CYLINDRICAL PANORAMA MATCHING

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Abstract

Classical image matching methods such as SURF, SIFT and ASIFT are meant to be used on planar images. SURF and SIFT are partially affine invariant, while ASIFT is fully affine invariant. When we use these methods on cylindrical panoramas, the results are not as good as expected. We present a method inspired by ASIFT that simulates different transformations of the panoramas to be matched and then tries to match them.

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Algorithm

1. Given two panoramas P and P', compute their SURF features.
2. Match P and P' with second nearest neighbour constraint. Store the matches in M.
3. Apply RANSAC on M and store the results in M'.
4. IF $\#M' < tresh$, define the set of directions Θ (respectively Θ') with highest SURF features density in P (respectively in P').
5. Apply "Plane Features Matching" with P, P', Θ and Θ' and store the results in M''.
6. Apply RANSAC on $M \cup M''$.

References

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Why is it difficult?

- Straight lines that are not vertical do not appear as straight lines on a cylindrical panorama.
- Affine transformations are not well defined on cylindrical panoramas.
- Urban scenes do not necessarily contain a lot of buildings.
- If we extract planar fields of view images from the panoramas, we need a criterion to select relevant ones.

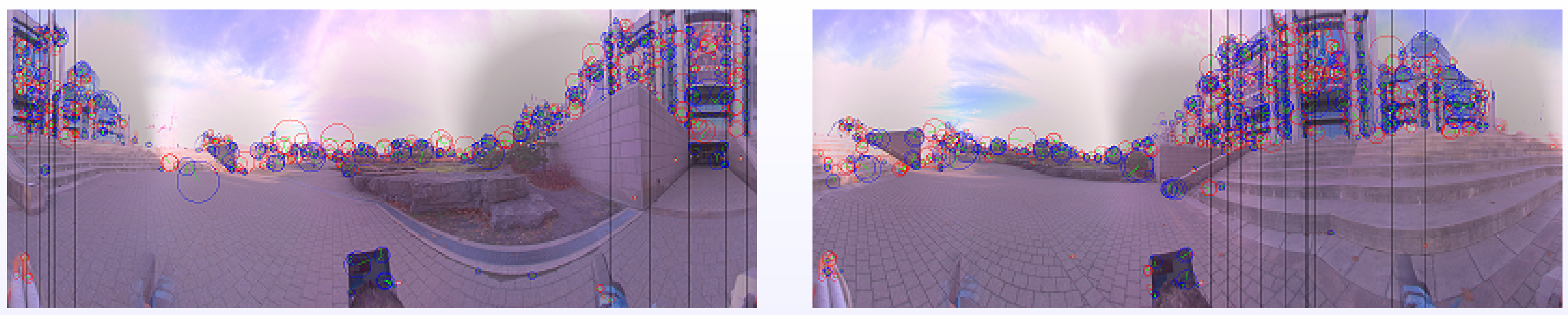
Tangent Plane Technique

1. Given a panorama P and a direction θ, let Π_0^θ be the plane tangent to P at θ.
2. Let Π_α^θ be obtained from Π_0^θ by a rotation of angle α with respect to the axis defined by the tangential line at θ.
3. Given a restricted field of view centered at θ, project P onto Π_α^θ for $-\frac{\pi}{3} \leq \alpha \leq \frac{\pi}{3}$.
4. Compute the SURF features on all Π_α^θ's.

