



ORB Feature Detection

By Ian Hudis

ORB Overview

- *A type of feature detection technique*
- *ORB is a combination of the Oriented FAST key point detector, a Harris Corner Detector, and a Rotated BRIEF*
- *Oriented fast, Rotated Brief*

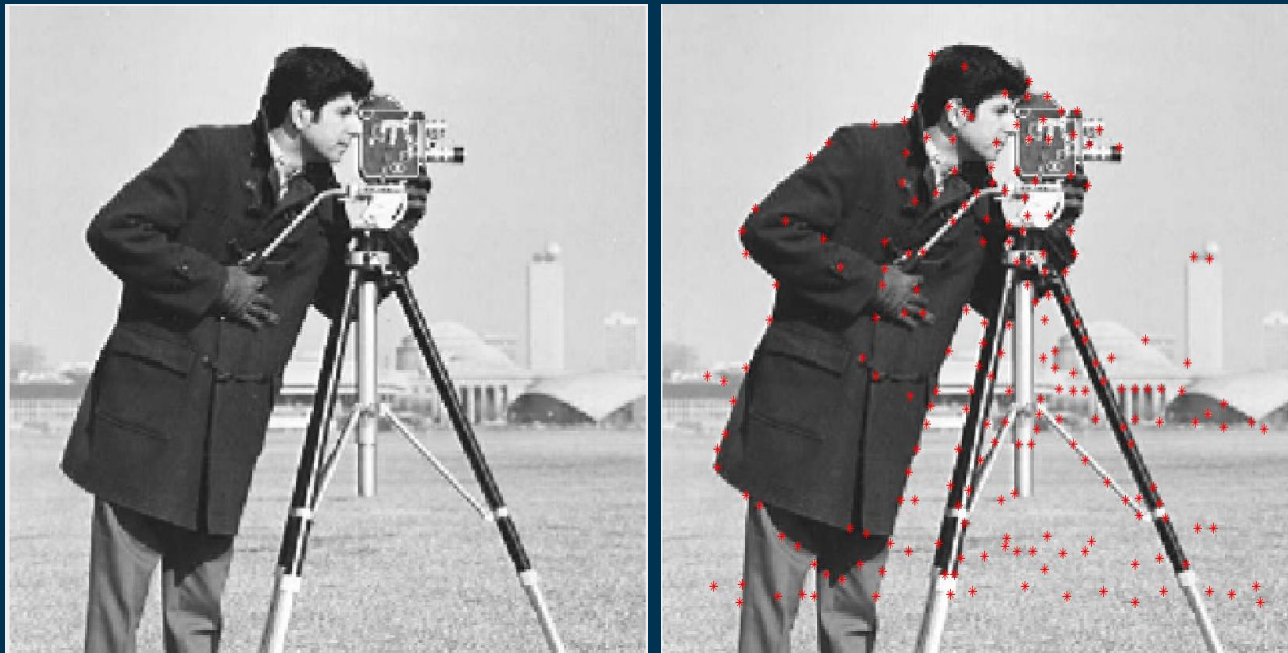
Comparison to other Types

- -Pros
 - *It is computationally faster than SIFT and SURF*
 - *Can sometimes be more efficient than BRISK*
- -Cons:
 - *ORB is less scale invariant than SIFT and SURF.*

