

AprilTag 2: Efficient and Robust Fiducial Detection

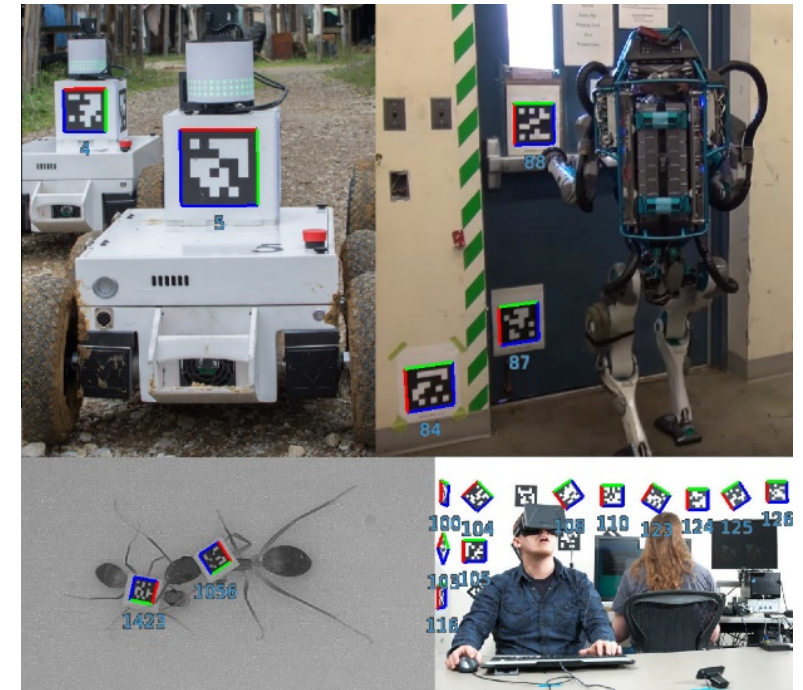
J. Wang and E. Olson, “Apriltag 2: Efficient and robust fiducial detection,” in 2016 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), pp. 4193–4198, IEEE, 2016.

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Outline of AprilTags

- **Free and open source visual fiducial system developed by the APRIL Robotics Lab of the University of Michigan**
- **2D bar code style “tag” similar to the QR code**
- **Allowing full 6-DOF localization of features from a single image**
- **Useful for augmented reality, robotics, and camera calibration**



Tag Detector



(a) Original image



(b) Adaptive thresholding



(c) Segmentation



(d) Detected quads



(e) Tag detections

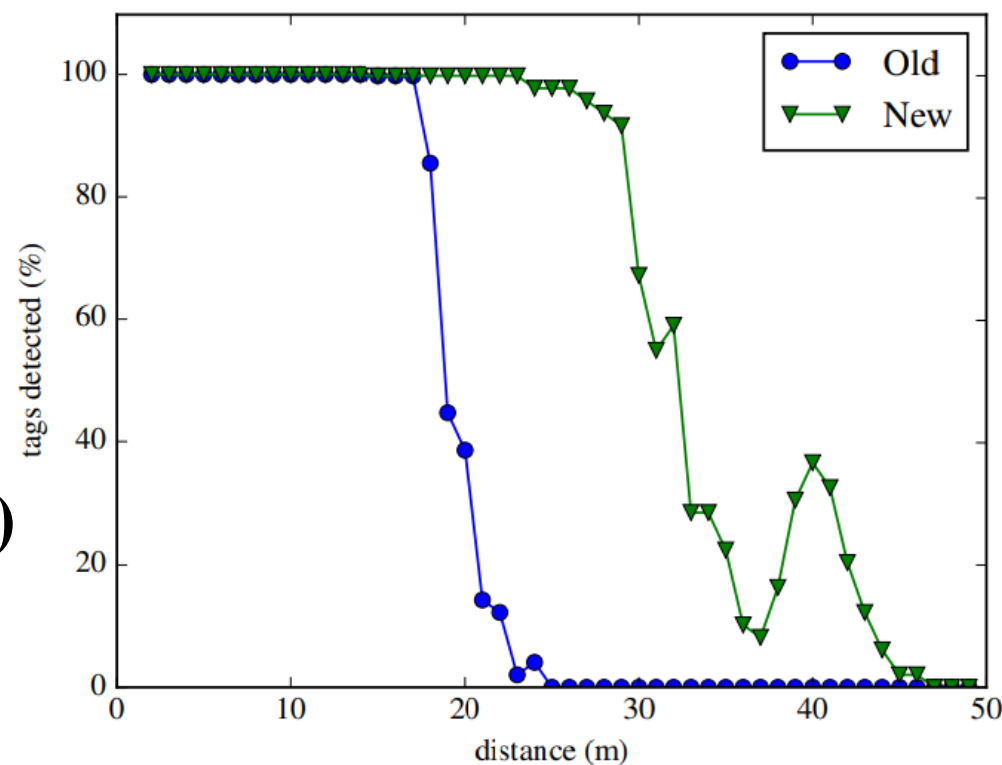
Coding System

- **Based on a near-optimal lexicode**
- **Reading the bits from the payload field**
- **Computing the tag-relative coordinates of each bit field**
- **Transforming them into image coordinates using the homography**
- **Spatially-varying thresholding the resulting pixels**

Advantages of AprilTag 2

- Improving robustness and efficiency to lighting conditions and view angles
- Higher detection rates
- Fewer false positives
- Lower computational time (78 ms versus 115 ms , for a 640×480 image)

	Candidate quads	False detections	False positive rate
Old	51,075,971	145	0.000284%
New	13,623,725	6	0.000044%

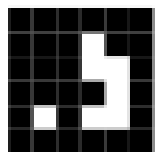


AprilTag 3

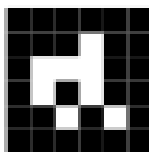
- Including a faster ($>2\times$) detector, bundle detection
- Improved detection rate on small tags, flexible tag layouts, and pose estimation
- Apriltag_ros package, choosing tag36h11 family

tag16h5

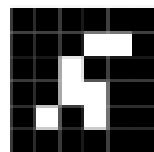
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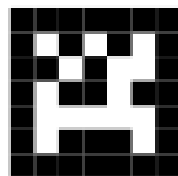


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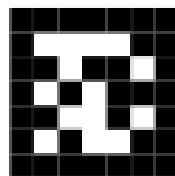


tag25h9

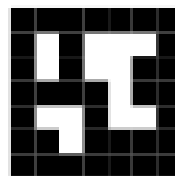
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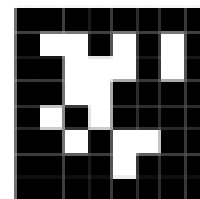


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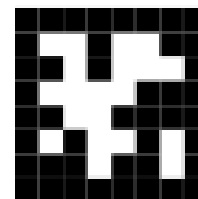


tag36h11

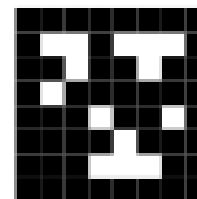
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1



2



Correlations of the Project

- **Localization of the tube holder**
- **Pose estimation of the centrifuge tube and the screw lid**

