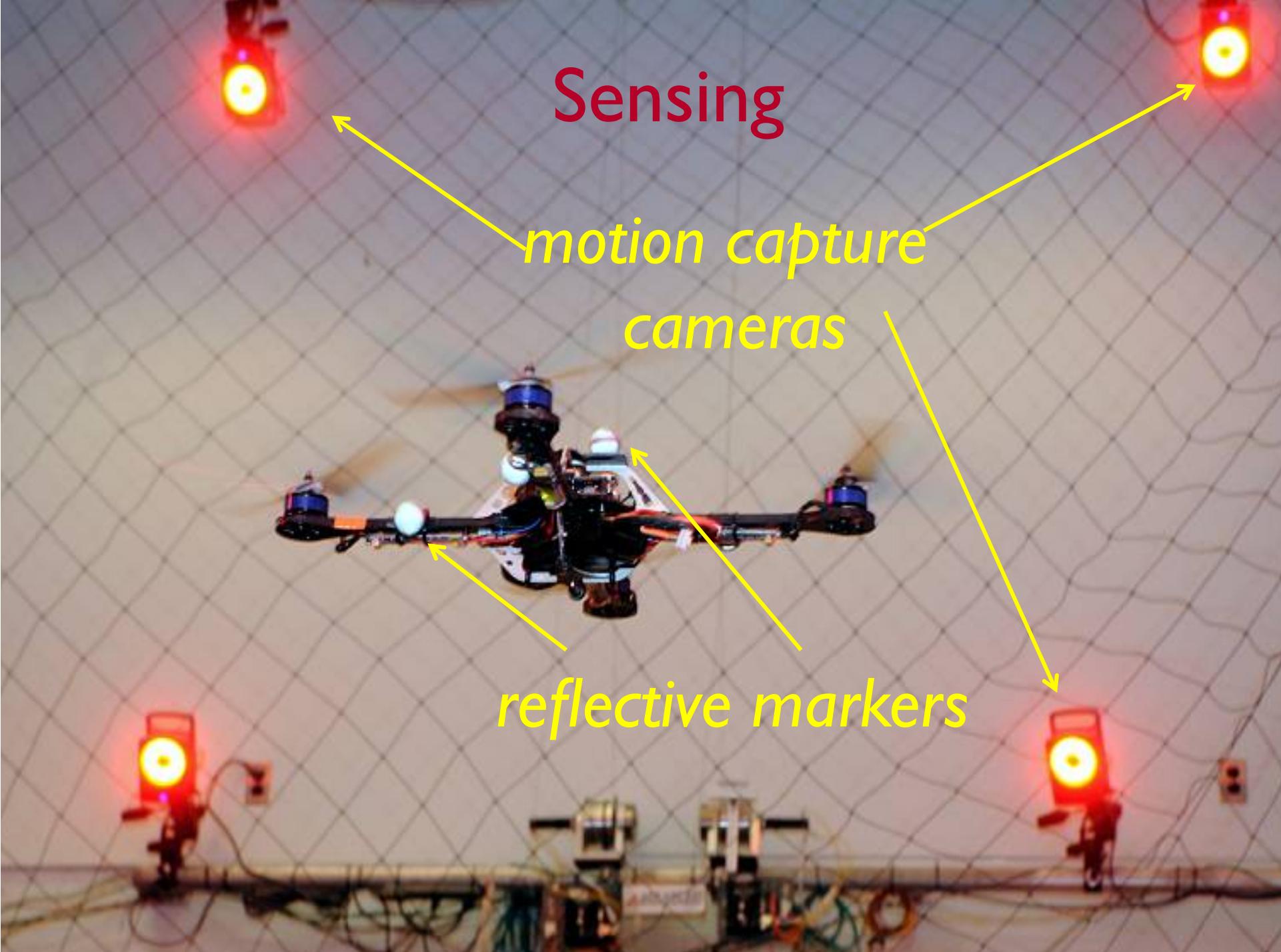


State Estimation

*obtain reliable estimates of
position and velocity*



Sensing

*motion capture
cameras*

reflective markers



X-47B Wins Popular Mechanics Magazine 2013 Breakthrough Award

Photograph by Joe McNally



Unreliable GPS



Operate indoors and outdoors

No GPS

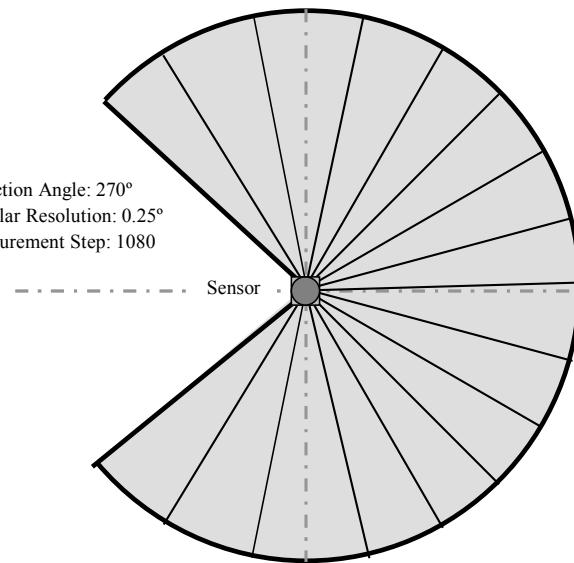
Small, maneuverable

Agile, fast

How to navigate without GPS or external motion capture cameras?



