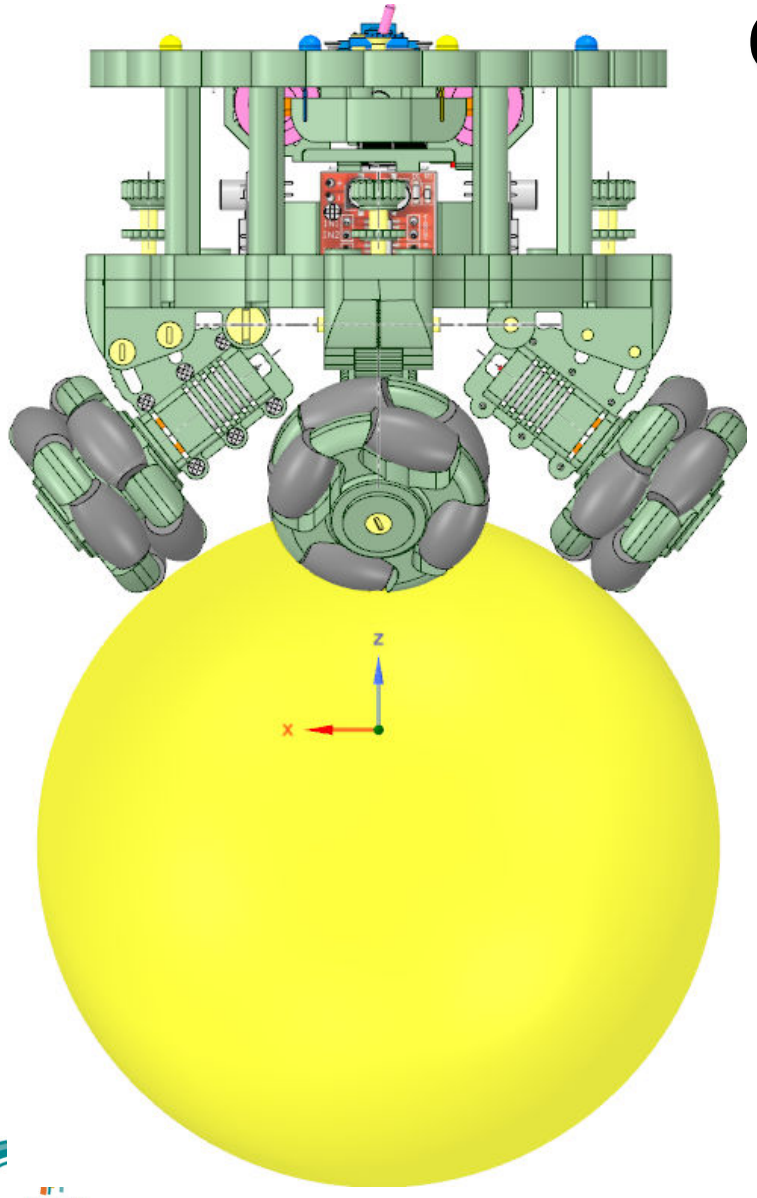
