



Marker Tracking with OpenCV (Group: 10)

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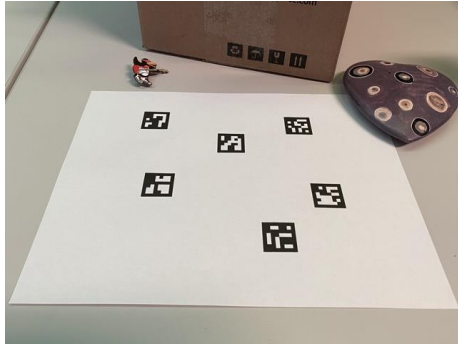
Technische Universität München



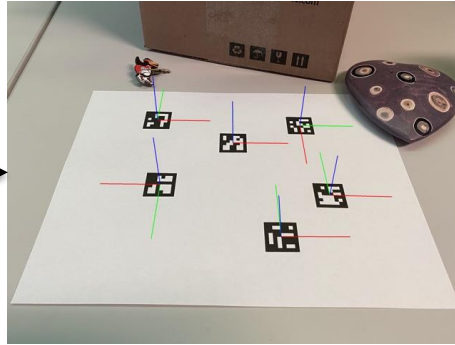
JOHNS HOPKINS
WHITING SCHOOL
of ENGINEERING

Marker Tracking - Objective

Input Image



Marker Detection
Pose Estimation



Virtual Object Overlay



Marker Detection

Input Image

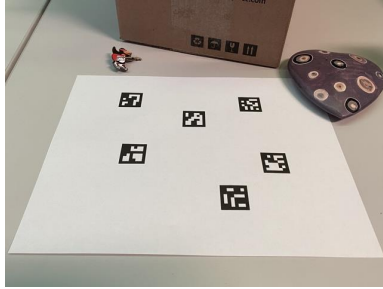
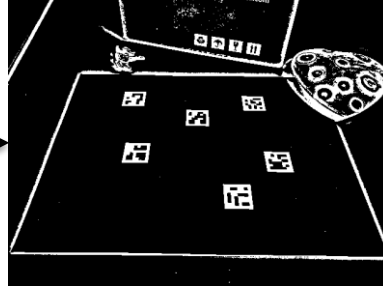
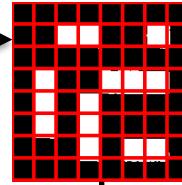


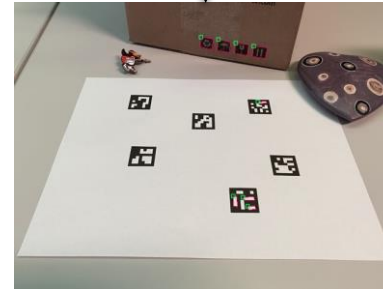
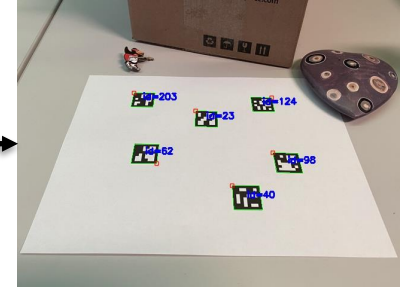
Image Processing
(Thresholding, Contours)



Matching
(Perspective removing,
Bits extraction)



