# ELE510 – Project 6 Feature Descriptors

Comparison of SIFT, FAST + BRIEF and ORB

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SIFT Feature Description

SIFT = Scale Invariant Feature Transform

➢ Divide neighborhood into cells

➢ Histogram on gradient direction to find primary orientation

➢ Summarize 4x4 cells into 8-bin orientation histogram

➢ Repeat for 16 windows

   → 128dim feature vector

➢ Scale & rotation invariant
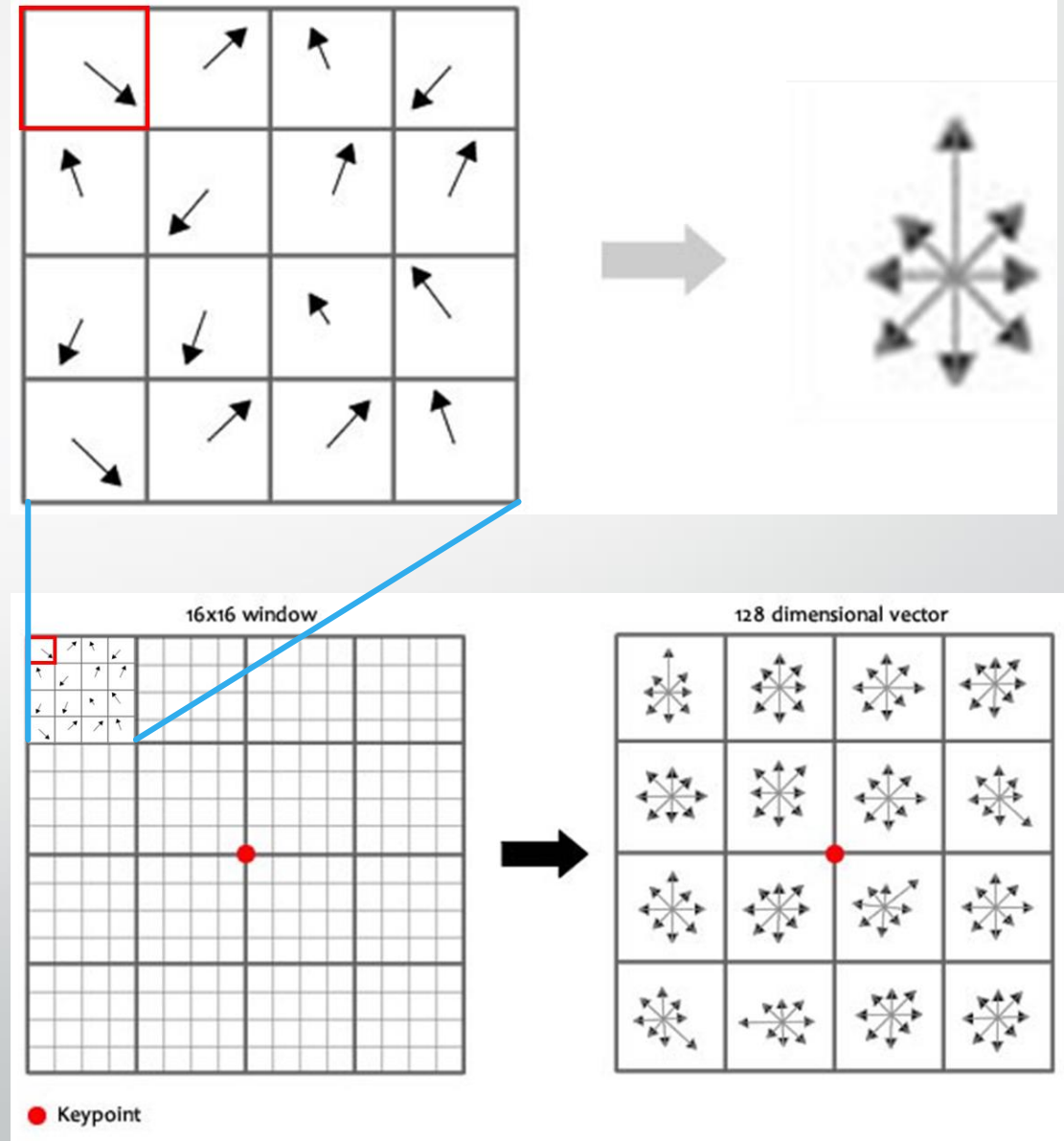
SIFT on Chessboard

