

# Summary of equations for mapping stretch sensor data to specific shoulder movements.

## Sensor names

backSensor: Sensor at the back of the shoulder.

shoulderSensor: Sensor on top the shoulder, coming down the upper arm.

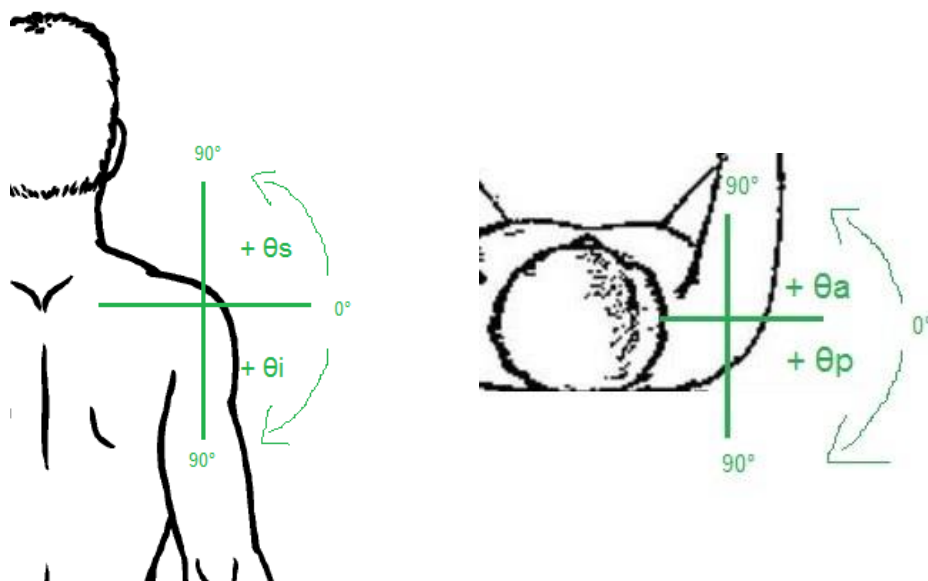
frontSensor: Sensor on the front of the shoulder.

bodySensor: Sensor along the side of the body.

## Target movements

Shoulder motion can be visualized in a 3D quadrant, where the arm moves in the frontal and axial planes<sup>1</sup>. This means we have 4 quadrants: Inferior & Superior within the frontal plane; Posterior & Anterior within the axial plane.

All angles are considered 0° while in a “T” pose. Negative-to-positive directions are from Inferior to Superior in the frontal plane, and Posterior to Anterior in the axial plane, as shown in the diagram below:



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<sup>1</sup> As defined here: <http://training.seer.cancer.gov/anatomy/body/terminology.html>

## Frontal plane: Inferior movement (away from the head)

Assuming linear relationship (initial assumption):

$$\theta_i = -\frac{shoulderSensor * 90^\circ}{shoulderSensorMAX} + a_i * \frac{backSensor}{backSensorMAX} + b_i * \frac{frontSensor}{frontSensorMAX}$$

Where  $\mathbf{a_i}$  is a factor correcting for anterior movements, and  $\mathbf{b_i}$  is a factor correcting for posterior movements.

## Frontal plane: Superior movement (toward the head)

Assuming linear relationship (initial assumption):

$$\theta_s = \frac{bodySensor * 90^\circ}{bodySensorMAX} - a_s * \frac{backSensor}{backSensorMAX} - b_s * \frac{frontSensor}{frontSensorMAX}$$

Where  $\mathbf{a_s}$  is a factor correcting for anterior movements, and  $\mathbf{b_s}$  is a factor correcting for posterior movements.

## Axial plane: Posterior movement (toward the back)

Assuming linear relationship (initial assumption):

$$\theta_p = -\frac{frontSensor * 90^\circ}{frontSensorMAX} + a_p * \frac{backSensor}{backSensorMAX} + b_p * \frac{frontSensor}{frontSensorMAX}$$

Where  $\mathbf{a_p}$  is a factor correcting for anterior movements, and  $\mathbf{b_p}$  is a factor correcting for posterior movements.

## Axial plane: Anterior movement (toward the stomach)

Assuming linear relationship (initial assumption):

$$\theta_a = \frac{backSensor * 90^\circ}{backSensorMAX} - a_a * \frac{backSensor}{backSensorMAX} - b_a * \frac{frontSensor}{frontSensorMAX}$$

Where  $\mathbf{a_a}$  is a factor correcting for anterior movements, and  $\mathbf{b_a}$  is a factor correcting for posterior movements.