INVARIANTI GEOMETRICI ISTANTANEI PER I MOTI CICLOIDALI

FORMULE GENERALI

ESPRESSIONE DELLA CURVATURA, E DELLE SUE DUE DERIVATE SUCCESSIVE NEL RIFERIMENTO CANONICO

ESPRESSIONE DELLA CIRCONFERENZA DEI FLESSI NEL RIFERIMENTO CANCONICO

$$ku := \frac{\Xi1(\chi)\,Y2(\chi) - \Xi2(\chi)\,Y1(\chi)}{(\Xi1(\chi)^2 + Y1(\chi)^2)^{(3/2)}}$$

$$kud1 := \frac{\Xi1(\chi)\,Y3(\chi) - \Xi3(\chi)\,Y1(\chi)}{(\Xi1(\chi)^2 + Y1(\chi)^2)^{(3/2)}} - \frac{3\,(\Xi1(\chi)\,Y2(\chi) - \Xi2(\chi)\,Y1(\chi))\,(2\,\Xi1(\chi)\,\Xi2(\chi) + 2\,Y1(\chi)\,Y2(\chi))}{2\,(\Xi1(\chi)^2 + Y1(\chi)^2)^{(5/2)}}$$

$$kud2 := (2\,\Xi1(\chi)\,\Xi2(\chi) + 2\,Y1(\chi)\,Y2(\chi))\,\Xi1(\chi)\,Y3(\chi) + (\Xi1(\chi)^2 + Y1(\chi)^2)\,\Xi2(\chi)\,Y3(\chi) + (\Xi1(\chi)^2 + Y1(\chi)^2)\,\Xi1(\chi)\,Y4(\chi) - (2\,\Xi1(\chi)\,\Xi2(\chi) + 2\,Y1(\chi)\,Y2(\chi))\,\Xi3(\chi)\,Y1(\chi) - (\Xi1(\chi)^2 + Y1(\chi)^2)\,\Xi4(\chi)\,Y1(\chi)$$
$$- (\Xi1(\chi)^2 + Y1(\chi)^2)\,\Xi3(\chi)\,Y2(\chi) - 3\,\Xi1(\chi)\,Y2(\chi)\,\Xi2(\chi)^2 - 3\,\Xi1(\chi)^2\,Y3(\chi)\,\Xi2(\chi) - 3\,\Xi1(\chi)^2\,Y2(\chi)\,\Xi3(\chi) + 3\,\Xi2(\chi)\,Y2(\chi)^2\,Y1(\chi) - 6\,\Xi1(\chi)\,Y2(\chi)\,Y1(\chi)\,Y3(\chi) - 3\,\Xi1(\chi)\,Y2(\chi)^3 + 6\,\Xi2(\chi)\,Y1(\chi)\,\Xi1(\chi)\,\Xi3(\chi) + 3\,\Xi2(\chi)^3\,Y1(\chi)$$
$$+ 3\,\Xi3(\chi)\,Y1(\chi)^2\,Y2(\chi) + 3\,\Xi2(\chi)\,Y1(\chi)^2\,Y3(\chi)$$

$$fless := \Xi1(\chi)\,Y2(\chi) - \Xi2(\chi)\,Y1(\chi)$$

ESPRESSIONE DELLA CURVATURA, E DELLE SUE DUE DERIVATE SUCCESSIVE MEDIANTE INVARIANTI ISTANTANEI GEOMETRICI CALCOLATI NEL RIFERIMENTO CANONICO

ESPRESSIONE DELLA CIRCONFERENZA DEI FLESSI MEDIANTE GLI INVARIANTI ISTANTANEI GEOMETRICI CALCOLATI NEL RIFERIMENTO CANONICO

$$cu := -\frac{\eta\, b_2}{(\eta^2 + \xi^2)^{(3/2)}} + \frac{\eta^2}{(\eta^2 + \xi^2)^{(3/2)}} + \frac{\xi^2}{(\eta^2 + \xi^2)^{(3/2)}}$$

