**To: Programming Group**

**From: Larry Basegio**

**Subject: Calibration Procedure for Autonomous Drive**

**Date: 23 February 2020**

**Summary**

This year the robot will use a “Mecanum Drive”. The traction characteristics of this drive do not allow a direct correlation between encoder value, gear reduction, wheel diameter and distance traveled. It is expected that traction characteristics for forward, backward movement and the side-to-side translation capabilities of this drive will differ and will be dependent on field surface. An empirical calibration method that relates distance to encoder values has been developed and the initial results are positive. It is quick and can easily be adapted to different field environments.

**Procedure (Forward/Backward)**

* Zero the encoder you intend to use for the measurements.
* Define a reference starting point.
* Make a series of forward and backward movements recording the distance from the reference point and the encoder value.
* Between each of the movements compute the difference in distance traveled and the difference in the encoder output.
* Divide the distance difference by the encoder difference at each of these intervals.
* Average this value – this is the average distance traveled per encoder count and is your calibration factor.

As an example consider the following table:

Move # Type Distance from Reference Encoder value Computed Calibration Factor

1 Fwd 53” 35.6 1.49

2 Fwd 96” 65.6 1.43

3 Fwd 135” 93.6 1.39

4 Bwd 100” 68.3 1.38

5 Bwd 18” 11.8 1.45

6 Bwd -24” -15.8 1.52

Average = 1.44 “/encoder count

**Procedure (side to side)**

* Zero the encoder you intend to use for the measurements.
* Define a reference starting point.
* Make a series of left and right movements recording the distance from the reference point and the encoder value.
* Between each of the movements compute the difference in distance traveled and the difference in the encoder output.
* Divide the distance difference by the encoder difference at each of these intervals.

Average this value – this is the average distance traveled per encoder count and is your calibration factor.

Here is a table for this movement:

Move # Type Distance from Reference Encoder value Computed Calibration Factor

1 Strafe Left -80” -68.7 1.16

2 Strafe Right -25” -20.0 1.13

3 Strafe Right 30” 27.3 1.16

4 Strafe Right 71” 64.7 1.10

Average = 1.14 “/encoder count

**Observations**

* With the motors in “brake” mode the movements were repeatable. A movement forward and back the same distance resulted in a return to the original position.
* This procedure was performed very quickly – it is expected that with a bit more rigor results could be improved.
* Note that this procedure does not care about gear reductions, wheel diameters, etc..
* The traction characteristics of “strafing” and forward/back are different. This was expected.
* “Tune-up” at the field should be one of the first priorities for autonomous operation.