Finding ORB Points



- FAST in this flowchart also incorporates the Harris Corner Detection

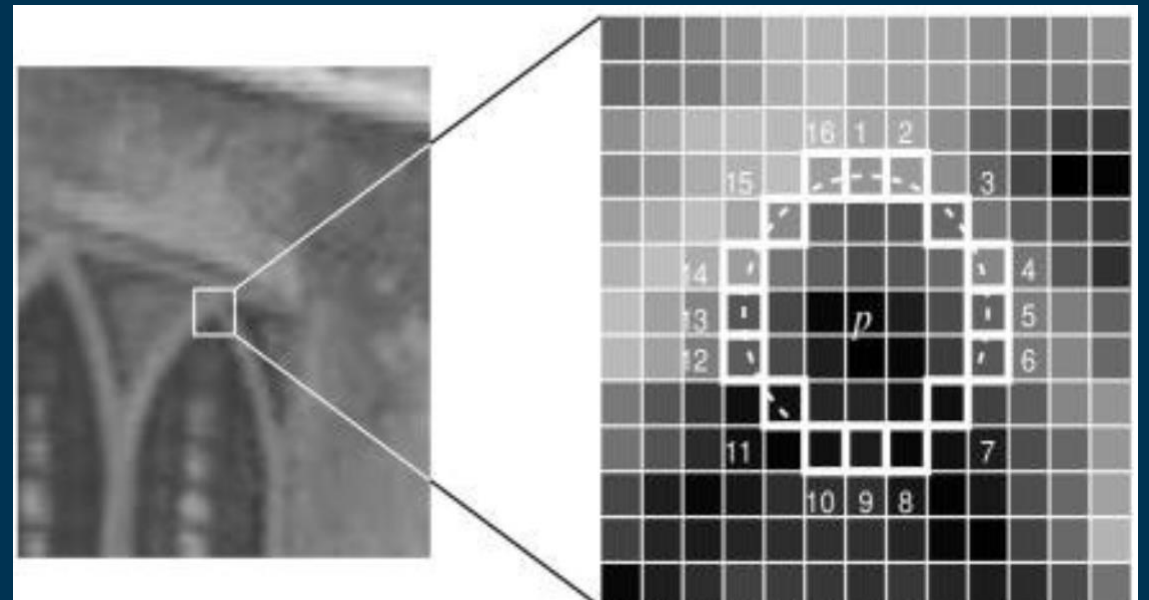


FAST

- Edge detector that works by comparing pixels with each other and separates them into categories using threshold value T.

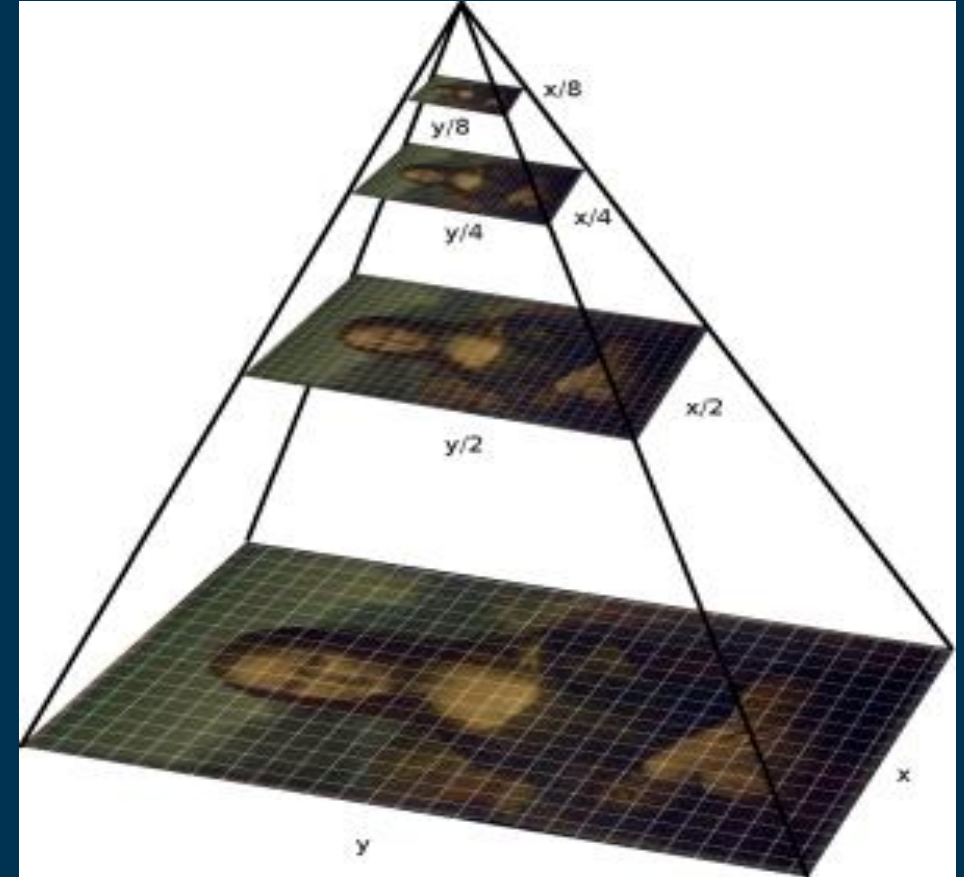
$$S_{p \rightarrow x} = \begin{cases} d, & I_{p \rightarrow x} \leq I_p - t & \text{(darker)} \\ s, & I_p - t < I_{p \rightarrow x} < I_p + t & \text{(similar)} \\ b, & I_p + t \leq I_{p \rightarrow x} & \text{(brighter)} \end{cases}$$

