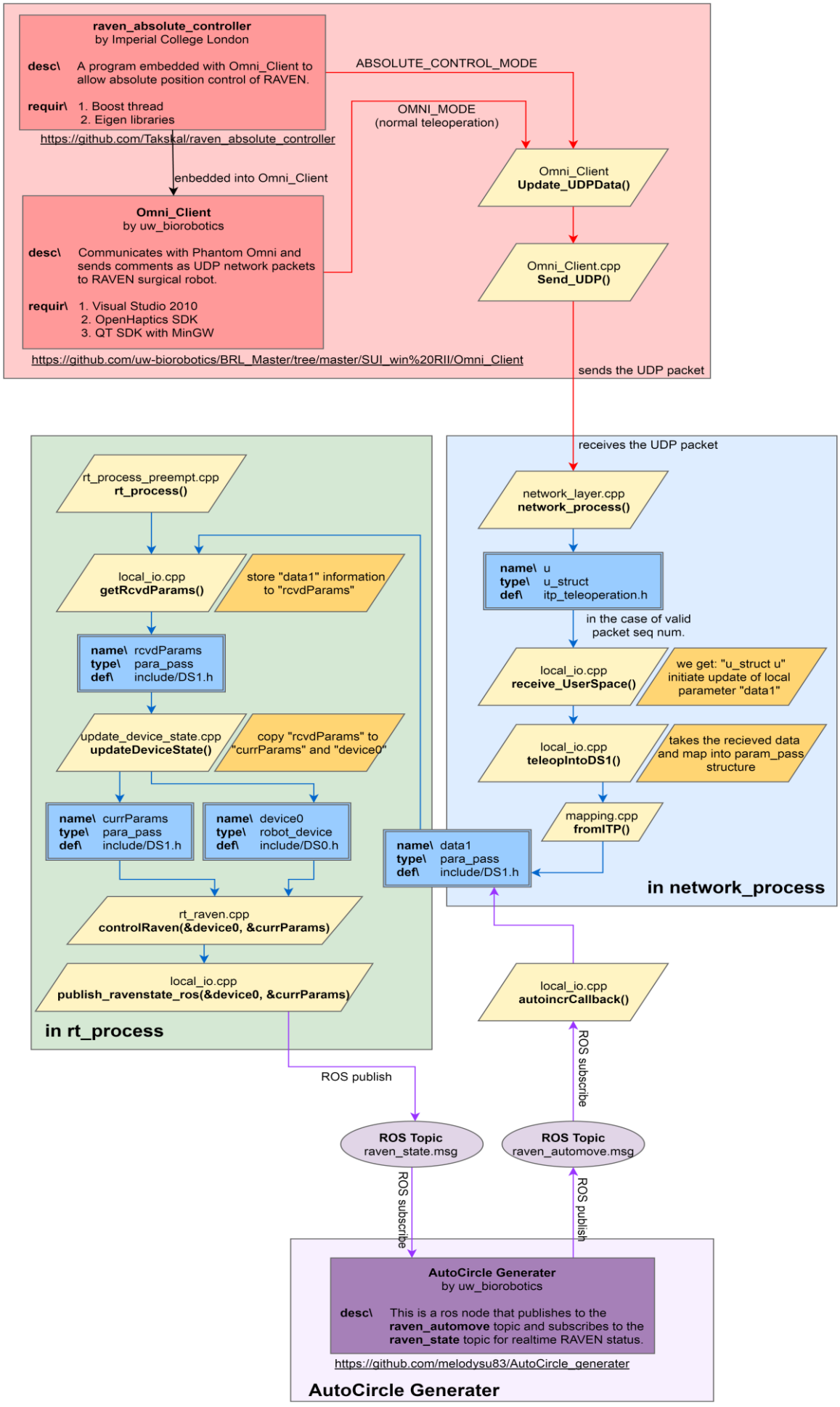