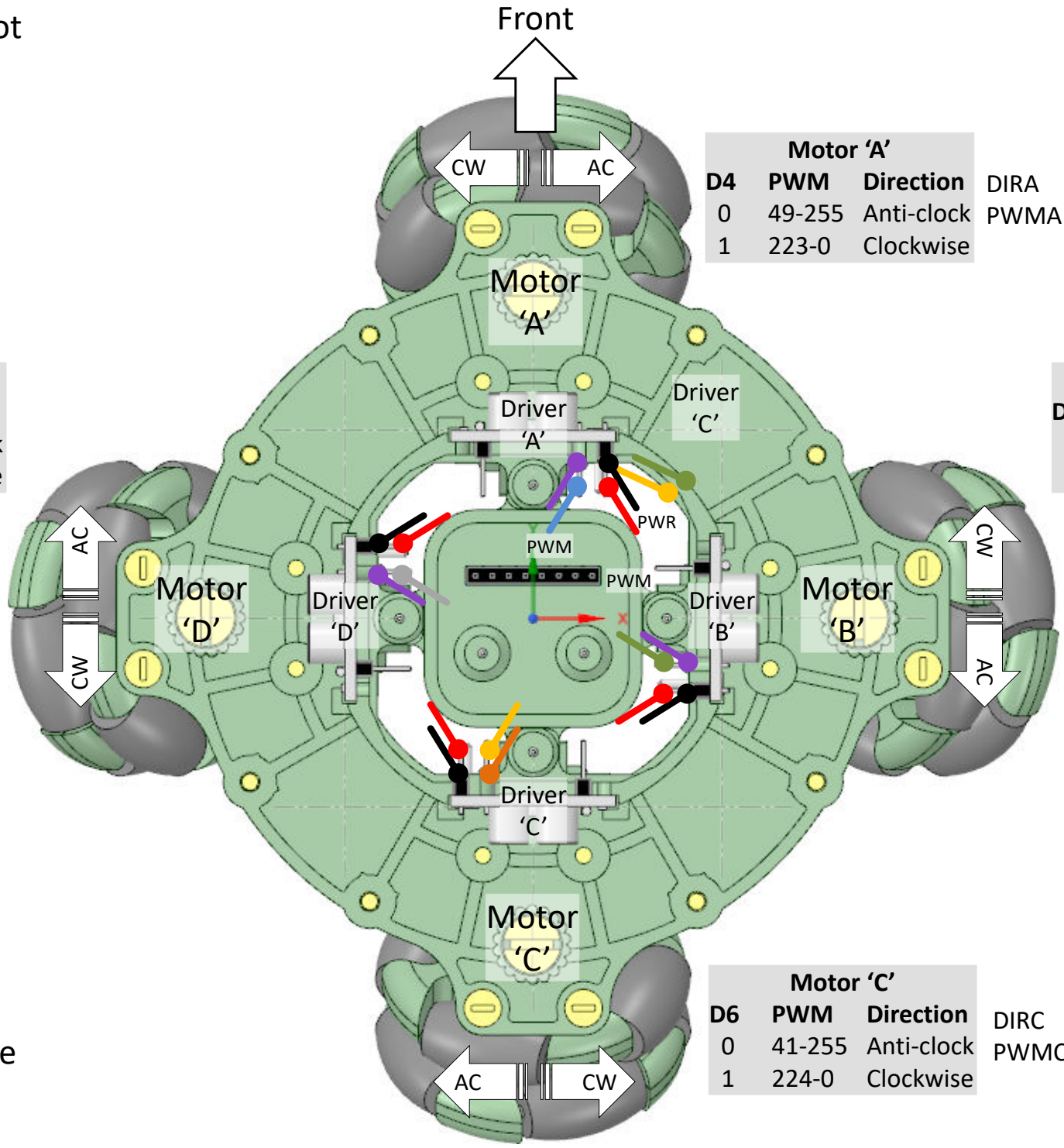
BallBot 4x4