- You also need a Harris Corner detector since Fast only finds edges.



FAST

- Part of ORB's FAST process can be thought of as using a multiscale image pyramid.
- Each level of the pyramid has different resolutions
- Stores different fast points for each level
- limited **Scale Invariance**



Orientation

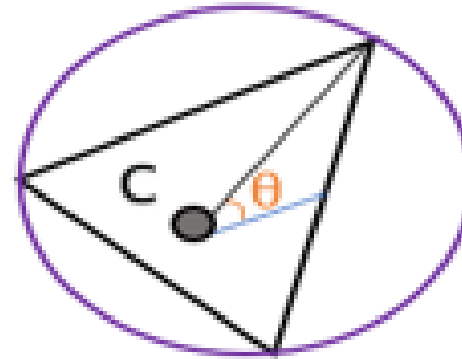
- Occurs once edges and corners are found
- The purpose of this is to find the angles of the corners

$$m_{pq} = \sum_{x,y} x^p \cdot y^q \cdot I(x,y)$$

$$C = \left(\frac{m_{10}}{m_{00}}, \frac{m_{01}}{m_{00}} \right)$$

$$\theta = \text{atan2}(m_{01}, m_{10})$$

Corner Circle

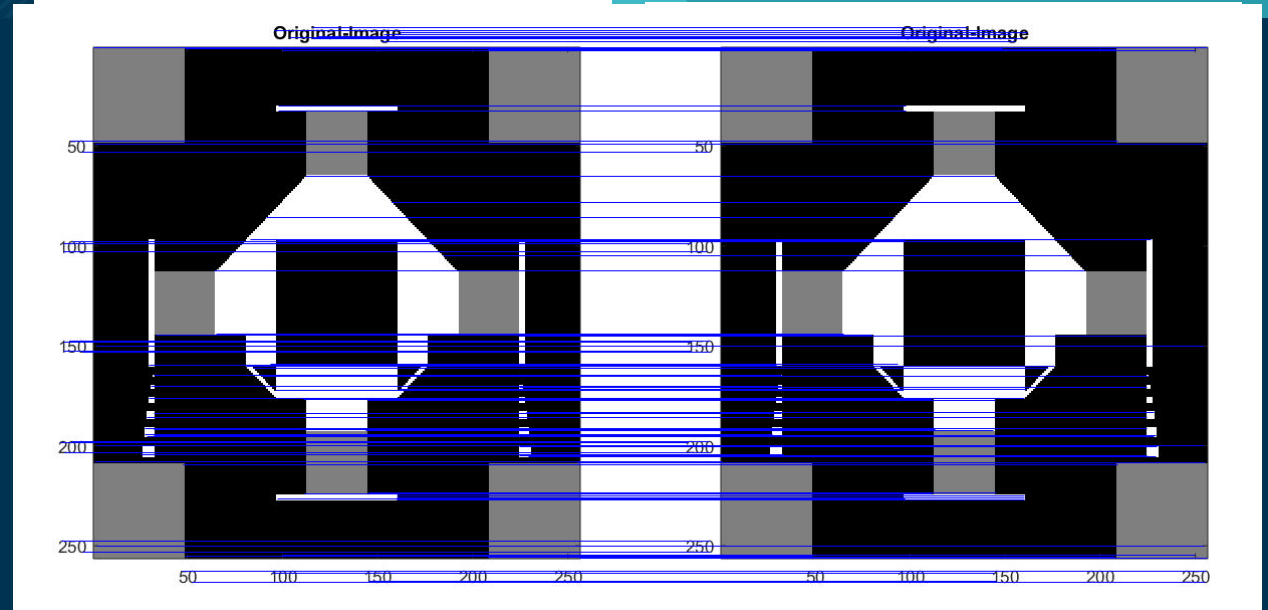


Rotated Brief