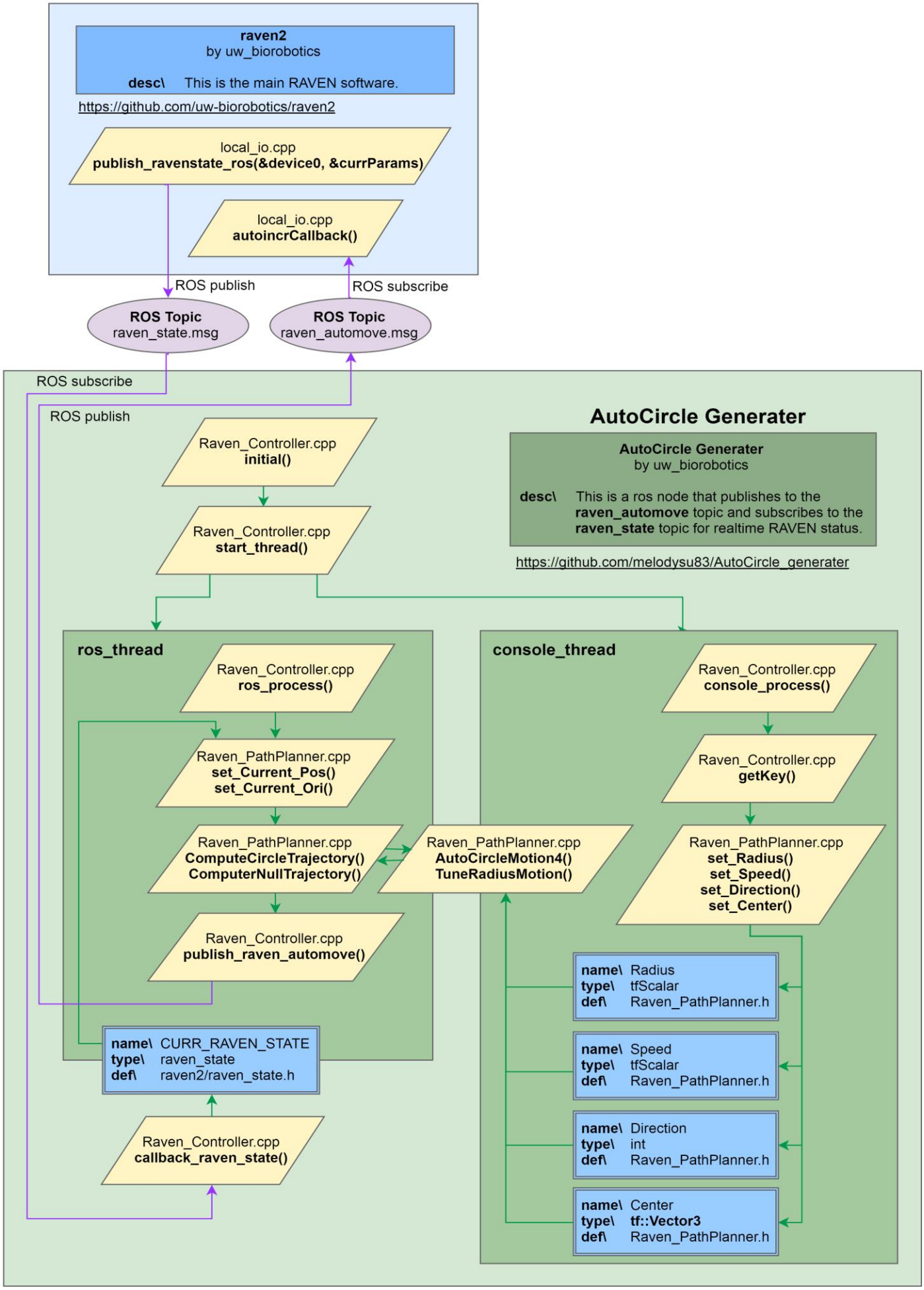
Contents