$$fless := -\eta\, b_2 + \eta^2 + \xi^2$$

$$cucusta = -\eta^3 b_3 - \eta\,\xi^2 b_3 - \xi\,\eta^2 a_3 - \xi^3 a_3 - 3\,\eta^2\,\xi\, b_2 + 3\,\eta\,\xi\, b_2^2 - 3\,\xi^3 b_2$$

$$cucu2 := 4\,\eta\,\xi\, b_2\, b_3 - 3\,\xi^2 b_2^2 + 3\,\eta\, b_2^3 + 5\,\eta\,\xi^2 b_2 - 4\,\eta^2 b_2\, a_3 - 4\,\xi^3 b_3 + 4\,\eta^3 a_3 - \xi^2\,\eta\, b_4 + 4\,\xi^2\,\eta\, a_3 - \eta^2\,\xi\, a_4 + 5\,\eta^3 b_2 - 4\,\eta^2\,\xi\, b_3 - 9\,\eta^2 b_2^2 - \xi^3 a_4 - \eta^3 b_4$$

EQUAZIONI DELLE CARATTERISTICHE DEL POLO DELLE VELOCITA' GEOMETRICHE

$$X1_0 := Xo_0 - Yo_1$$
$$Y1_0 := Yo_0 + Xo_1$$
$$X1_1 := 0$$
$$Y1_1 := 0$$
$$X1_2 := Xo_2 + Yo_1$$
$$Y1_2 := Yo_2 - Xo_1$$
$$X1_3 := Xo_3 + Xo_1$$
$$Y1_3 := Yo_3 + Yo_1$$
$$X1_4 := Xo_4 - Yo_1$$
$$Y1_4 := Yo_4 + Xo_1$$

INDIVIDUAZIONE DEL RIFERIMENTO CANONICO (OVVERO DEI VERSORI T ED N)

$$N := \left[\frac{Xo_2 + Yo_1}{b_2}, \frac{Yo_2 - Xo_1}{b_2} \right]$$
$$T := \left[\frac{Yo_2 - Xo_1}{b_2}, -\frac{Xo_2 + Yo_1}{b_2} \right]$$

CALCOLO DEGLI INVARIANTI

$$b_2 := \sqrt{Xo_2^{\,2} + 2\, Xo_2\, Yo_1 + Yo_1^{\,2} + Yo_2^{\,2} - 2\, Yo_2\, Xo_1 + Xo_1^{\,2}}$$
$$a_3 := \frac{(Xo_3 + Xo_1)\,(Yo_2 - Xo_1) - (Yo_3 + Yo_1)\,(Xo_2 + Yo_1)}{\sqrt{Xo_2^{\,2} + 2\, Xo_2\, Yo_1 + Yo_1^{\,2} + Yo_2^{\,2} - 2\, Yo_2\, Xo_1 + Xo_1^{\,2}}}$$
$$b_3 := \frac{(Xo_3 + Xo_1)\,(Xo_2 + Yo_1) - (Yo_3 + Yo_1)\,(Yo_2 - Xo_1)}{\sqrt{Xo_2^{\,2} + 2\, Xo_2\, Yo_1 + Yo_1^{\,2} + Yo_2^{\,2} - 2\, Yo_2\, Xo_1 + Xo_1^{\,2}}}$$

$$a_4 := \frac{(Xo_4 - Yo_1)(Yo_2 - Xo_1) - (Yo_4 + Xo_1)(Xo_2 + Yo_1)}{\sqrt{Xo_2^{\,2} + 2\,Xo_2\,Yo_1 + Yo_1^{\,2} + Yo_2^{\,2} - 2\,Yo_2\,Xo_1 + Xo_1^{\,2}}}$$

$$b_4 := \frac{(Xo_4 - Yo_1)(Xo_2 + Yo_1) - (Yo_4 + Xo_1)(Yo_2 - Xo_1)}{\sqrt{Xo_2^{\,2} + 2\,Xo_2\,Yo_1 + Yo_1^{\,2} + Yo_2^{\,2} - 2\,Yo_2\,Xo_1 + Xo_1^{\,2}}}$$

FORMULE DI TRASFORMAZIONE

$$X := Xo_0 + x\cos(\theta) - y\sin(\theta)$$
$$Y := Yo_0 + x\sin(\theta) + y\cos(\theta)$$