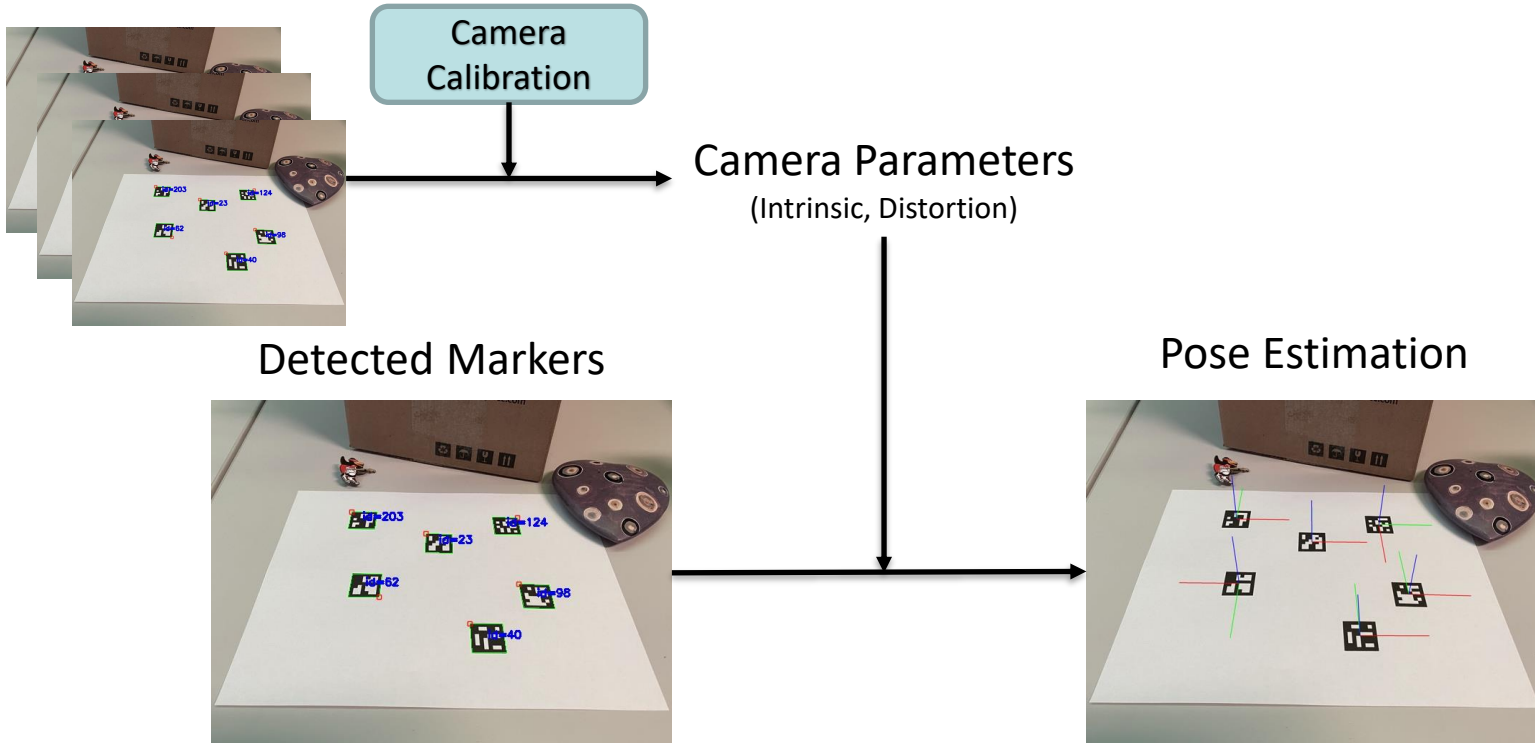
Detected Markers



Rejected Candidates



Pose Estimation



Integration with Unity

DLL creation

Used as Unity plugin

**Pose
Conversion**

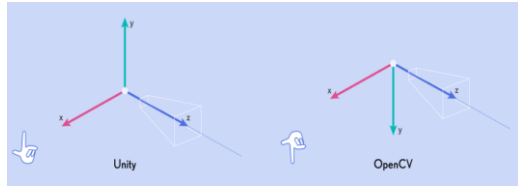
OpenCV to Unity

**Camera and Object
Simulation**

For virtual object overlay in Unity

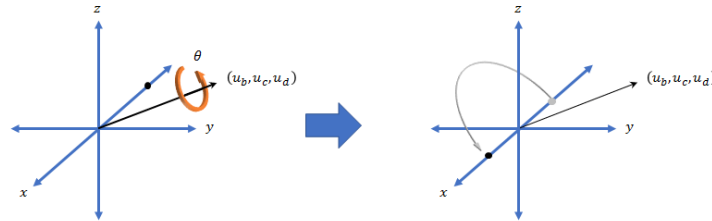


Integration with Unity - Pose



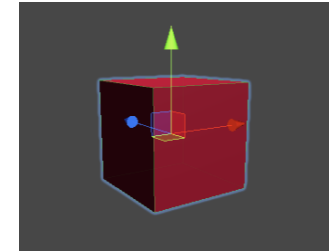
Co-ordinate system

(Transform from right-hand to left-hand)