1. Connection with Raven Software

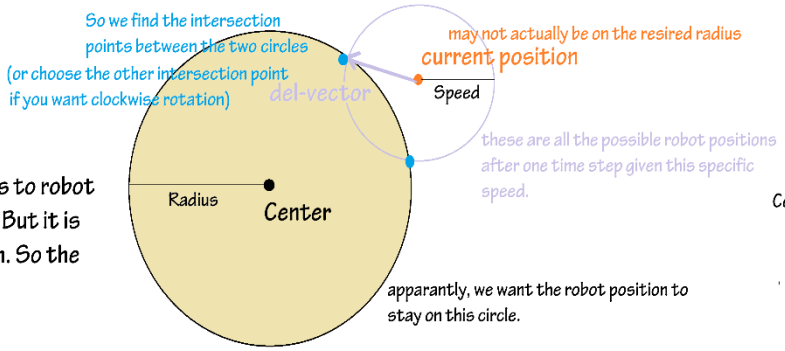


2. AutoCircle generater Design Hierarchy

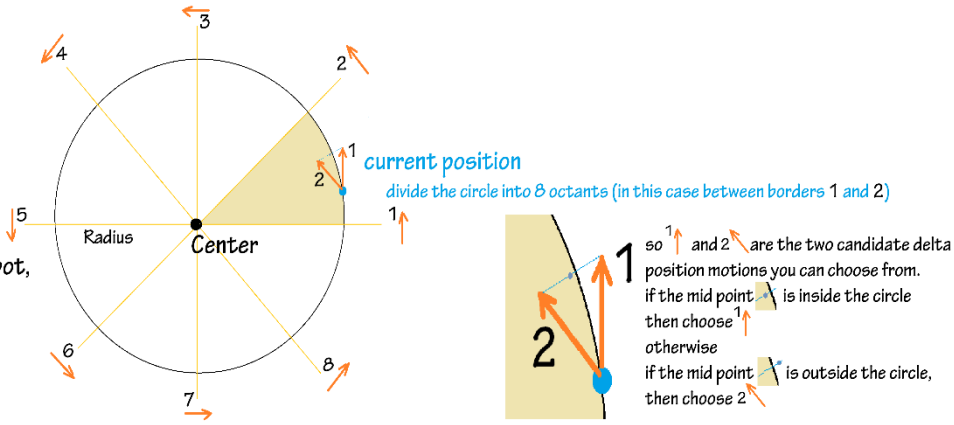


3. Circle Trajectory Algorithms

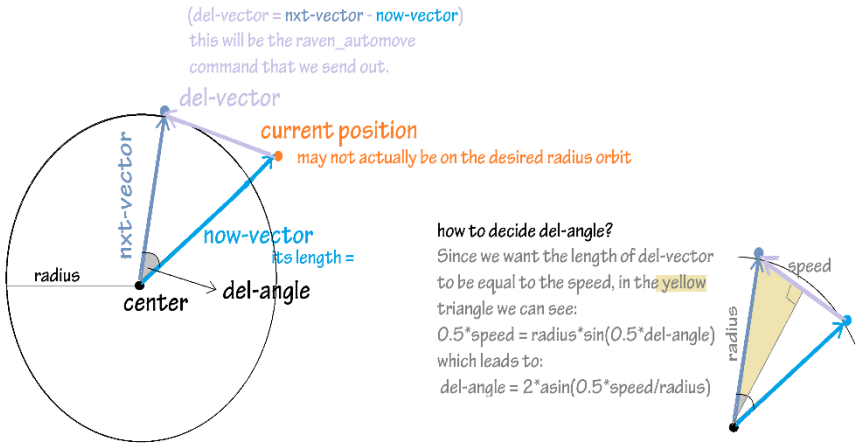
AutoCircleMotion1
The most precise way of generating commands that closely corresponds to robot current position, radius, and speed. But it is very not consistant and not smooth. So the outcome was pretty unstable.



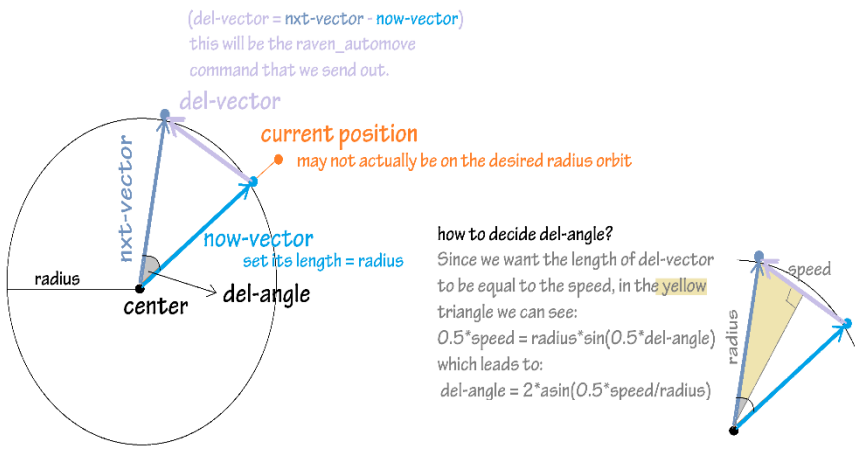
AutoCircleMotion2
This is known as "The Bresenham Circle Algorithm". It is a famous algorithm in computer graphics but again in terms of sending as motion commands to actual robot, this is also pretty discontinuous.