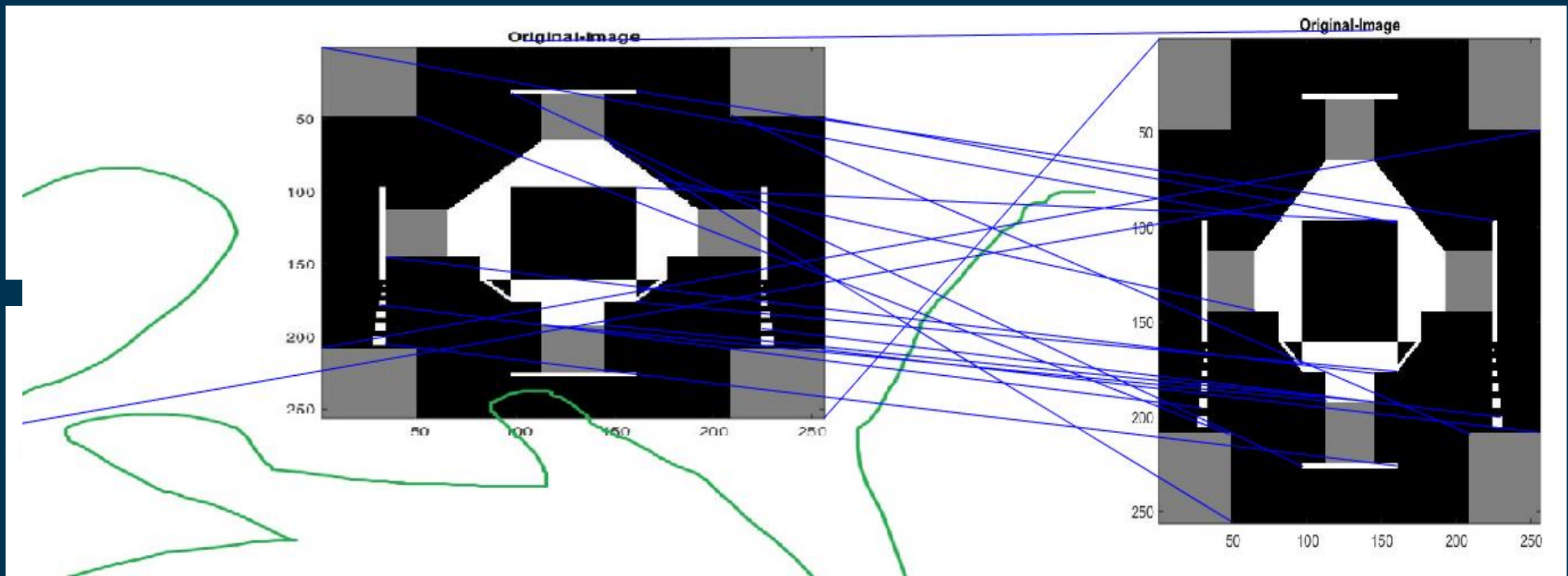
- A BRIEF in image processing is a description composed of a string of binary values.
- The problem with normal briefs is that they are computationally expensive and slow in performance.
- A Rotated Brief takes the angles that were found in the orientation process and then uses them to find the rotations at which the input images' corners were located.
- For each corner, two rotational brief estimations were found with the same input angle.
- By using these angles, the rotational brief could pick out key points of an image without having to scan every single patch of pixels which makes the process significantly more efficient.

