Measured Translation Repeatability and Deviation With Respect to Motor Velocity

Procedure:

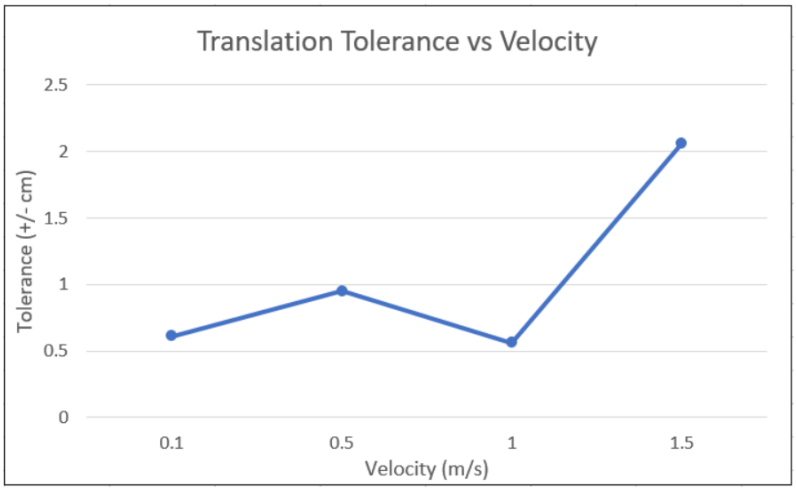
Four arbitrary velocity values were selected for this testing (0.1, 0.5, 1.0, & 1.5), all measured in meters per second respectively. Rover position zeroing was accomplished through the use of an arbitrary floor marking and a square; vehicle translation was recorded with a fixed measuring tape and a square. The vehicle was programmed to drive 100cm, and the translation test was conducted ten times at each of the four velocities, summing forty trials in total.

The positional tolerance values for each velocity were obtained by subtracting the shortest distance of each velocity from the highest and then dividing by two. This leaves the maximum variation observed within these trials concerning the desired distance.

$$Tolerance = \pm\frac{(\Delta x_{max} - \Delta x_{min})}{2} \qquad Sample\ Variance = \frac{\sum(X - \bar{x})^2}{n - 1}$$

Motor Translation Repeatability for 100cm Run				
Trial #	Travel at 0.1 m/s	Travel at 0.5 m/s	Travel at 1.0 m/s	Velocity = 1.5 m/s
1	100.013	107.633	100.965	98.425
2	99.695	107.95	101.283	101.6
3	99.5363	106.363	100.33	101.759
4	99.695	107.633	101.283	101.918
5	99.2188	106.363	100.965	102.553
6	100.171	108.109	100.33	101.918
7	100.171	106.521	100.965	98.425
8	100.648	106.998	100.171	101.6
9	99.695	108.268	100.33	96.8375
10	99.3775	107.95	100.013	101.759

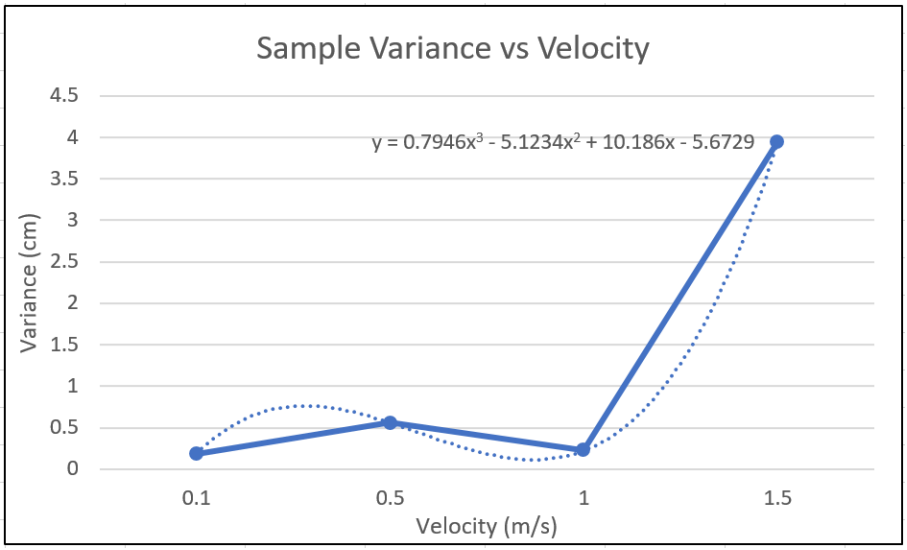
A somewhat steady trend in tolerance can be seen for velocity values under 1.0m/s.



Translation Tolerances	
Velocity (m/s)	Accuracy Range (cm)
0.1	± 0.64
0.5	± 0.95
1	± 0.56
1.5	± 2.06

The following rise in tolerance is primarily due to external factors such as the friction coefficient of the tires and the hubs being programmed to disable following the translation, leading to a slight coast.

A very similar trend can be seen in the rover's sample variance. We can again explain this rise in variance as a product of the rover's reduced surface friction and lack of braking current.



Observations:

As reflected in most trials, we can safely say that operating velocities which are less than or equal to 1.0m/s will result in the most predictable and consistent results. Some future modifications could be made to increase accuracy past this point, including additional software tuning and a physical addition of material to the tires, but for most applications the given velocity window will be sufficient.