MOTI CICLOIDALI

CALCOLO DELLE CARATTERISTICHE DELL'ORIGINE o DEL SISTEMA MOBILE

ESPRESSIONE DELL'ANGOLO DI ROTAZIONE DEL PIANO MOBILE NEI MOTI CICLOIDALI

$$\theta := -\frac{r\,\psi}{R - r}$$

ESPRESSIONE DELLE CARATTERISTICHE DELL'ORIGINE DEL RIFERIMENTO MOBILE o

$$Xo_0 := (R - r)\cos\left(\frac{r\,\psi}{R - r}\right)$$

$$Yo_0 := -(R - r)\sin\left(\frac{r\,\psi}{R - r}\right)$$

$$Xo_1 := -\sin\left(\frac{r\,\psi}{R - r}\right) r$$

$$Yo_1 := -\cos\left(\frac{r\,\psi}{R - r}\right) r$$

$$Xo_2 := -\frac{\cos\left(\frac{r\,\psi}{R-r}\right) r^2}{R-r}$$

$$Yo_2 := \frac{\sin\left(\frac{r\,\psi}{R-r}\right) r^2}{R-r}$$

$$Xo_3 := \frac{\sin\left(\frac{r\,\psi}{R-r}\right) r^3}{(R-r)^2}$$

$$Yo_3 := \frac{\cos\left(\frac{r\,\psi}{R-r}\right) r^3}{(R-r)^2}$$

$$Xo_4 := \frac{\cos\left(\frac{r\,\psi}{R-r}\right) r^4}{(R-r)^3}$$

$$Yo_4 := -\frac{\sin\left(\frac{r\,\psi}{R-r}\right) r^4}{(R-r)^3}$$

DEFINIZIONE DELLA POSIZIONE DELL'ORIGINE (ANGOLO PSI NULLO) E CONSEGUENTE CALCOLO

$$\psi := 0$$

assign

$$vel\_o\_x := 0$$

$$vel\_o\_Y := -r$$

$$acc\_o\_x := -\frac{r^2}{R-r}$$

$$acc\_o\_y := 0$$

$$jerk\_o\_x := 0$$

$$jerk\_o\_y := \frac{r^3}{(R-r)^2}$$

$$jounce\_o\_x := \frac{r^4}{(R-r)^3}$$

$$jounce\_o\_y := 0$$

$$inv\_b2 := \sqrt{\frac{r^2 R^2}{(-R+r)^2}}$$

$$inv\_a3 := -\frac{r^2 R^2 (-R+2r)}{(-R+r)^3 \sqrt{\frac{r^2 R^2}{(-R+r)^2}}}$$

$$inv\_b3 := 0$$

$$inv\_a4 := 0$$

$$inv\_b4 := -\frac{r^2 R^2 (R^2 - 3Rr + 3r^2)}{(-R+r)^4 \sqrt{\frac{r^2 R^2}{(-R+r)^2}}}$$

Assegnazione dei parametri input.

R = raggio della polare fissa
r = raggio della polare mobile

$$R := 1$$

$$r := 0.25$$

$$-\frac{0.3333333333\,\eta}{(\eta^2+\xi^2)^{(3/2)}} + \frac{\eta^2}{(\eta^2+\xi^2)^{(3/2)}} + \frac{\xi^2}{(\eta^2+\xi^2)^{(3/2)}}$$

$$-0.3333333333\,\eta + \eta^2 + \xi^2$$

$$-0.7777777777\,\xi\,\eta^2 - 0.7777777777\,\xi^3 + 0.3333333333\,\eta\,\xi$$

$$-0.3333333333\,\xi^2 + 0.1111111111\,\eta + 1.037037036\,\eta\,\xi^2 - 0.7037037037\,\eta^2 + 1.037037036\,\eta^3$$

$$rag\_cer := 0.01000000000$$

$$fless\_R = 0.3333333333\,\xi + 1.000000000\,\xi^2 + 1.000000000\,\eta^2$$

$$eq\_fless := 0.3333333333\,\xi - 0.3333333333 + 1.000000000\,(\xi - 1.00)^2 + 1.000000000\,\eta^2 = 0$$

cardan := {Λ(*color* = *cyan*, *thickness* = 1), *CERO*(*color* = *black*, *thickness* = 2, *filled* = *true*), *CERB*(*color* = *blue*, *thickness* = 2, *filled* = *true*), λ(*color* = *cyan*, *thickness* = 1), *FLEX*(*color* = *red*, *thickness* = 1), *CERS*(*color* = *yellow*, *thickness* = 4, *filled* = *true*)}