Plane Features Matching

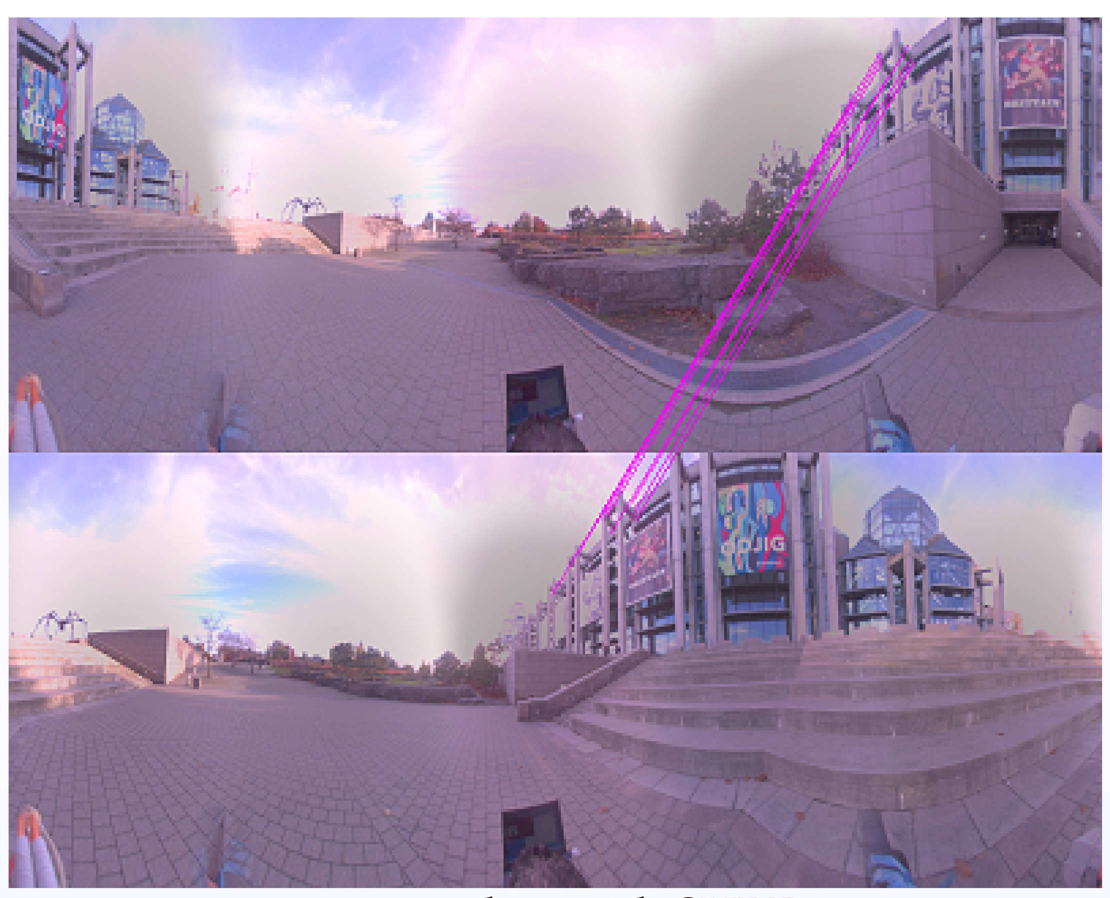
1. Given two panoramas P and P', let Θ and Θ' be two sets of directions.
2. For each $\theta_i \in \Theta$,
   2.1 match $\Pi_0^{\theta_i}$ with all $\Pi_\alpha'^{\theta'}$'s ($-\frac{\pi}{3} \leq \alpha \leq \frac{\pi}{3}, \theta' \in \Theta$).
   2.2 Store the matches of the best pair (θ_i, θ').