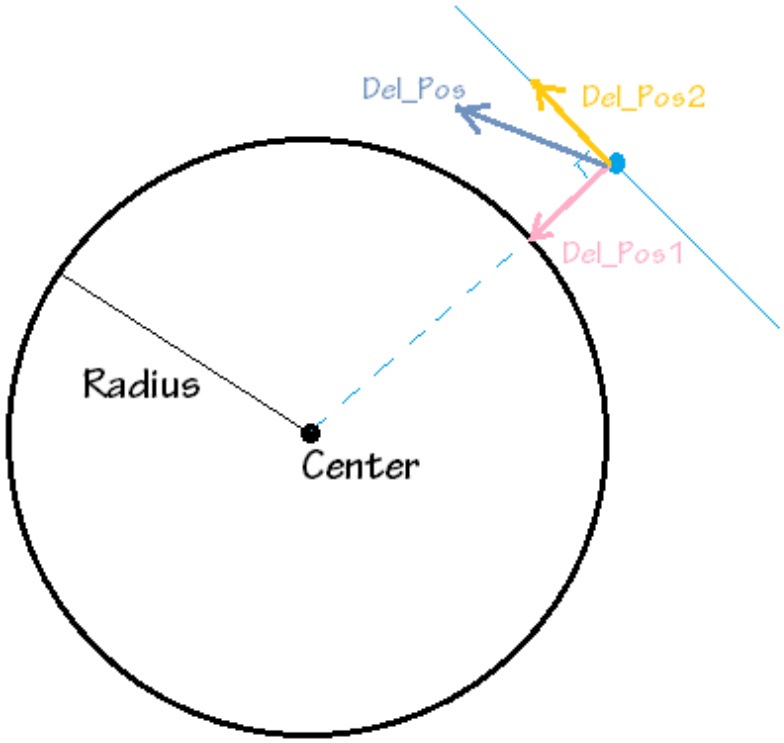
AutoCircleMotion3
This is better at generating customized commands to regulate the distance from center to be around the desired radius. But causes discontinuous commands which makes the robot a little shaky (especially with faster speed).



AutoCircleMotion4 (currently in use!!)
This algorithm ensures raven-automove commands to be smooth and continuous. But it does not give any moditication when the radius is off. So, we need another mode to tune the radius if the distance from center is too different from desired radius.



4. Regulating Motion Around Desired Radius



$Kp = 0.000001 * (Speed)^{0.7}$

$Error = abs(Distance - Radius)$

$K = Kp * Error$

$Del\_Pos = (K) * Del\_Pos1 + (1-K) * Del\_Pos2$

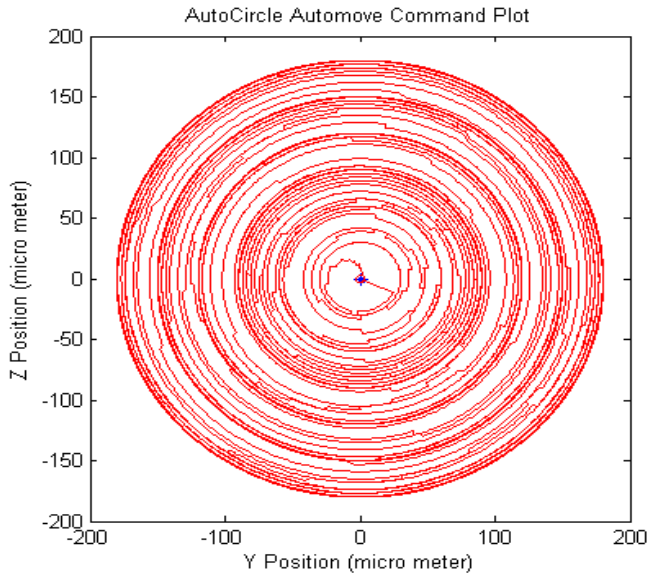
5. Demo Screenshots of AutoCircle generater