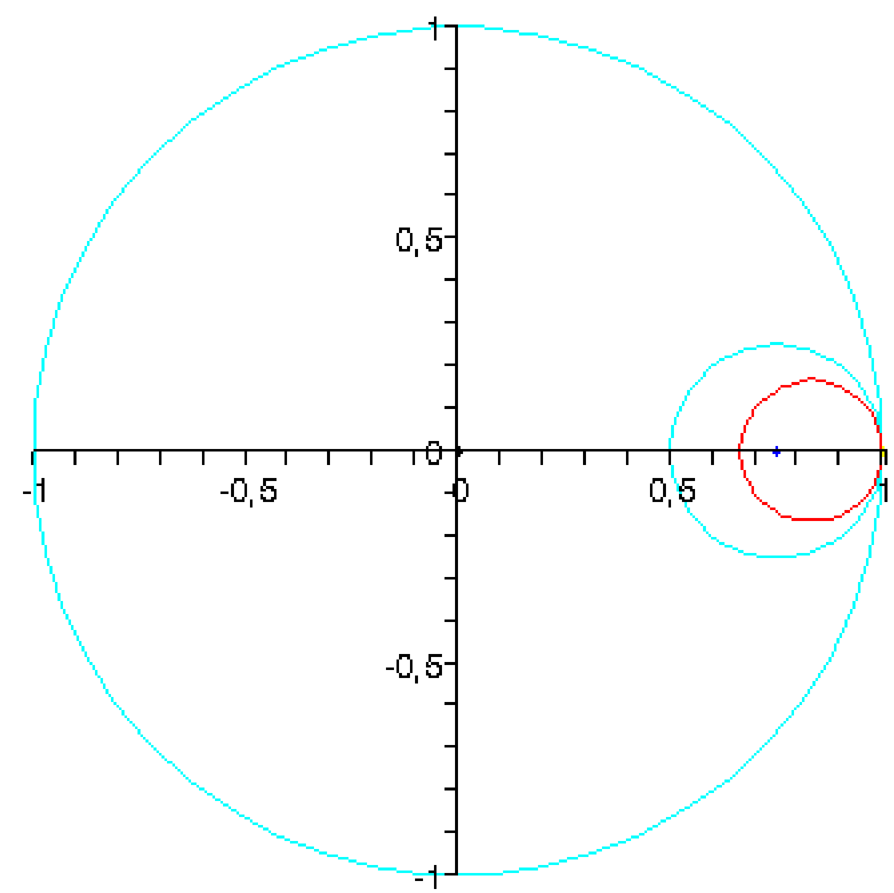


GRAFICO DELLA CUBICA DI CURVATURA STAZIONARIA E DELLA SUA DERIVATA

(parametrica)

$$cucupar := -0.1111111111\,h^2\cos(\zeta)\,(7.\,h - 3.\,\sin(\zeta))$$

$$cucupar := -0.1111111111\cos(\zeta)\,(7.\,h - 3.\,\sin(\zeta))$$

$$h(\zeta) := 0.4285714286\sin(\zeta)$$

$$cucu\_2D\_par := 0.3703703704\,h^2\cos(\zeta)^2 - 0.7037037037\,h^2 + 0.1111111111\,h\sin(\zeta) + 1.037037036\sin(\zeta)\,h^3$$

$$cucu\_2D\_par := 0.3703703704\,h\cos(\zeta)^2 - 0.7037037037\,h + 0.1111111111\sin(\zeta) + 1.037037036\,h^2\sin(\zeta)$$