Rotation representation

(Axis-angle to quaternion)



Local transformation

(Marker to Object Centre for virtual objects to appear on top of marker)



Integration with Unity - Camera

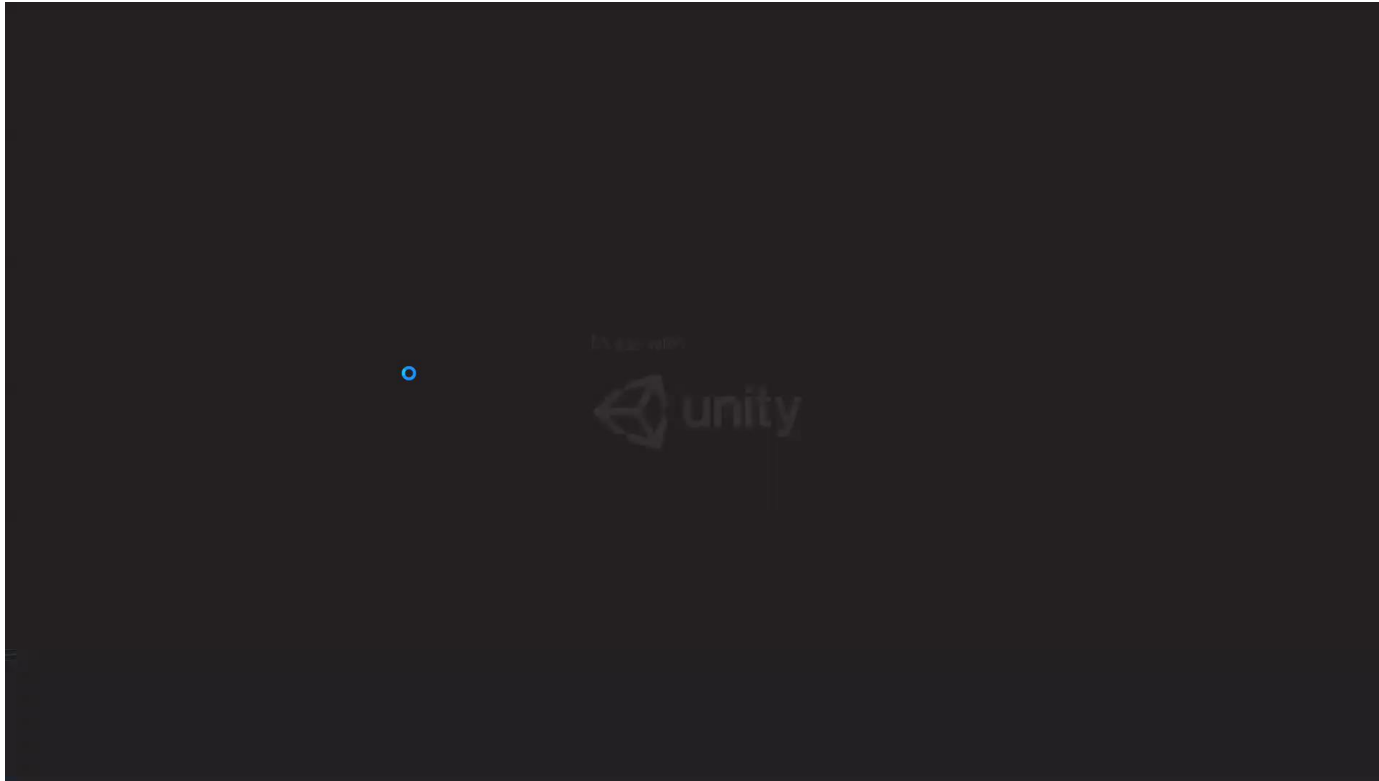


Single camera used for both virtual objects and image

- Simulate unity camera using intrinsic parameters
 - Distortion is ignored



Marker Tracking - Demo

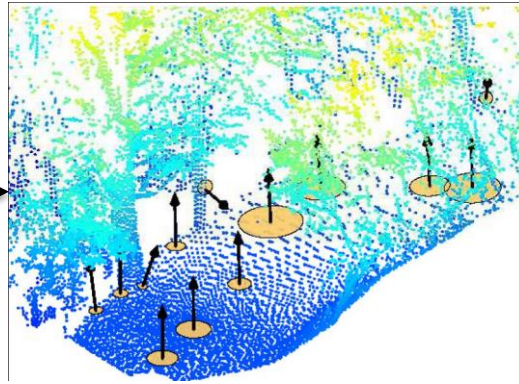


Markerless AR - Objective

RGB-D Camera
(Point Cloud)



