Positioning the AMS7262 6 channel color sensor for the Samplelator

Summary

The AMS7262 sensor is an off the shelf color sensor tuned to sense 6 color channels of Violet, Blue, Green, Yellow, Orange, and Red. Most large surface materials reflect light as a range of colors, and to gain accuracy in color determination it is best to be as close to the reflected light as possible to focus on a small but stable portion of the material.

Sensor Characteristics

From the AMS7262 specs, the field of view of the sensor aperture is a 40 degree cone (+/- 20 degrees from centerline). For example, at 25.4 mm (1 inch) distance from a sample, the radius of the cone base is tan(20 degrees) * 25.4 mm = 9.2448 mm, or a little less than 10 mm. The selection of distance depends on the overall size of the sample and the speed at which the sample moves, plus the integration time needed for the sensor to complete its sampling.

The specs for sampling of all 6 channels (which are stored on 2 bank registers) takes 2 * 2.9 ms = 5.8 ms. This value is for 1 unit of integration time. Currently, we choose 2 units of integration time, or 11.6 ms. This value was chosen by empirical means to balance the gain used (which is 64 times unity) and the integration time to get the best color readings for the smallest practical integration time. This means any stability calculations require a minimum of 11.6 ms of leeway in getting a decent color sample.

The Samplelator Characteristics

The Samplelator uses dowels of about 36 mm diameter from which the color samples are glued to the bottoms. The maximum disk sample will then have a radius of about 18 mm. With a stationary color sample, the maximal distance that the sensor sample can be position is tan(70) * 18 mm = 49.4546 mm, or a little less than 50 mm (less than 2 inches) from the sample. Again, that calculation is at a non-moving sample.

The dowels, however, are on a rotating disk, and are located at 6 different tracks/radii. With the disk rotating at 1 complete circle very 30 seconds, each point on the disk will have a rotational speed of 2 * pi * r / 30 = pi * r / 15.

So each point at 1 meter radius will have a rotation speed of pi / 15 meters per second, or about 209 mm per second. A more useful translation would be 209 mm / 1000 mm/s = 0.209 mm per ms. With a chosen integration time of 11.6 ms, the distance a sample moves would be 11.6 ms * 0.209 mm / ms = 2.42 mm. This means the base of the cone for the sample should be reduced by at least 2.42 mm to get a stable sampling area. Rounding off to 2.5 mm, the stable sampling area at 1 meter from the center of the spinning disk is now 18 – 2.5 mm = 15.5 mm. The distance from the color sample should now be at tan(70) * 15.5 = 42.59 mm from the material at 1 meter out from center.

For 2 meters from center, the rotational speed would double at 0.418 mm / ms. The sampling radius would then be 18 – 4.84 = 13.15 mm. The maximum distance from the color sample should now be at tan(70) * 13.15 mm = 36.13 mm.

For 3 meters from center, the rotational speed would be at 0.627 mm / ms. Sampling radius at 18 – 6.27 = 11.73 mm. The maximum distance of the color sensor from the sample would be tan(70) * 11.73 = 32.23 mm.

So, a nice round-ish number would be 25.4 mm (1 inch) from the sample all the way out to 9 feet from center. This allows a safe deviation of disk wobble of +/- ¼ inch. If possible, ½ inch from the sample would be nice, though the probability of the sensor getting hit by the disk wobble increases as the distance from the sample decreases, obviously. However, this distance allow for a stable sampling to be done even at higher RPMs than 2 that is currently targetted.