$$h2\_soluz = \frac{4.821428576\ 10^{-11}\left(3.333333333\ 10^{9} + 3.703703704\ 10^{9}\sin(\zeta)^{2} + \sqrt{1.111111111\ 10^{19} - 2.139917690\ 10^{19}\sin(\zeta)^{2} + 1.371742113\ 10^{19}\sin(\zeta)^{4}}\right)}{\sin(\zeta)},$$

$$\frac{4.821428576\ 10^{-11}\left(3.333333333\ 10^{9} + 3.703703704\ 10^{9}\sin(\zeta)^{2} - 1.\sqrt{1.111111111\ 10^{19} - 2.139917690\ 10^{19}\sin(\zeta)^{2} + 1.371742113\ 10^{19}\sin(\zeta)^{4}}\right)}{\sin(\zeta)}$$

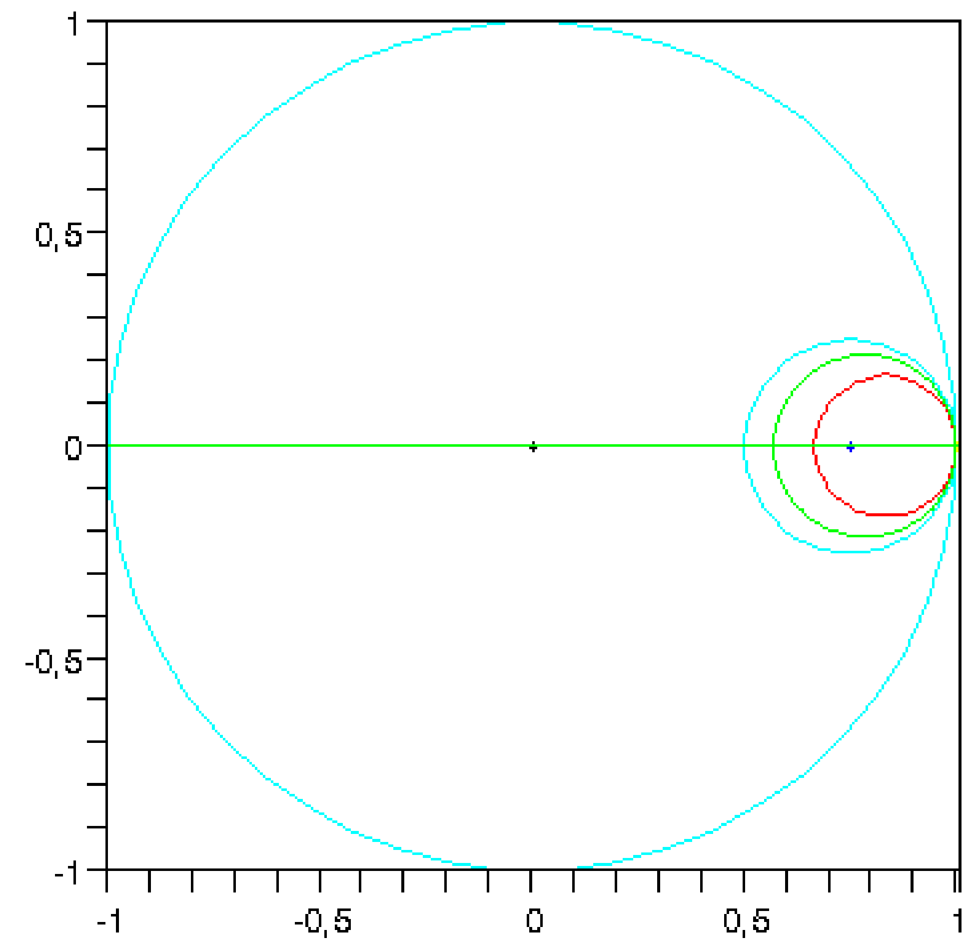
$$h2(\zeta) := \frac{4.821428576\ 10^{-11}\left(3.333333333\ 10^{9} + 3.703703704\ 10^{9}\sin(\zeta)^{2} + \sqrt{1.111111111\ 10^{19} - 2.139917690\ 10^{19}\sin(\zeta)^{2} + 1.371742113\ 10^{19}\sin(\zeta)^{4}}\right)}{\sin(\zeta)}$$