Calibration



Ball Balancing Robot
Motor Cal.



Motor 'A'		
D4	**PWM**	**Direction**
0	49-255	Anti-clock
1	223-0	Clockwise

DIRA — D4
PWMA — D3

Motor 'D'		
D12	**PWM**	**Direction**
0	36-255	Anti-clock
1	233-0	Clockwise

DIRD — D12
PWMD — D11

Left Wheel

Motor 'B'		
D5	**PWM**	**Direction**
0	36-255	Anti-clock
1	233-0	Clockwise

DIRB — D5
PWMB — D9

Right Wheel

Motor 'C'		
D6	**PWM**	**Direction**
0	41-255	Anti-clock
1	224-0	Clockwise

DIRC — D6
PWMC — D10

Rear Wheel

Viewed from above

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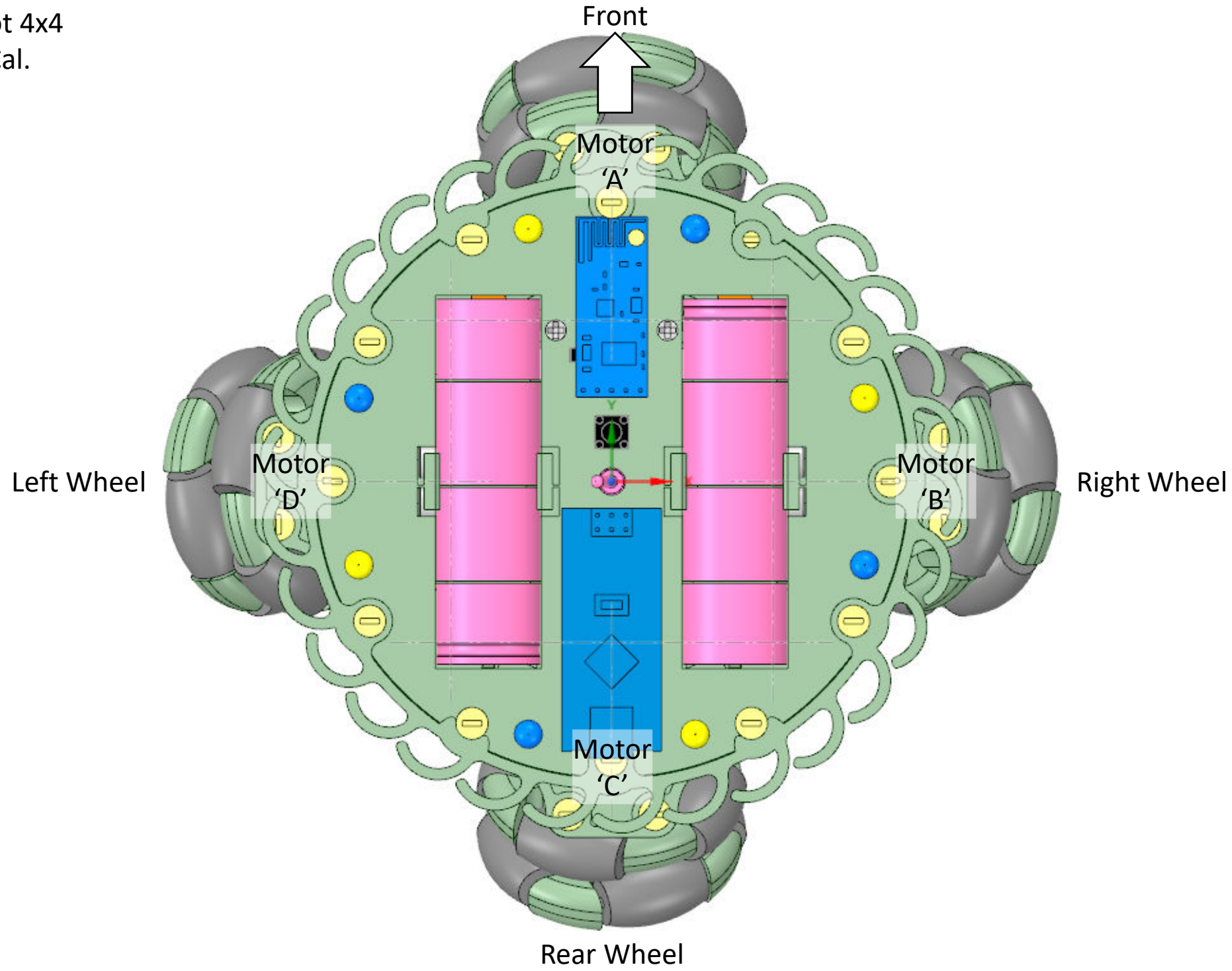
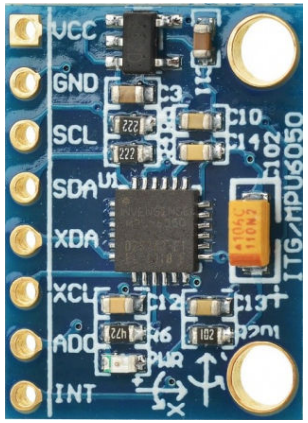
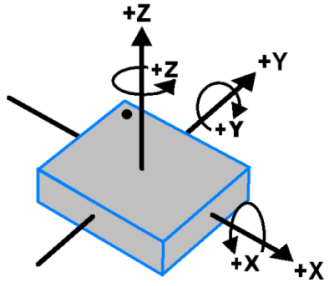
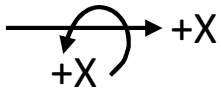

