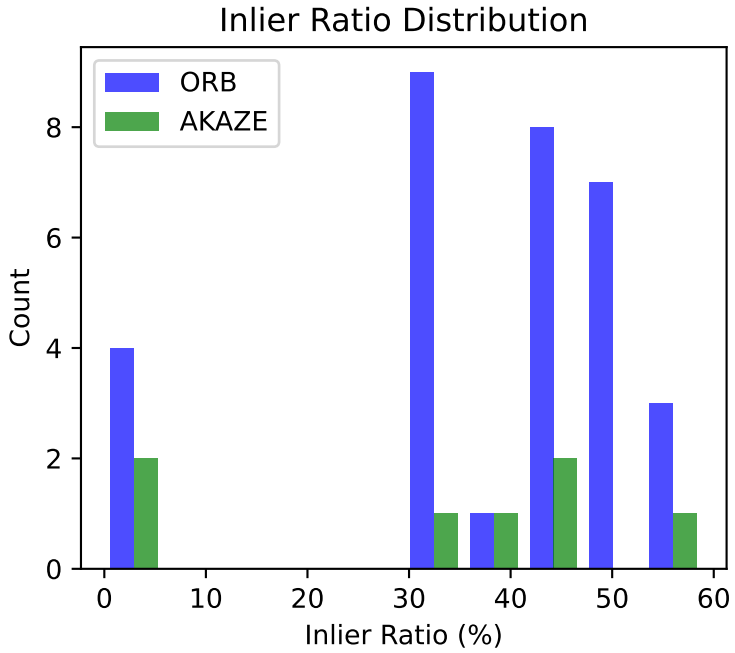
1. Feature Detection: ORB (50k features) and AKAZE (variable features)
2. Feature Matching: Brute-force matching with Lowe's ratio test (0.7)
3. Homography Estimation: RANSAC with varying thresholds (1.0-5.0)
4. Image Warping: Perspective transformation to common coordinate frame
5. Blending: Three modes - Simple overlay, Feathering, Multi-band