$$h22(\zeta) := \frac{4.821428576\ 10^{-11}\left(3.333333333\ 10^{9} + 3.703703704\ 10^{9}\sin(\zeta)^{2} - 1.\sqrt{1.111111111\ 10^{19} - 2.139917690\ 10^{19}\sin(\zeta)^{2} + 1.371742113\ 10^{19}\sin(\zeta)^{4}}\right)}{\sin(\zeta)}$$

$$cucu\_li\_parte = \xi = 0$$

$$cucu\_li\_parte = 1.000000000\ \eta = 0$$

$$cucu\_li\_parte = 1.000000000\ \eta = 0$$



DERIVATA DELLA CUBICA DI CURVATURA STAZIONARIA

$i := 18$

$zeta\_par := 0.3141592654$

$$\frac{4.821428576\ 10^{-11} \left(3.333333333\ 10^{9} + 3.703703704\ 10^{9} \sin(\zeta)^2 + \sqrt{1.111111111\ 10^{19} - 2.139917690\ 10^{19} \sin(\zeta)^2 + 1.371742113\ 10^{19} \sin(\zeta)^4}\right)}{\sin(\zeta)}$$

$h\_polar := 1.048323963$

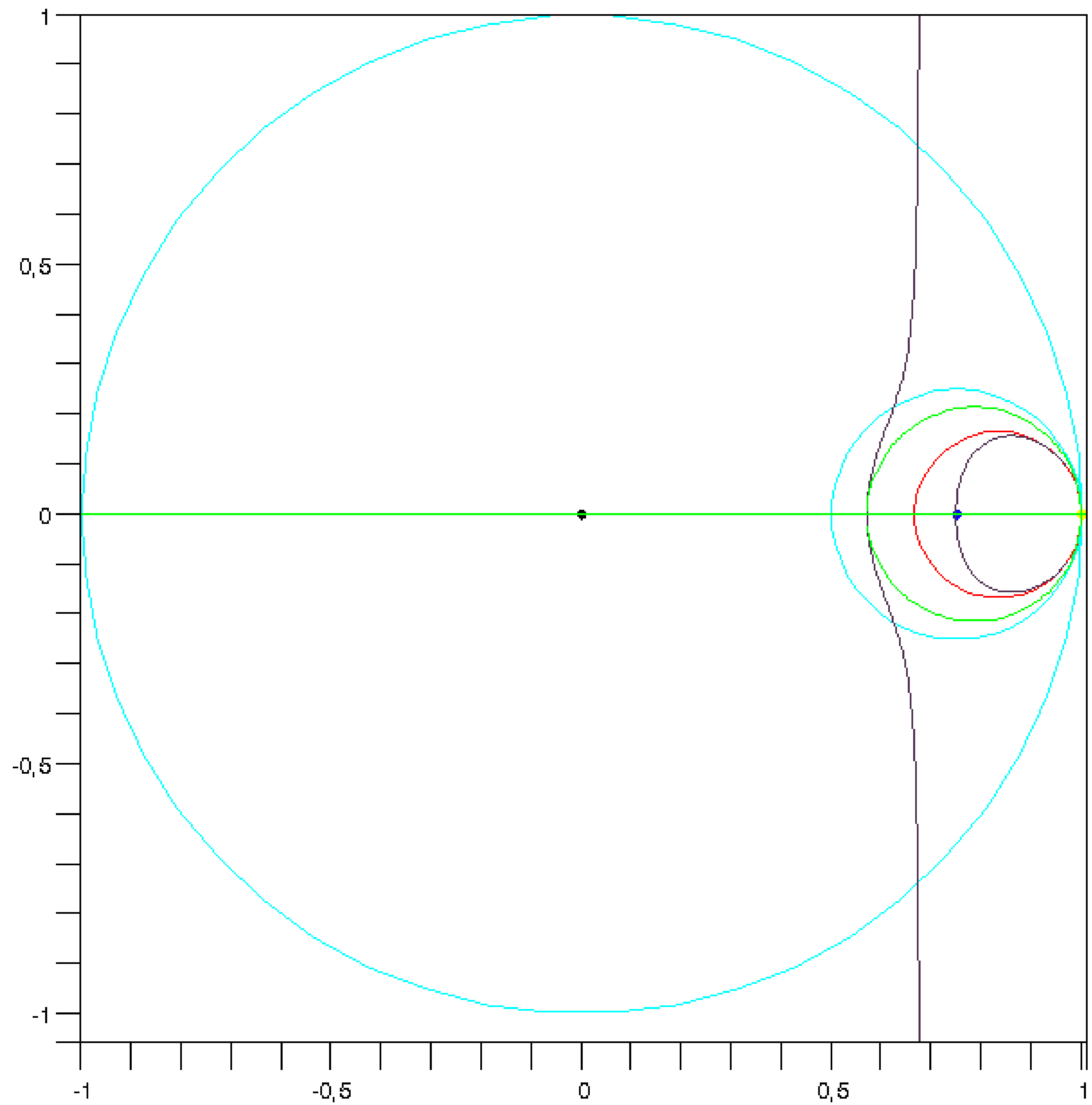
$i := 18$

$zeta\_par := 0.3141592654$

$$\frac{4.821428576\ 10^{-11} \left(3.333333333\ 10^{9} + 3.703703704\ 10^{9} \sin(\zeta)^2 - 1.\ \sqrt{1.111111111\ 10^{19} - 2.139917690\ 10^{19} \sin(\zeta)^2 + 1.371742113\ 10^{19} \sin(\zeta)^4}\right)}{\sin(\zeta)}$$