Front
Motor
'A'
Left Wheel
Motor
'D'
Motor
'B'
Right Wheel
Motor
'C'
Rear Wheel

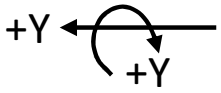
MPU-6050 Orientation

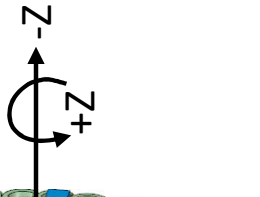




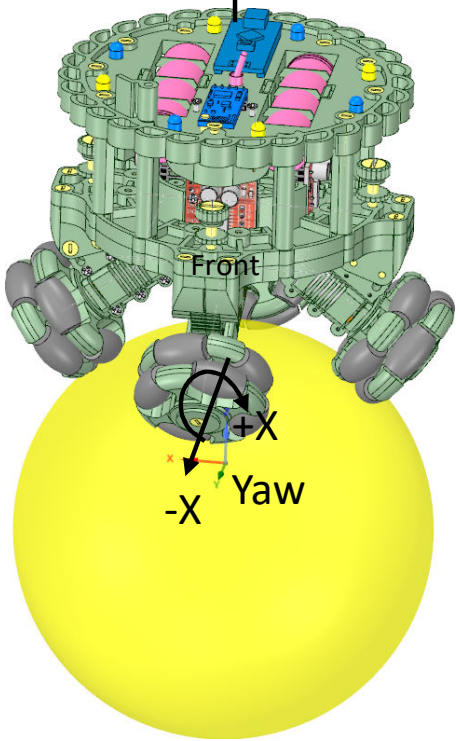
MPU-6050
Orientation & Polarity of Rotation





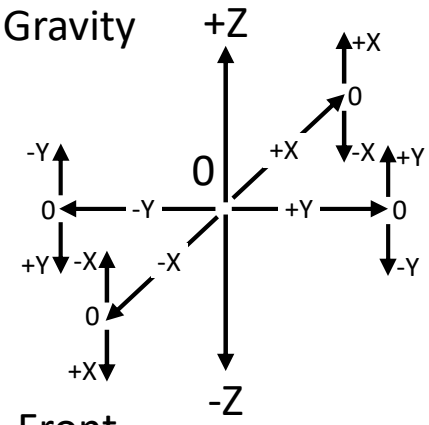


Acceleration



Pitch

Gravity



Front

Gyroscopes are set at +/-250 °/sec FSD.
Hence at 32,767 FSD; rotation of 1 °/sec = 131.
To convert this to a gyro angle we use the time between readings.
On 10 ms cycle we would accumulate a count of 1310 over a 100 cycles when rotating at 1 °/sec.
So delta angle per 10ms cycle = gyro rate * 0.00007633