Surface Normals

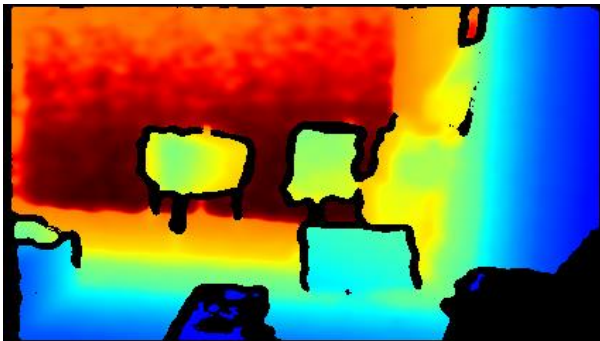


Virtual Object Overlay

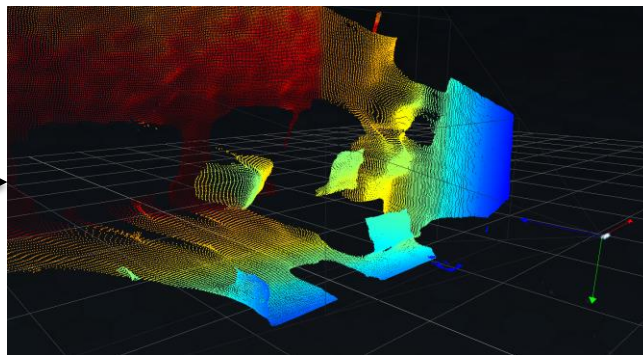


Surface Normals - Computation

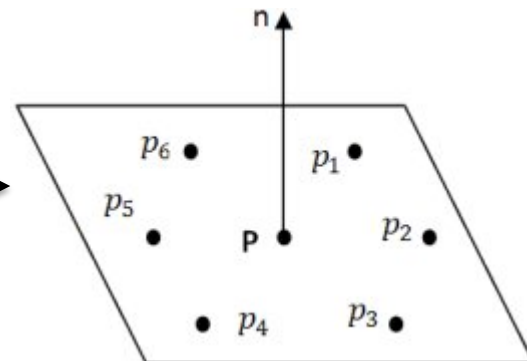
Align Depth Image to Color Image



Point Cloud Computation



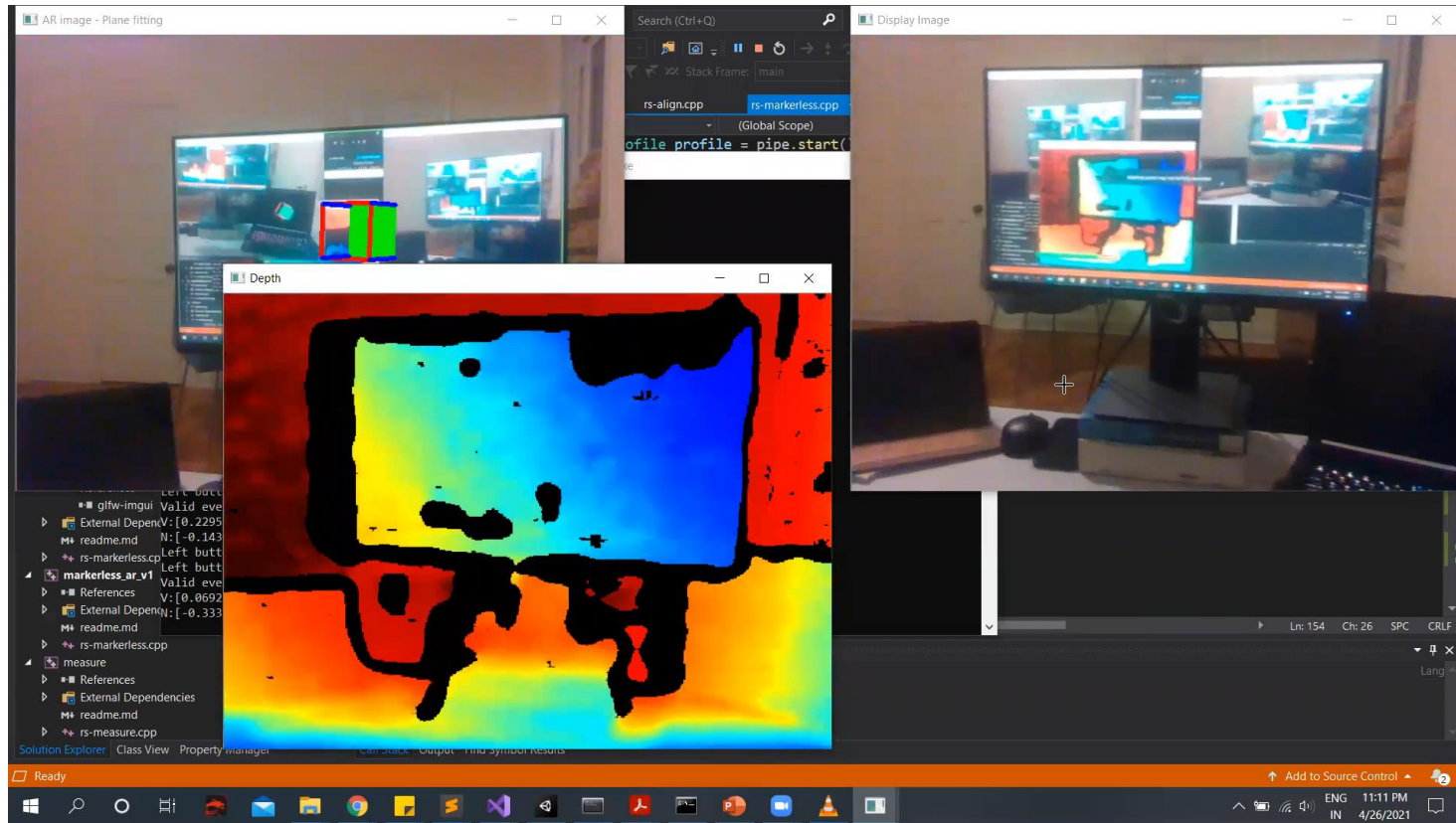
Plane fitting
(Least-squares plane fit on
nearest neighbors of query point)



Markerless AR - Demo



Markerless AR - Demo



Markerless AR – Non-static Camera



R and T is used for transforming pose of objects in previous frame to current frame





Thank You!

References

- https://docs.opencv.org/master/d5/dae/tutorial_aruco_detection.html
- <https://medium.com/comerge/what-are-the-coordinates-225f1ec0dd78>
- https://www.mathworks.com/help/robotics/ref/quaternion.html?s_tid=mwa_osa_a
- <https://www.cs.cmu.edu/~./hebert/scale.htm>
- https://www.researchgate.net/publication/262290525_Accurate_and_fast_extraction_of_planar_surface_patches_from_3D_point_cloud
- https://dev.intelrealsense.com/docs/code-samples?_ga=2.150342835.466639750.1619284241-727732183.1617202949