$h\_polar := 0.1022039570$

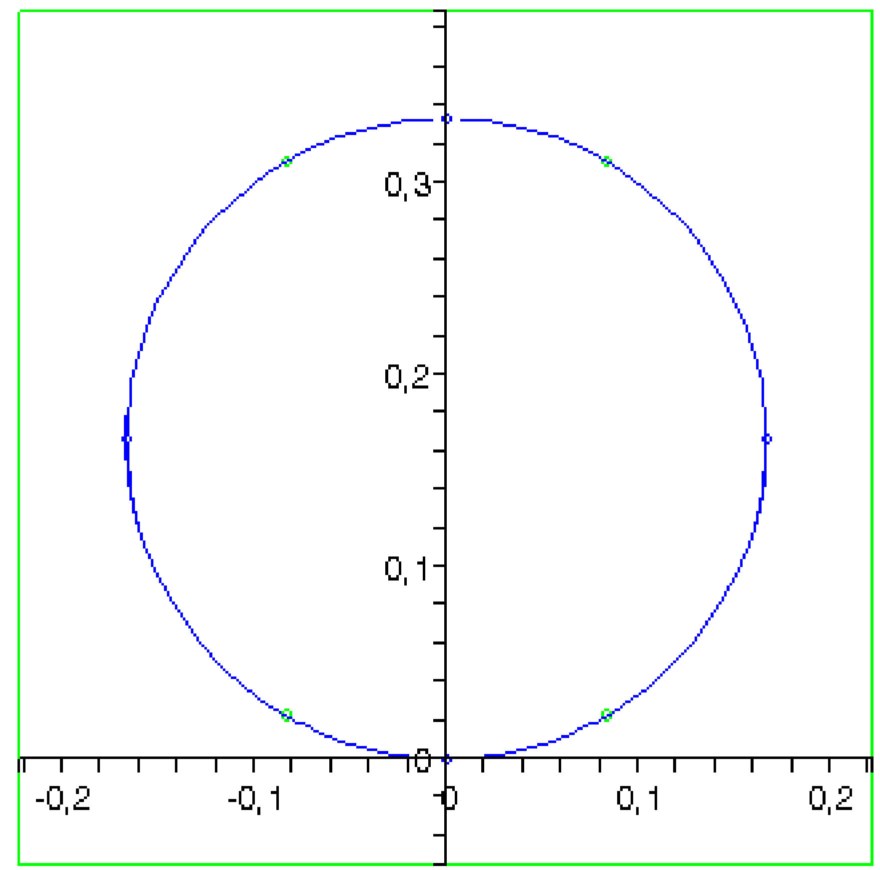
$i := 200$



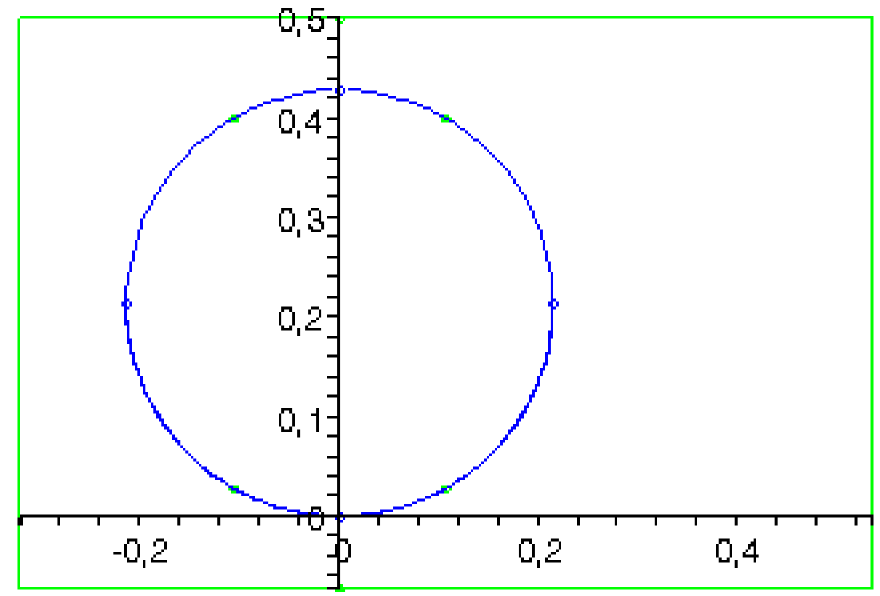
1
0,5
0
-0,5
-1
-1
-0,5
0
0,5
1

```
Warning, the name homology has been redefined