➢ 4 keypoints in center of 4 central black squares (global features)

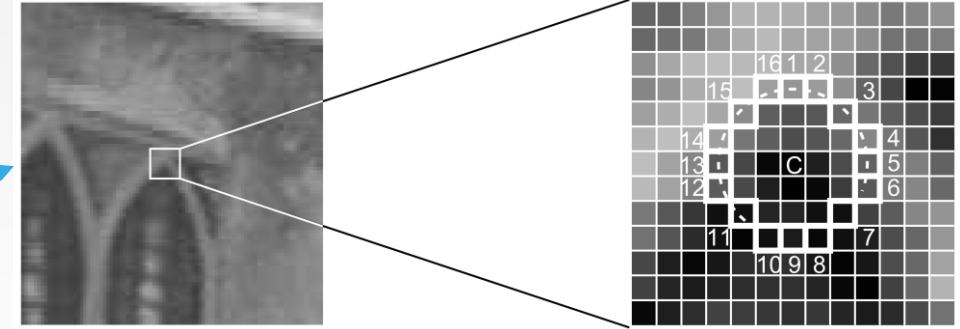➢ Orientation vector pointing towards strongest gradient (edges)
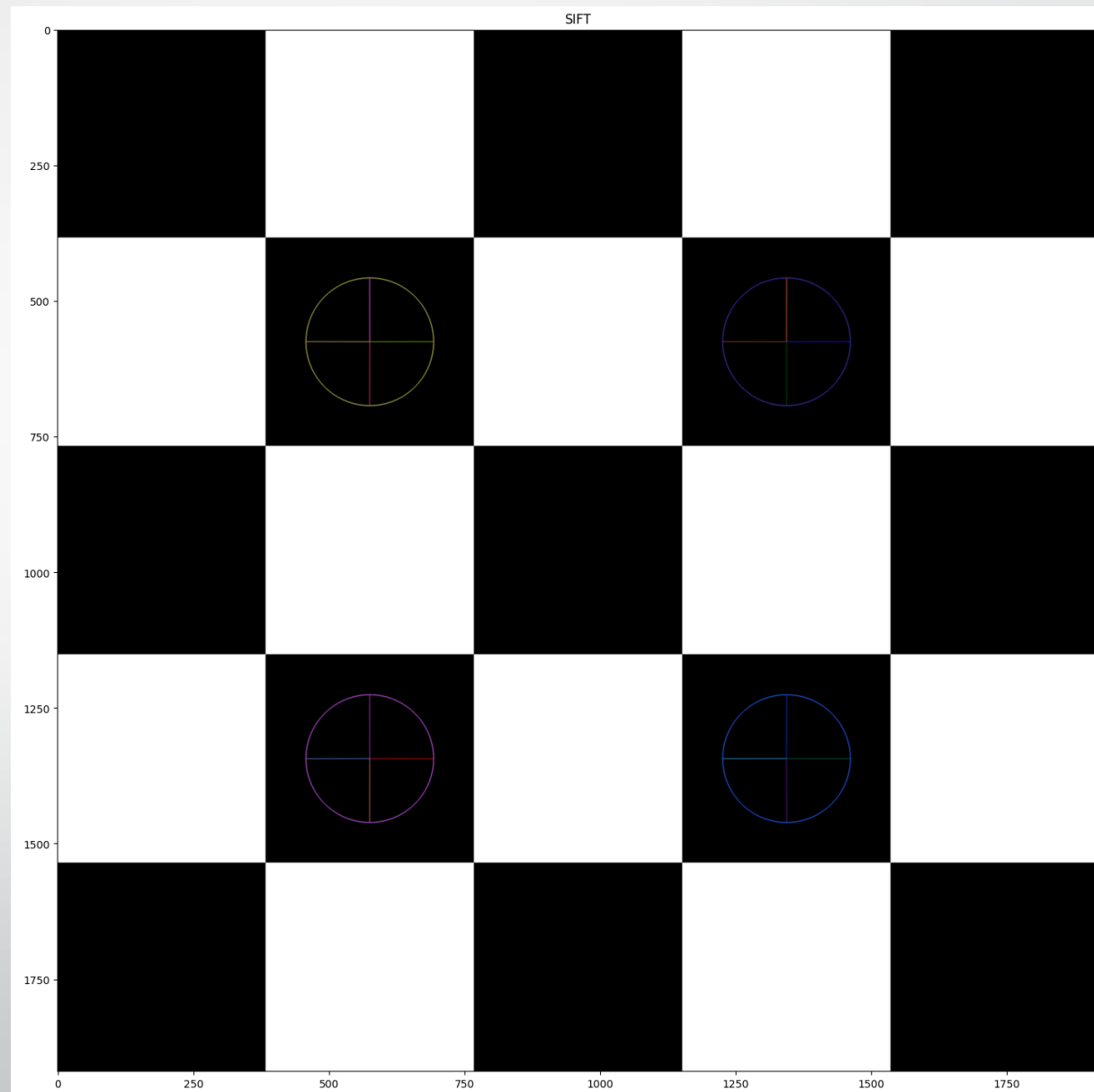
649 ms ± 82 ms per loop (mean ± std. dev. of 7 runs, 1 loop each)