SURF Features Detection

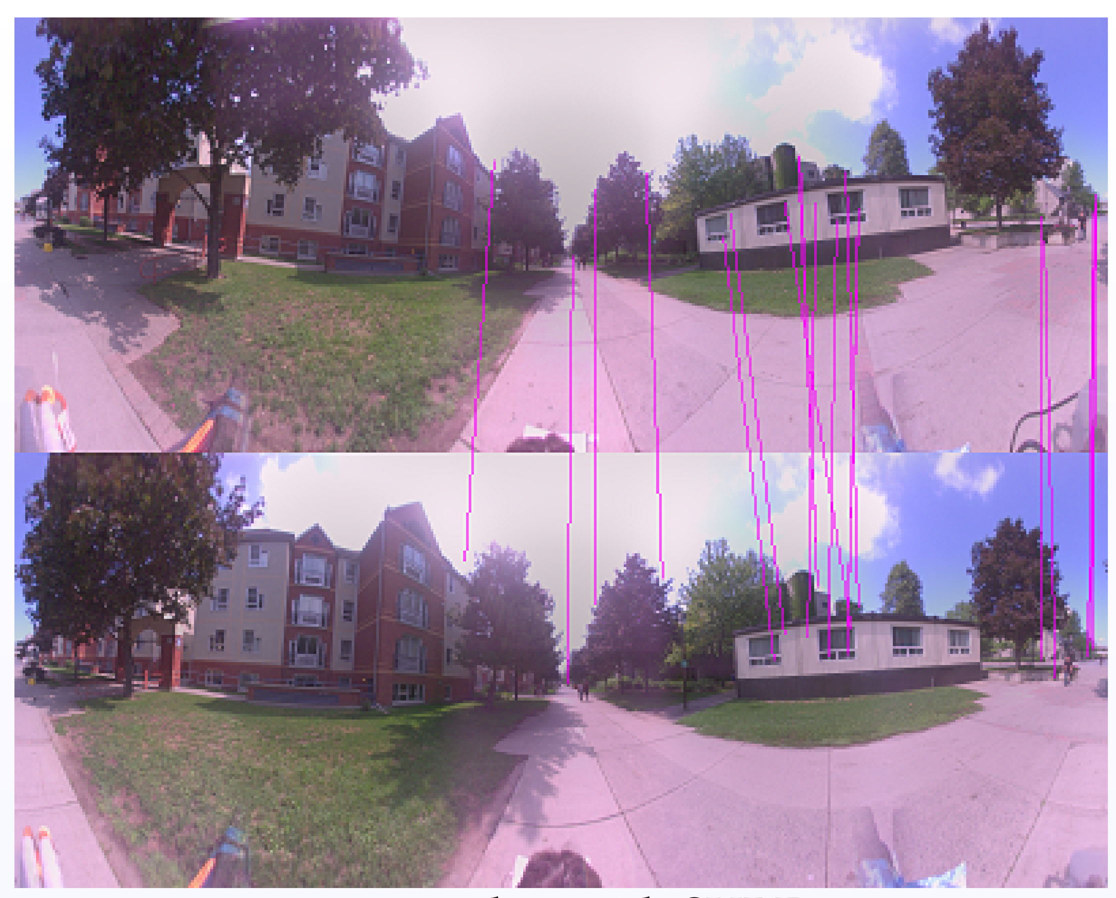


Directions of high SURF features density are identified by a vertical line.

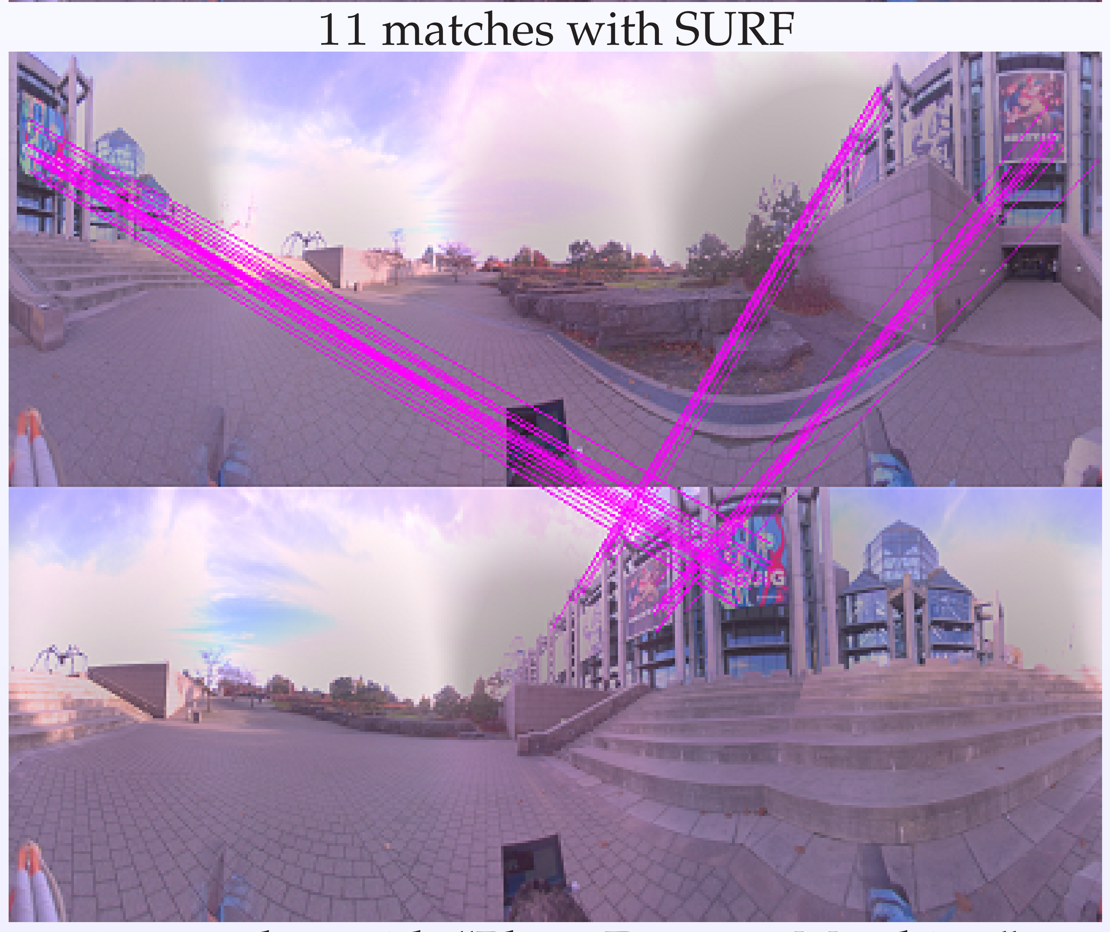
Example



11 matches with SURF



19 matches with SURF



73 matches with "Plane Features Matching"

44 matches with "Plane Features Matching"