ORB Feature Detection

- Finds the ORB points on 2 images and then compare them to see Feature Detection.
- Can be more than 2 images.



ORB Feature Detection



Applications of the ORB Feature Detector

Testing ORB with real world applications.

Image Threading Application

Oversaturated Cameraman

Dark and Blurry Cameraman

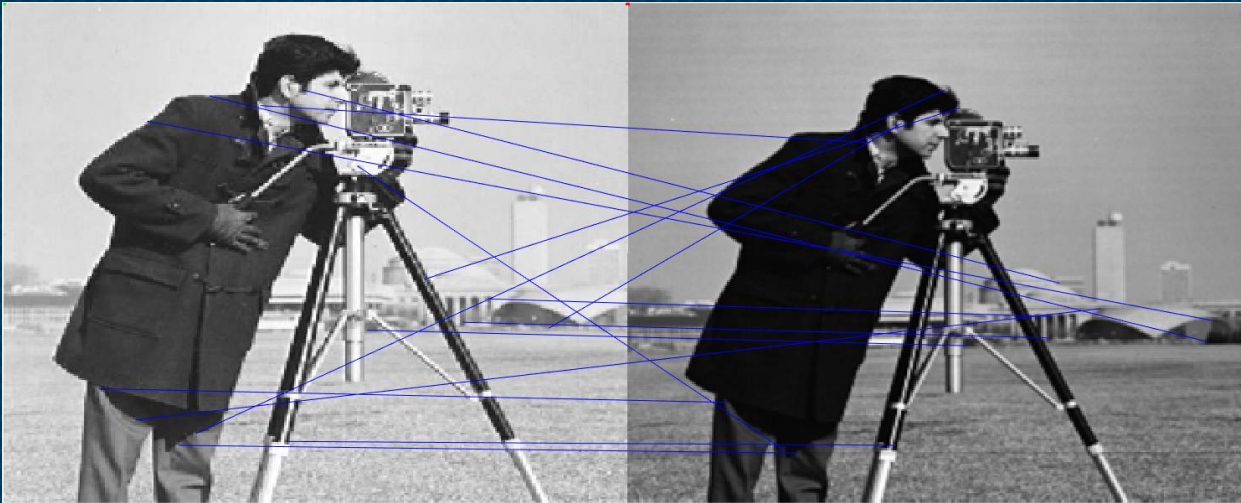


Image Stitching Result



Facial Detection

Section from Professor Index



- The goal here is take to see how well ORB can recognize a person's face.

A zoomed in frame from camera footage.



Facial Detection

What we Are Looking Into



What we Are Looking For



The Matched feature between the two images



Facial Detection

- Notice the distortion is only on the right side of the face.



References

- -Ethan, R., Rabaud, V., Konolige, K. and Bradski, G.
(2017). http://www.willowgarage.com/sites/default/files/orb_final.pdf.
- -Mordvintsev , Alexander. “ORB (Oriented FAST and Rotated BRIEF)¶.” *OpenCV*, 2013, https://opencv-python tutroals.readthedocs.io/en/latest/py_tutorials/py_feature2d/py_orb/py_orb.html.
- - Tyagi, Deepanshu. “Introduction to ORB (Oriented FAST and Rotated BRIEF).” *Medium*, Medium, 29 May 2019, medium.com/@deepanshut041/introduction-to-orb-oriented-fast-and-rotated-brief-4220e8ec40cf.

Any Questions?



**Thank you and have a
good break!**