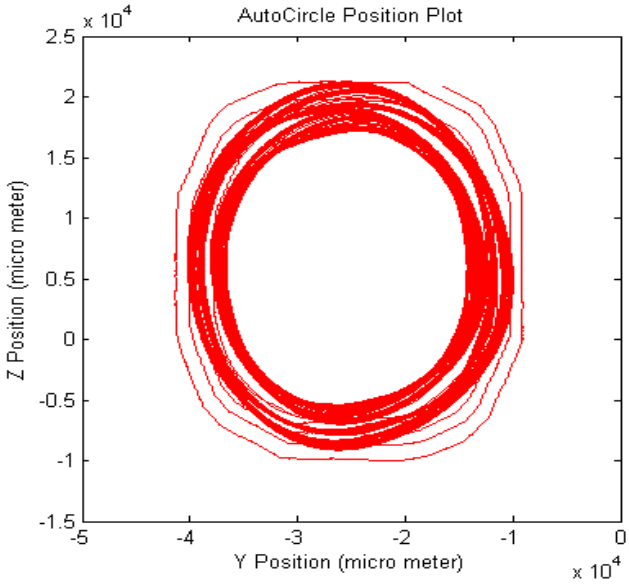
```
Auto Circle Generator Selection Menu:
-----------------------------------------------------
        '1' : Increase Circle Radius
        '2' : Decrease Circle Radius
        '3' : Increase Raven Moving Speed
        '4' : Decrease Raven Moving Speed
        '5' : Toggle circling direction
        '6' : Toggle pause/resume
        '7' : Toggle console messages
        '8' : Quit
```

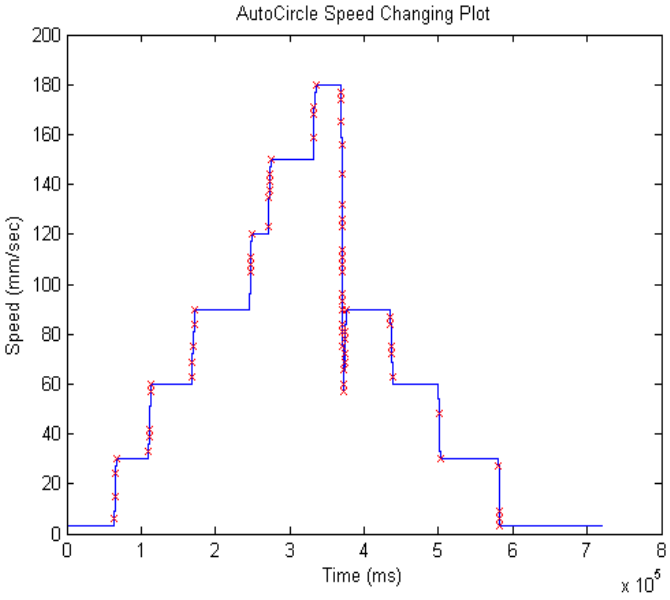
```
       pos_d[0] = 1061 pos_d[1] = 1061 pos_d[2] = 1061
       pos_d[0] = 1061 pos_d[1] = 1061 pos_d[2] = 1061

RADIUS = 1
SPEED = 1

[ INFO] [1472765358.583097032]: talkerAutoCircle publish: raven_automove[98]
[ INFO] [1472765358.625165353]: talkerAutoCircle subscribe: raven_state[1040]
       pos[0] = 1071   pos[1] = 1071   pos[2] = 1071
       pos[3] = 1071   pos[4] = 1071   pos[5] = 1071
       pos_d[0] = 1071 pos_d[1] = 1071 pos_d[2] = 1071
       pos_d[0] = 1071 pos_d[1] = 1071 pos_d[2] = 1071

RADIUS = 1
SPEED = 1

[ INFO] [1472765359.582715020]: talkerAutoCircle publish: raven_automove[99]
[ INFO] [1472765359.623574904]: talkerAutoCircle subscribe: raven_state[1050]
       pos[0] = 1081   pos[1] = 1081   pos[2] = 1081
       pos[3] = 1081   pos[4] = 1081   pos[5] = 1081
       pos_d[0] = 1081 pos_d[1] = 1081 pos_d[2] = 1081
       pos_d[0] = 1081 pos_d[1] = 1081 pos_d[2] = 1081

RADIUS = 1
```

