1 Coordinates to use in the ship's IMU

Reference point **X** drilled into the deck outside the compressor room is referred to as point 'ref.' That reference point is about 4 feet = 48/39 m= 1.23 m above sea level during measurements. The following are coordinates of position vectors from ref. to other points as measured in meters:

ref. to Primary GPS antenna $G = [0.0, -3.784, -6.144]$

ref. to Ray Marine in the Dry Lab in com2 $\equiv$ POS MV GPS2 $\equiv$ ship's GPS2 $A = [9.440, -6.379, -3.974]$

ref. to IMU $I = [19.567, -4.128, -0.15]$

ref. to Lidar $L = [32.61, 0.82, -4.84]$;

ref. to NOAA/K $K = [11.40, 0.84, -5.30]$

ref. to roof W-band $W = [-9.19, -2.88, -2.88]$

ref. to compensated W-band $C = [-6.22, -1.18, -1.42]$

ref. to roof X-band $R = [-10.26, -2.03, -2.99]$

ref. to center of rotation of the ship (estimated) $S = [0.0, -0.94, 0.0]$

Let NOAA/K be the new reference point entered into the IMU. The the 'lever' arms to be entered in the IMU for its reference point 'ref' is

NOAA/K to Primary GPS antenna $G - K = \begin{bmatrix} -11.4 & -4.624 & -0.844 \end{bmatrix}$

NOAA/K to POS MV GPS2 $A - K = \begin{bmatrix} -1.96 & -7.219 & 1.326 \end{bmatrix}$

NOAA/K to IMU $I - K = \begin{bmatrix} 8.167 & -4.968 & 5.15 \end{bmatrix}$

NOAA/K to Lidar $L - K = \begin{bmatrix} 21.21 & -0.02 & 0.46 \end{bmatrix}$

NOAA/K to roof W-band $W - K = \begin{bmatrix} -20.59 & -3.72 & 2.42 \end{bmatrix}$

NOAA/K to comp W-band $C - K = \begin{bmatrix} -17.62 & -2.02 & 3.88 \end{bmatrix}$

NOAA/K to roof X $R - K = \begin{bmatrix} -21.66 & -2.87 & 2.31 \end{bmatrix}$

NOAA/K to center of rotation of the ship $S - K = \begin{bmatrix} -11.4 & -1.78 & 5.3 \end{bmatrix}$

Sensor 1 has been assigned to the lidar IMU

At 13:40 UTC on January 13, sensor 2 was changed to the roof X-band. Prior to that time, sensor 2 was the roof W-band.

Univ. Miami's priority list is the following order from most to least important: roof W-band, compensated W-band, and roof X.

The position of the Lidar IMU box center is recorded above for comparison with lidar motion data. The lidar mirror changes its position relative to the lidar IMU as its periscope rotates. The periscope center is displaced about 21 inches forward, 15 inches starboard, and the mirror center is $37 + 5$ inches above the IMU box.

The center of rotation of the ship is estimated to be at wall which is $0.94m$ toward port side of the drilled **X** reference point.