BRIEF Feature Description

FAST = Features from Accelerated Segment Test

***BRIEF = Binary Robust Independent Elementary Features***

➢ Feature detection (e.g. using FAST)

➢ Pre-smoothing using Gaussian

➢ Use sampling geometry to find binary test pairs (pixels) in neighborhood

➢ Compare intensity of pixel pairs ➔ 0 or 1

➢ Combine into binary string ➔ descriptor

➢ Not scale/rotation invariant!

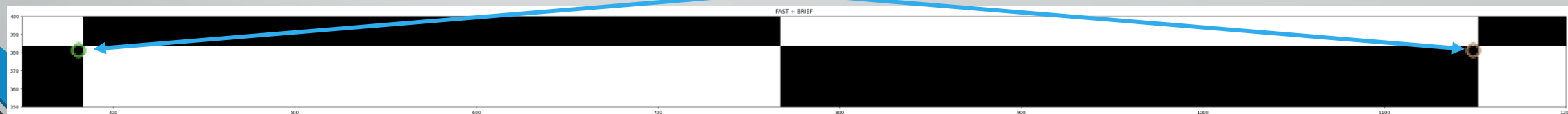
G I   G II   G III

G IV   G V
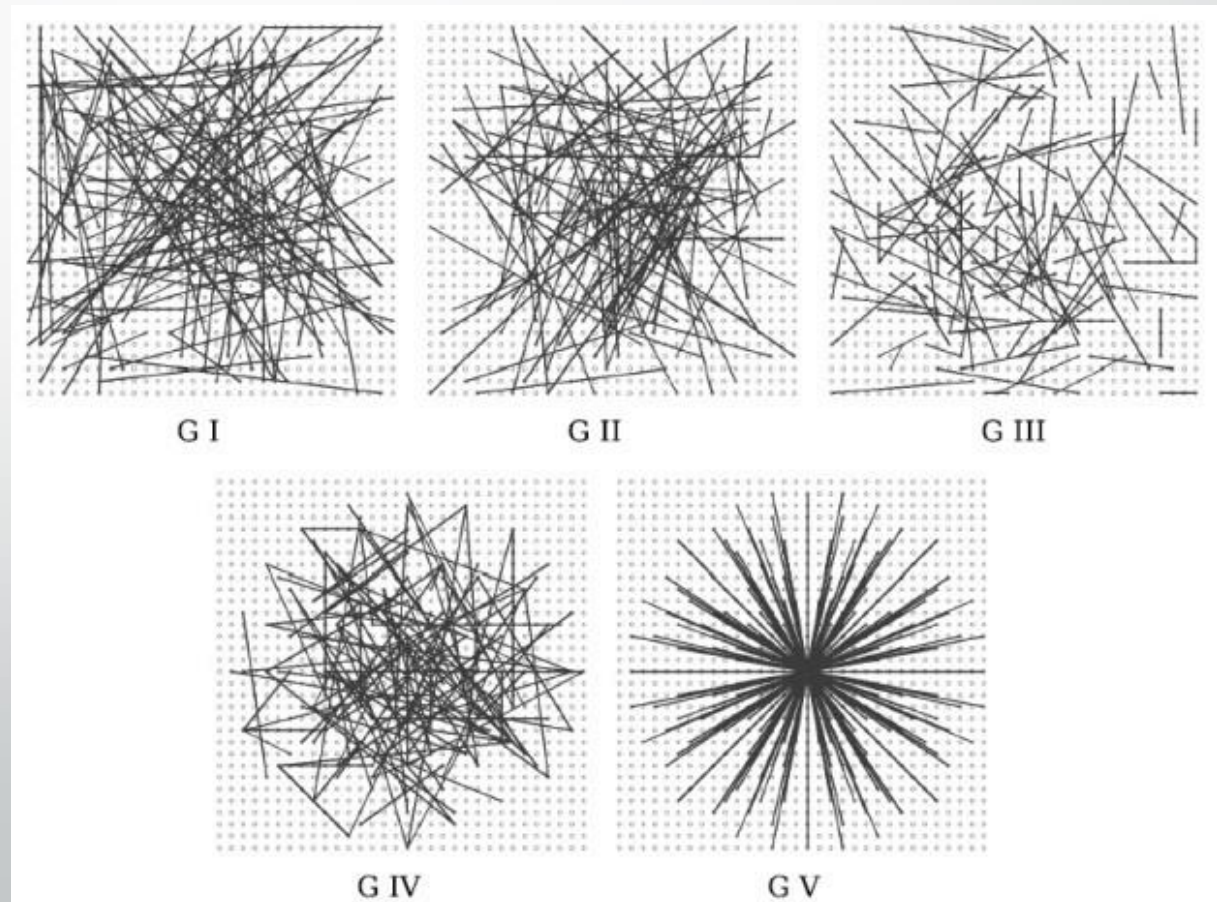
FAST + BRIEF on Chessboard

- ➤ Feature in each corner of each square
- ➤ Descriptors for features in repeating corners identical
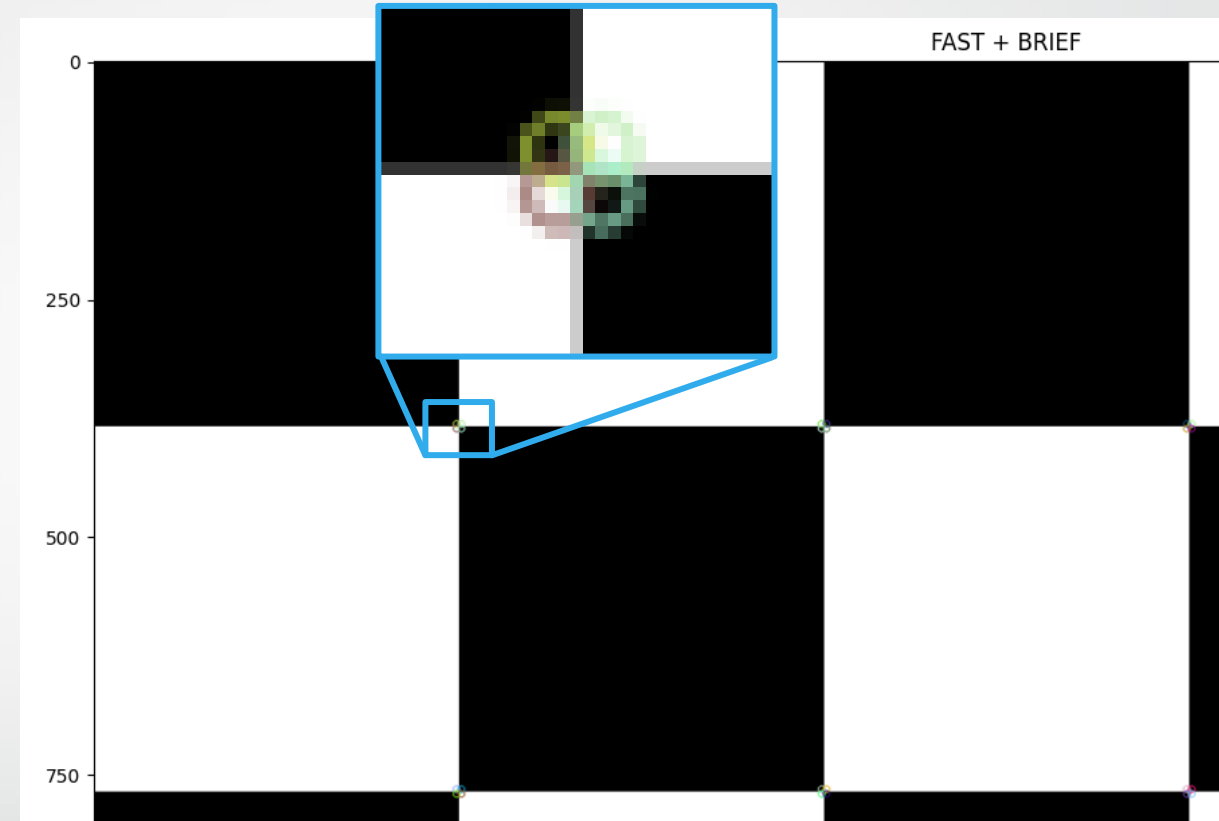