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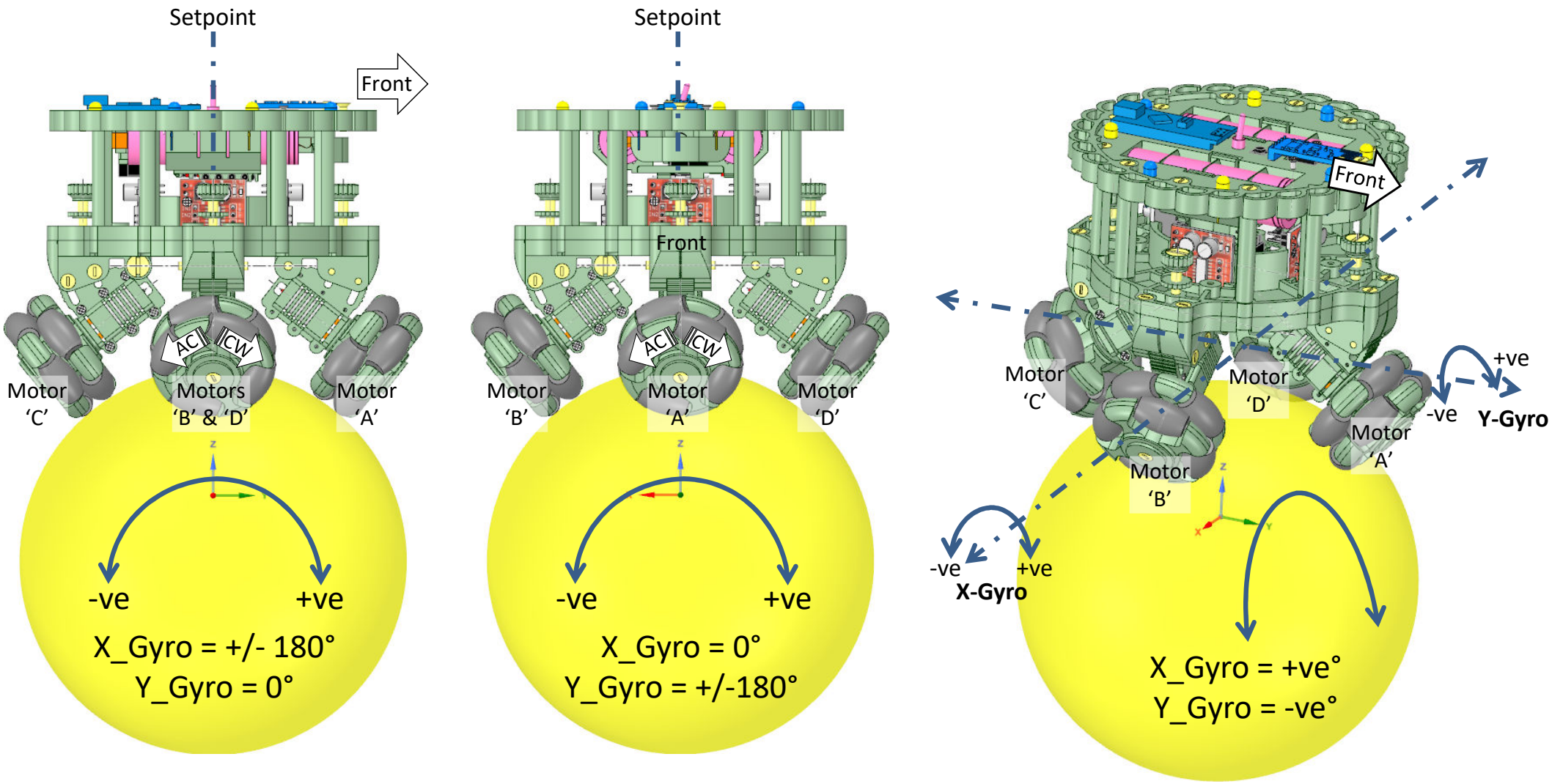
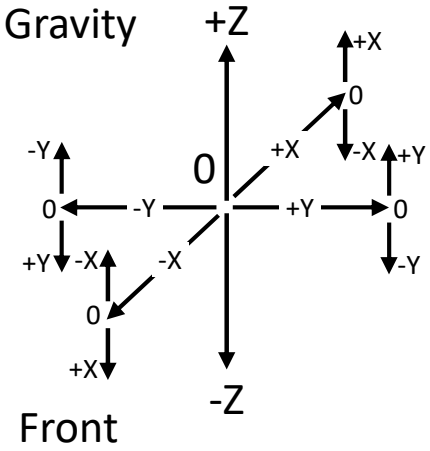


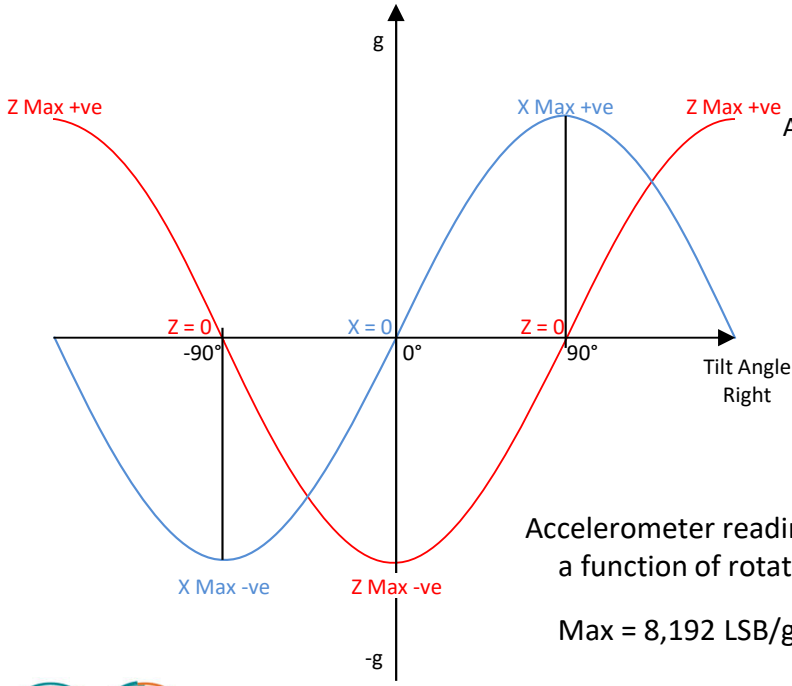
Gyro X & Y angles to Motor clockwise drive relationships:

Motor A^{CW} = Y_Gyro
Motor B^{CW} = X_Gyro
Motor C^{CW} = -Y_Gyro
Motor D^{CW} = -X_Gyro

Note: here we are calling the Pitch gyro X_Gyro and Yaw gyro Y_Gyro to be consistent with the accelerometer values, which are used in the code for gyro drift correction.



Accelerometers read 0 when horizontal, and maximum +/- when vertical. Gravity can be used to aid the measurement of angle, but it is greatly affected by accelerating forces.

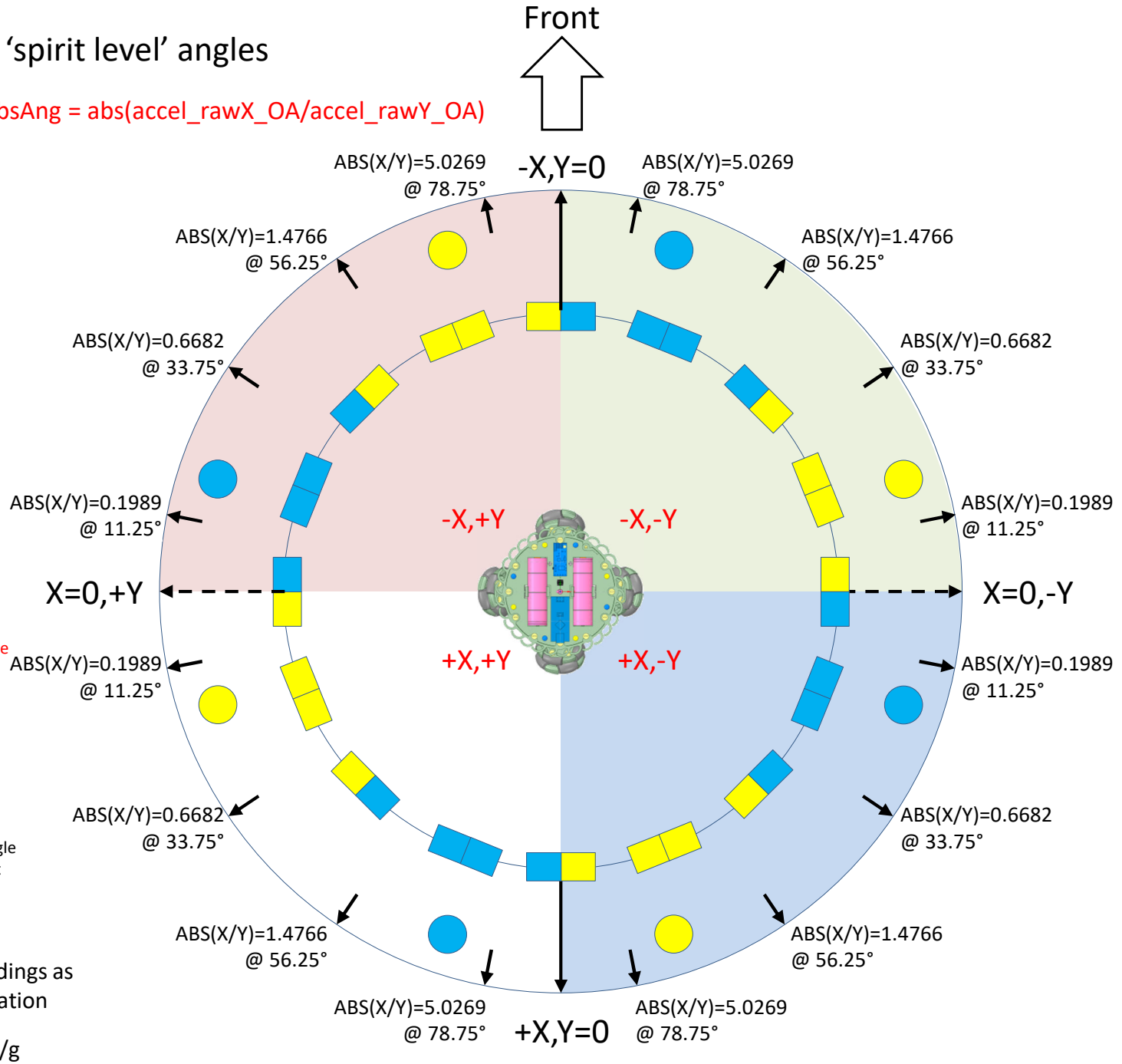


Accelerometer readings as a function of rotation

Max = 8,192 LSB/g

LED 'spirit level' angles

AccAbsAng = abs(accel_rawX_OA/accel_rawY_OA)



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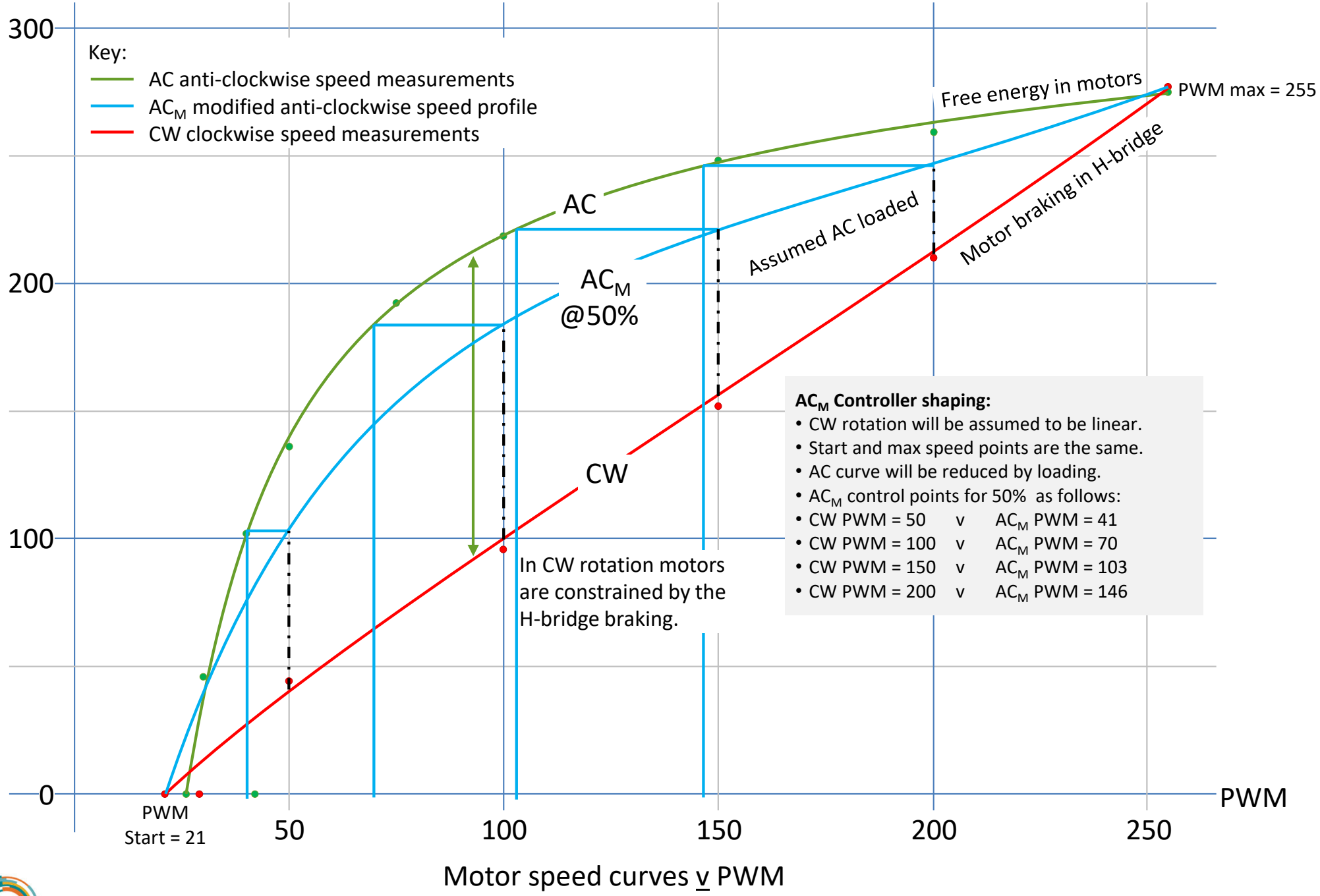
RPM @ 50 counts of ball rotation