Hokuyo UTM-30LX
Scanning Laser
Rangefinder

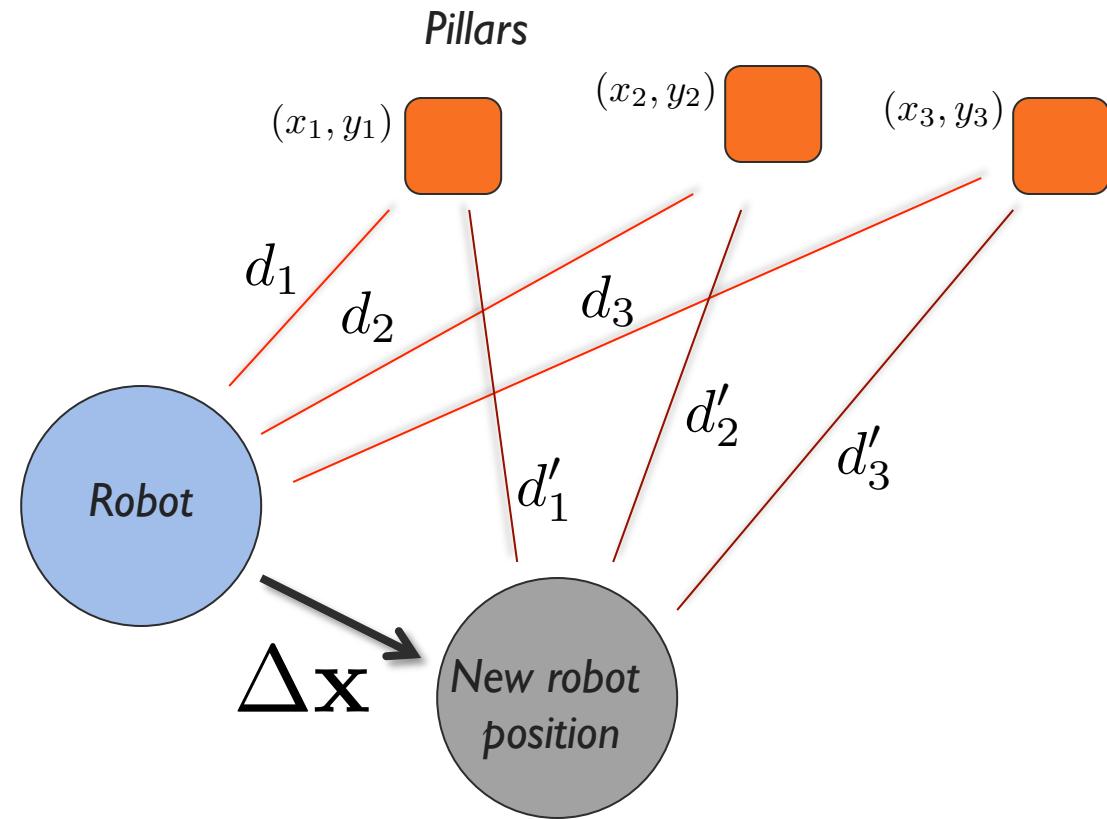


mvBlueFox USB
camera

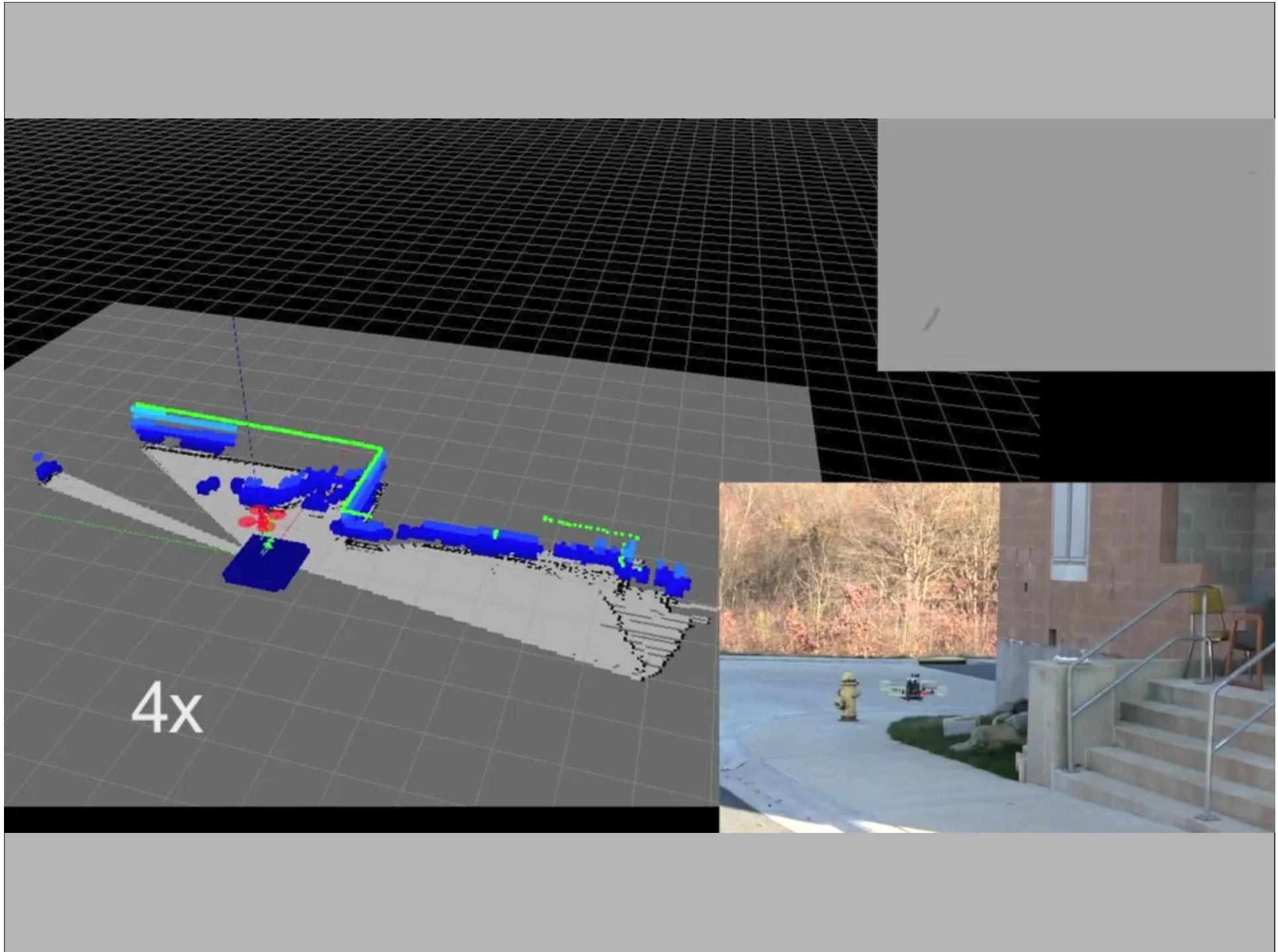


Kinect sensor for
XBOX 360

Simultaneous Localization And Mapping



Concurrently estimate
Locations of pillars (6)
Displacement of the robot (2)





1750 g (laser, 3 cameras, GPS, IMU)



650 g (camera, IMU)