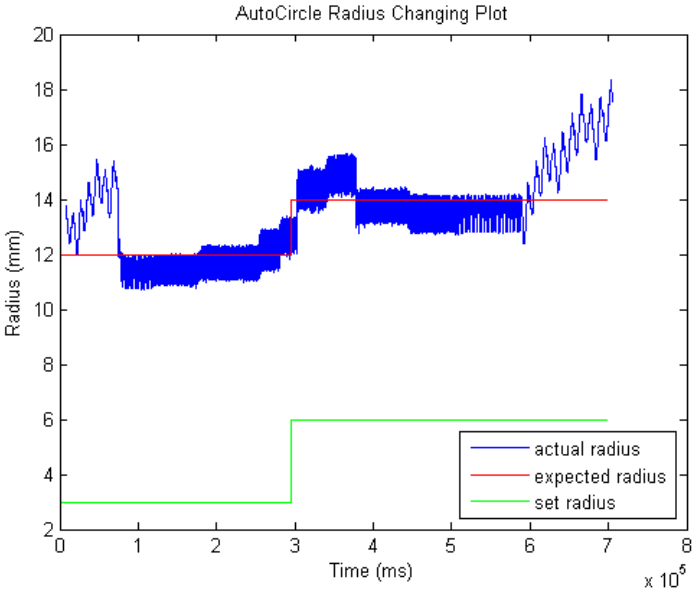
```
[ INFO] [1472765358.622699015]: listenerAutoCircle publish: raven_state[1071]
[ INFO] [1472765359.582907637]: listenerAutoCircle subscribe: raven_automove[98]
       data1.xd[0] = (99,99,99)
       data1.rd[0] =
               0.997007        0.0625567       -0.0454212
               -0.0611202      0.997606        0.0323557
               0.0473365       -0.0294827      0.998444
       data1.xd[1] = (99,99,99)
       data1.rd[1] =
               -0.638107       0.069689        0.766787
               0.716603        -0.310486       0.624563
               0.281602        0.94802 0.148184


[ INFO] [1472765359.623292417]: listenerAutoCircle publish: raven_state[1081]
[ INFO] [1472765360.583542681]: listenerAutoCircle subscribe: raven_automove[99]
       data1.xd[0] = (100,100,100)
       data1.rd[0] =
               0.72746 0.607357        -0.319248
               -0.476538       0.781968        0.401793
               0.493674        -0.140155       0.858279
       data1.xd[1] = (100,100,100)
```

6. Data Analysis on Matlab









Radius Level	Speed Level	Actual Radius (distance from center)	K Value
Level 1 (=0.3cm)	Level 1 (=0.3cm/sec)	1.2 cm ~ 1.3 cm	0.02
Level 1 (=0.3cm)	Level 10 (=3cm/sec)	1.2 cm ~ 1.3 cm	0.08 ~ 0.09
Level 1 (=0.3cm)	Level 20 (=6cm/sec)	1.1 cm ~ 1.2 cm	0.15
Level 1 (=0.3cm)	Level 30 (=9cm/sec)	1.1 cm ~ 1.2 cm	0.20
Level 1 (=0.3cm)	Level 40 (=12cm/sec)	1.2 cm ~ 1.3 cm	0.26
Level 1 (=0.3cm)	Level 50 (=15cm/sec)	1.2 cm ~ 1.3 cm	0.3
Level 2 (=0.6cm)	Level 1 (=0.3cm/sec)	1.43 cm	0.018
Level 2 (=0.6cm)	Level 10 (=3cm/sec)	1.35 cm	0.08
Level 2 (=0.6cm)	Level 20 (=6cm/sec)	1.33 cm	0.13
Level 2 (=0.6cm)	Level 30 (=9cm/sec)	1.39 cm ~ 1.40 cm	0.18
Level 2 (=0.6cm)	Level 50 (=15cm/sec)	1.443 cm	0.28