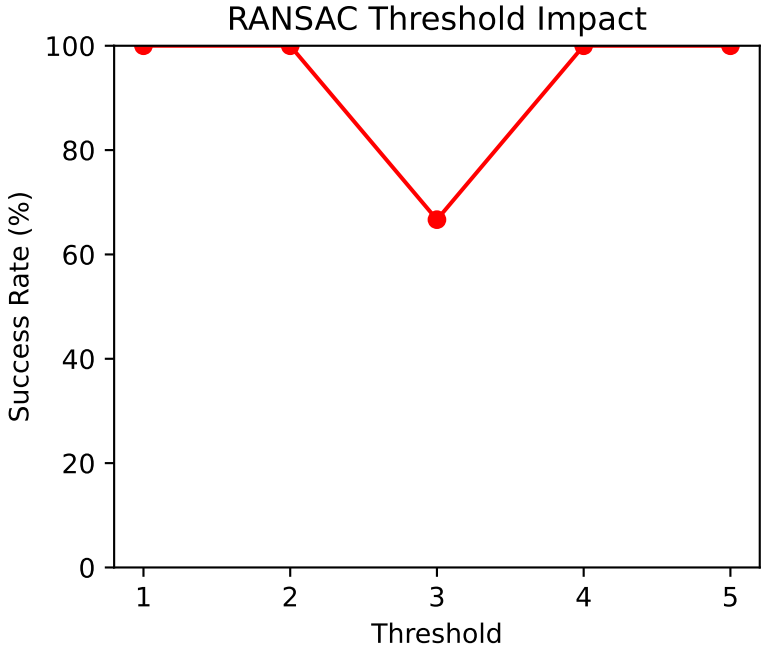
System Architecture

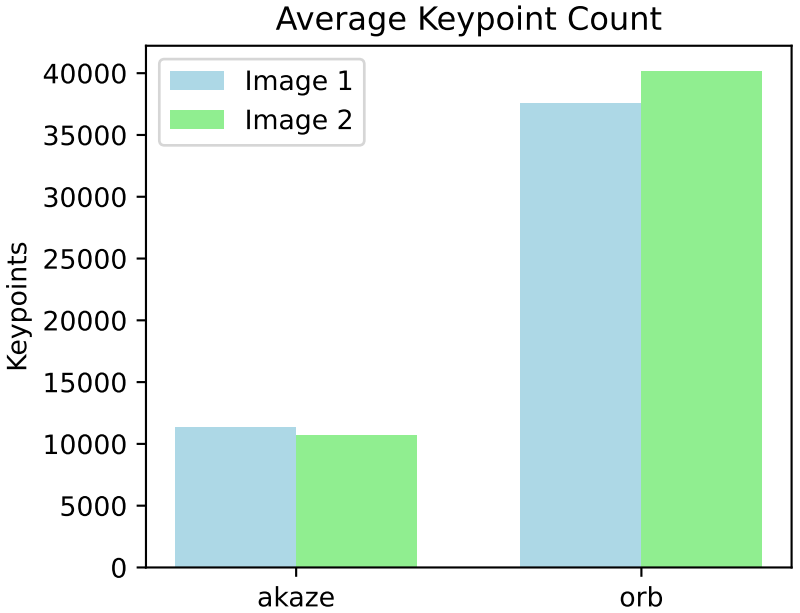


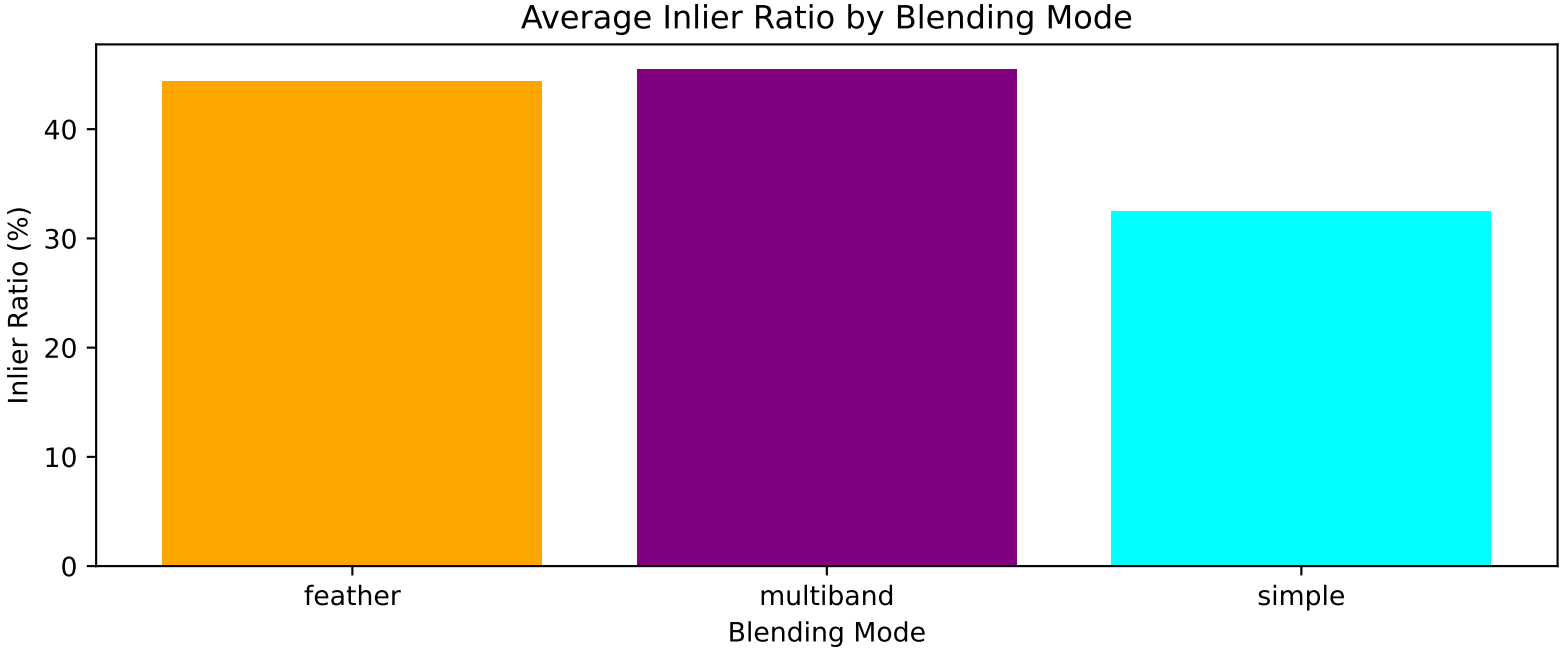
Experimental Results and Analysis











Discussion and Conclusions

Key Findings

1. Feature Detector Performance:
   • ORB: 32/36 successful (88.9%), avg 38882 keypoints
   • AKAZE: 7/11 successful (63.6%), avg 11021 keypoints

2. RANSAC Threshold Impact:
   • Lower thresholds (1.0-2.0) provide stricter outlier filtering
   • Higher thresholds (4.0-5.0) allow more matches but may include outliers
   • Optimal threshold appears to be around 3.0 for most scenes

3. Scene-Specific Observations:
   • Indoor scenes: Higher success with AKAZE due to better corner detection
   • Outdoor scenes: ORB performs well with high keypoint count (50k)
   • Multi-image stitching requires careful parameter tuning

Recommended Configurations

Scene Type	Detector	RANSAC	Blending	Notes
Indoor (structured)	AKAZE	3.0	Feather	Good for corners/edges
Outdoor (textured)	ORB	3.0	Multiband	Fast with many features
Low texture	AKAZE	2.0	Feather	More robust features
Multi-image	ORB	3.0	Multiband	Balance speed/quality

Conclusions

This experimental evaluation demonstrates the importance of parameter tuning in panorama stitching pipelines. Key insights include:

• Feature detector choice significantly impacts both speed and robustness
• RANSAC threshold must balance between outlier rejection and sufficient inliers
• Blending methods show minimal impact on geometric accuracy but affect visual quality
• Multi-image stitching remains challenging, especially with limited overlap

Future improvements could include:
• Adaptive threshold selection based on initial match quality
• Hybrid detector approaches combining ORB speed with AKAZE robustness
• Automatic exposure compensation for better visual consistency