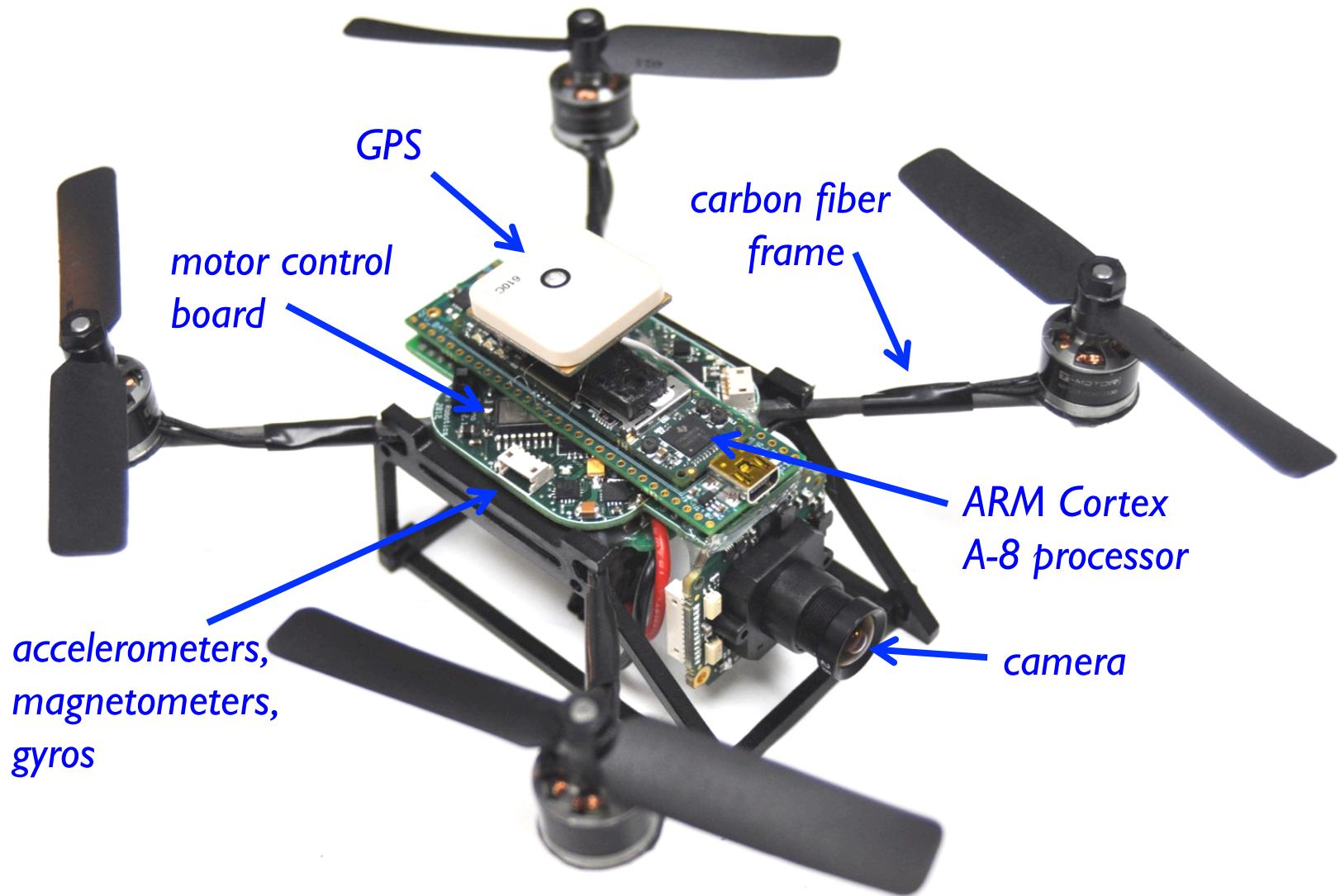


740 g (2 cameras, IMU)



1800 g (laser, Kinect, IMU)

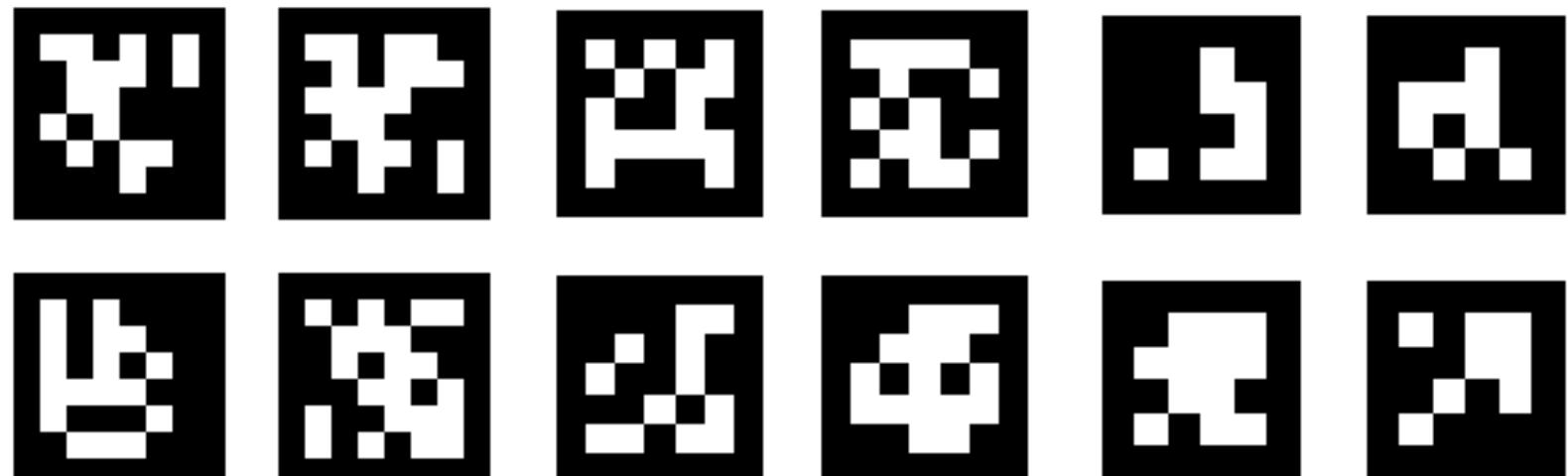
Experimental Platform



KMel Robotics

www.kmelrobotics.com

Beacons that are easy to recognize



<http://april.eecs.umich.edu/wiki/images/9/94/Tagsampler.png>