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[224 234    4 138   52 237 214 103 157 202   85 135   75   40 223 181
 82   51 159   76 111 103   26 213 196   33   76 160   65 186 239 199]
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7.02 ms ± 542 μs per loop (mean ± std. dev. of 7 runs, 100 loops each)
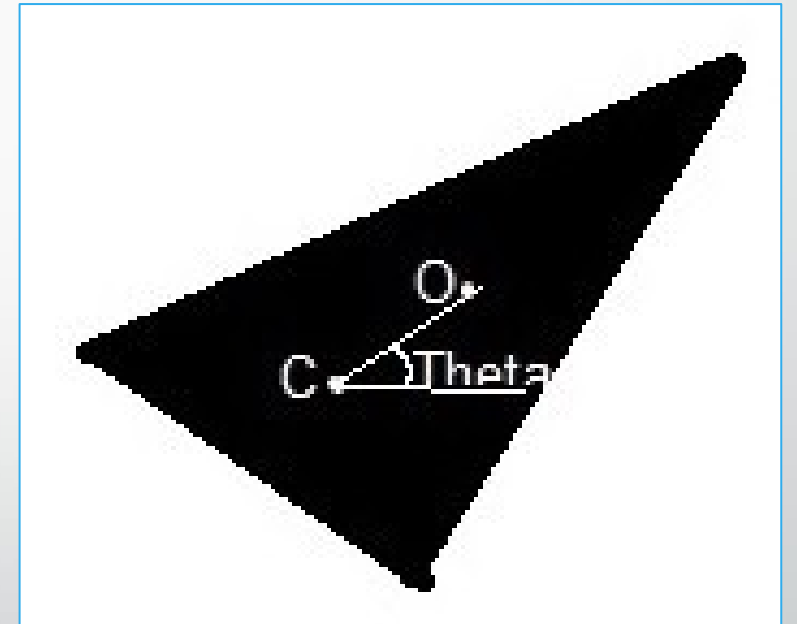
ORB Feature Description

ORB = Oriented FAST and Rotated BRIEF

Scale invariance:

