CNC machining time calculator concept

Proposal: Universal G-code sender which is presently the used platform for CNC milling has an unreliable timer. This makes it hard to gauge quickly the actual machining time a particular job will take. This affects scheduling times as it becomes hard to know how long a job will take. The proposed solution for this is utilizing the g-code of any job and analysing it with a python script.

This script will analyse every line, calculating the difference in length between each discrete point and calculating either the Euclidean distance or arc length for linear and circular interpolations respectively. These lengths will then be divided by the feed rate applied to a respective line to find the minute changes in time. These minute changes in time will then be summed to give the total expected time a machining job will take.

G1 – Linear interpolation

To calculate the distance between two points we can utilize the method of evaluating a Euclidean distance which utilizes Pythagoras. This is also referred to as the distance formula.

$$d = \sqrt{(x_2 - x_1)^2 + {(y_2 - y_{1)}}^2}$$

Ex1.

$$d_1 = \sqrt{(x_2 - x_1)^2 + {(y_2 - y_{1)}}^2}$$

$$\therefore\ d_1 = \sqrt{(8-5)^2 + (0-0)^2}$$

$$\therefore d_1 = 3$$

Ex2.

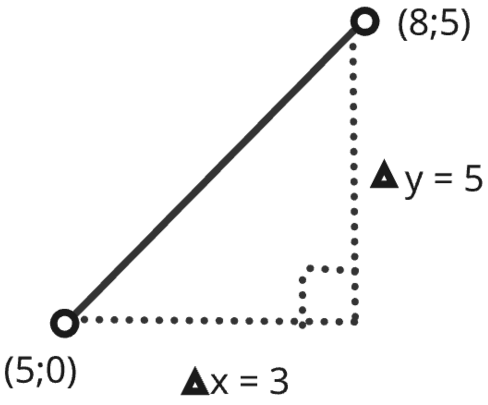

Figure 1 – Line at an angle

$$d_2 = \sqrt{(x_2 - x_1)^2 + (y_2 - y_{1)}{}^2}$$

$$\therefore\ d_{12} = \sqrt{(8-5)^2 + (5-0)^2}$$

$$\therefore d_2 = 5.83$$

G2 & G3 – Circular interpolation

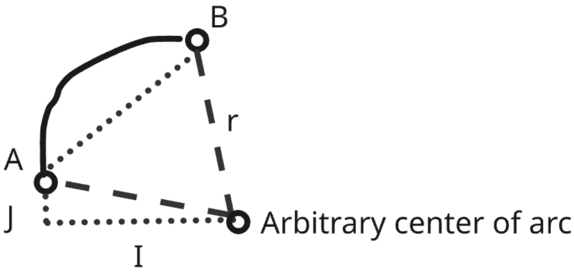

Figure 2 – arc

The length of an arc is given by:

$$Arc\ length = r\theta(\frac{\pi}{180})$$

Where:

r = radius

$\theta = angle\ in\ degrees$

r can be found by using I and J which are the distances in the x and y plane respectively from the starting point of the arc to the centre of that arc.

$$r = \sqrt{(I)^2 + (J)^2}$$

The linear distance AB can also be found using the distance formula. The angle θ which is subtended by the arc can then be found using the cosine rule.

$$AB^2 = r^2 + r^2 - 2r \cdot r\cos(\theta)$$

$$2r^2\cos(\theta) = 2r^2 - AB^2$$

$$\cos(\theta) = \frac{(2r^2 - AB^2)}{2r^2}$$

$$\theta = \cos^{-1}(\frac{(2r^2 - AB^2)}{2r^2})$$

The minute times between discrete points can be then calculated with:

$$t_i = \frac{l_i}{F_i}$$

For the total time, we sum all the minute changes in time:

$$t = \sum_{n=1}^{i}(\frac{l_i}{F_i})$$

$$= \frac{l_1}{F_1} + \frac{l_2}{F_2} + \frac{l_3}{F_3} \cdots \frac{l_i}{F_i}$$