Motor speed curves v PWM

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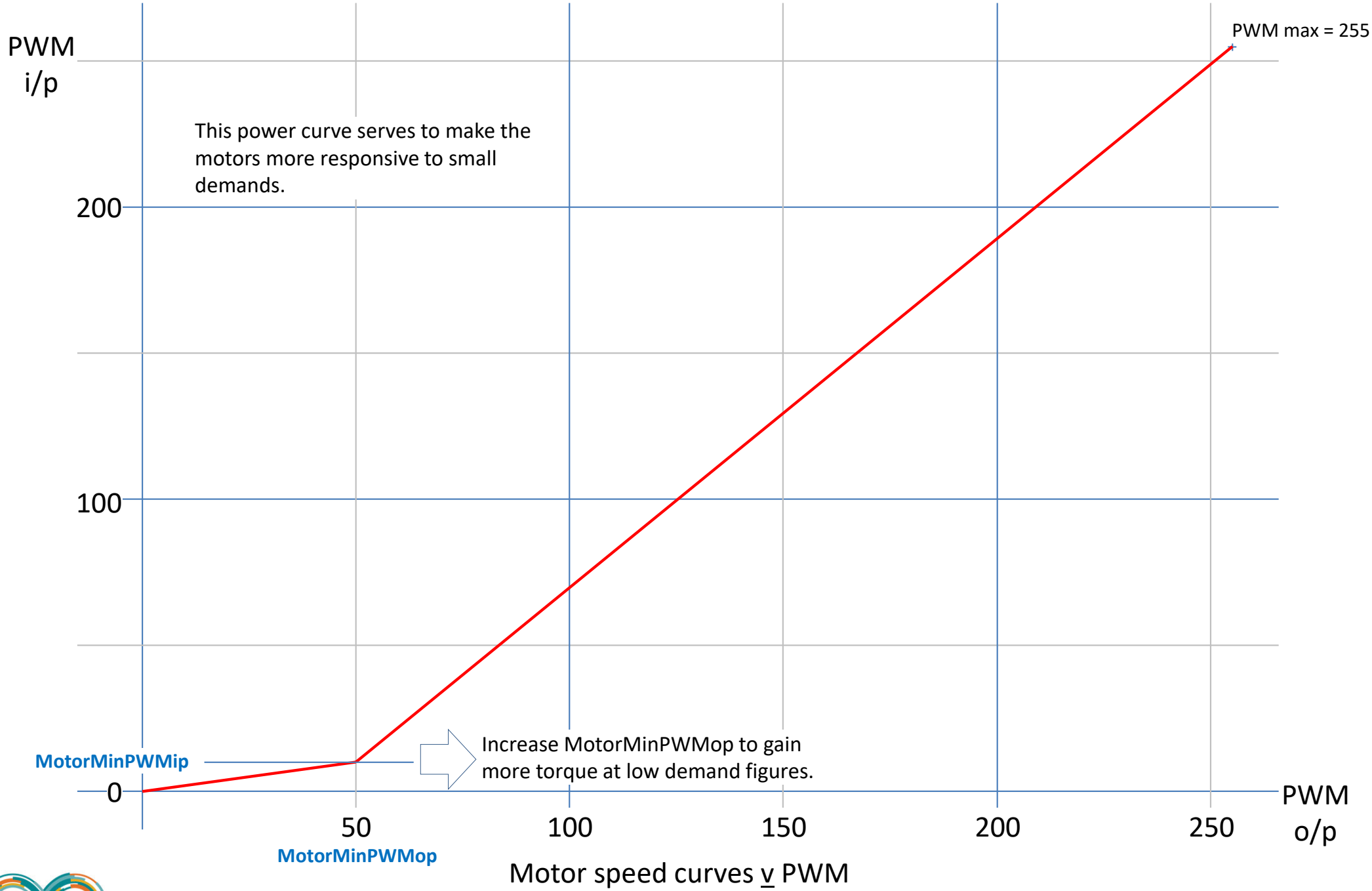
Motor PWM Demand v Power chart



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