➤ FAST on multiscale pyramid
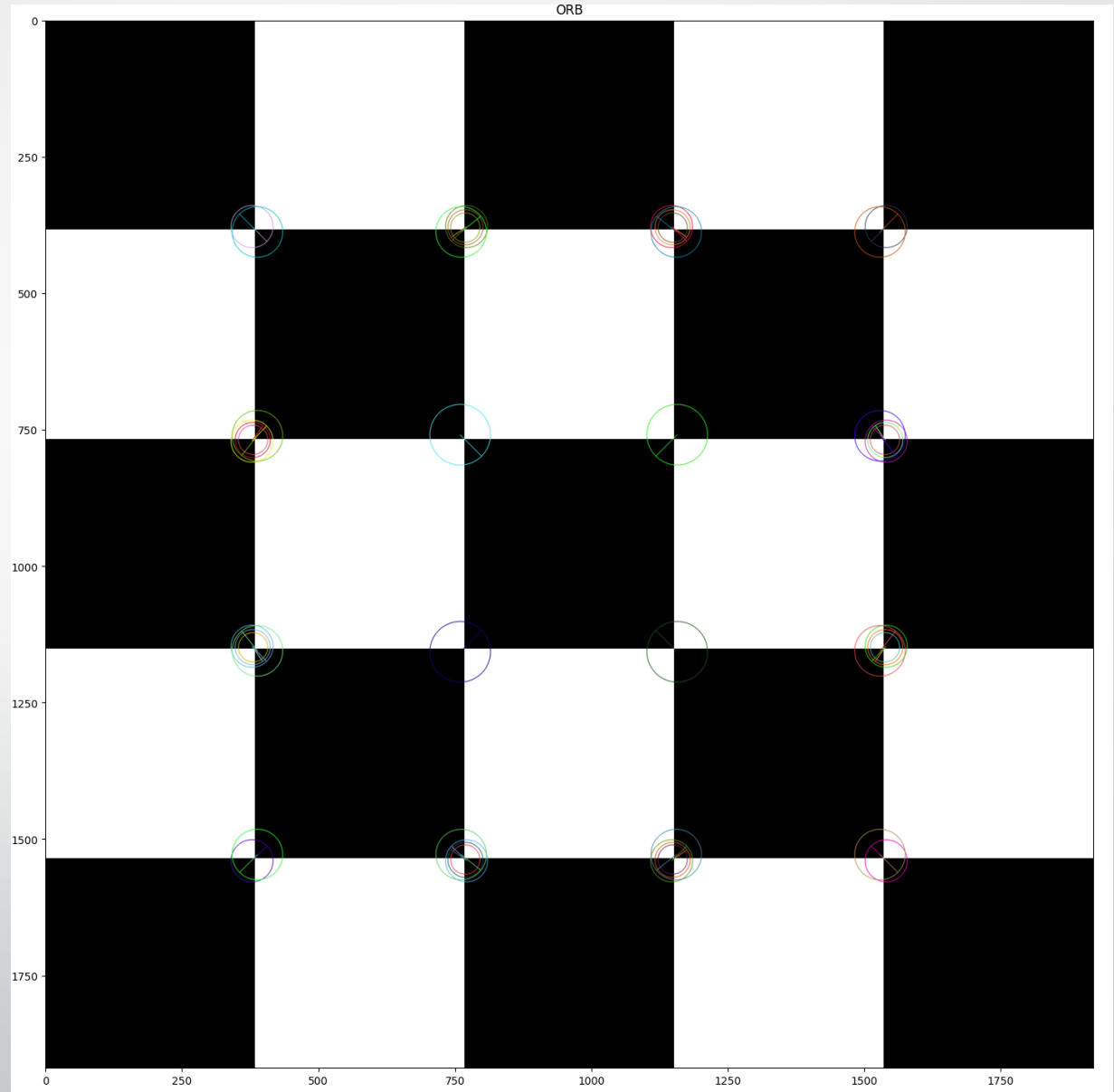
➤ Harris Corner Measure → Top n features

Rotational invariance:

➤ Intensity weighted centroid → Primary orientation

➤ Rotate sampling geometry (BRIEF)

ORB on Chessboard

- ➤ Feature locations same as FAST
- ➤ Orientation vector points to center of intensity

ORB

27.9 ms ± 2.7 ms per loop (mean ± std. dev. of 7 runs, 10 loops each)

ORB on Real Photograph