```

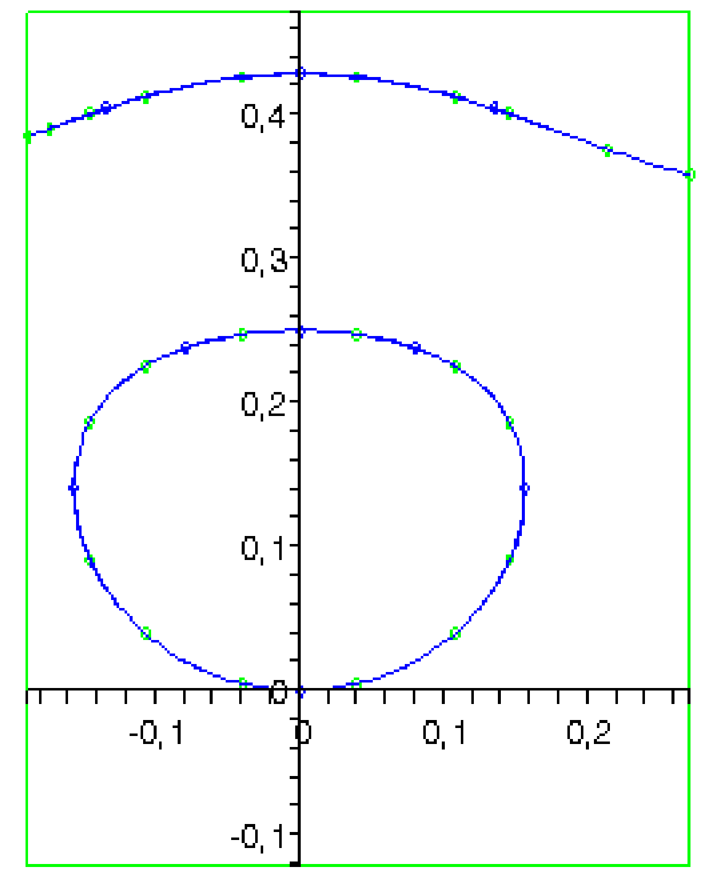
$$fless\_p := -0.3333333333\,y + y^2 + x^2$$



$$cucusta\_p := -0.7777777777\,x\,y^2 - 0.7777777777\,x^3 + 0.3333333333\,y\,x$$



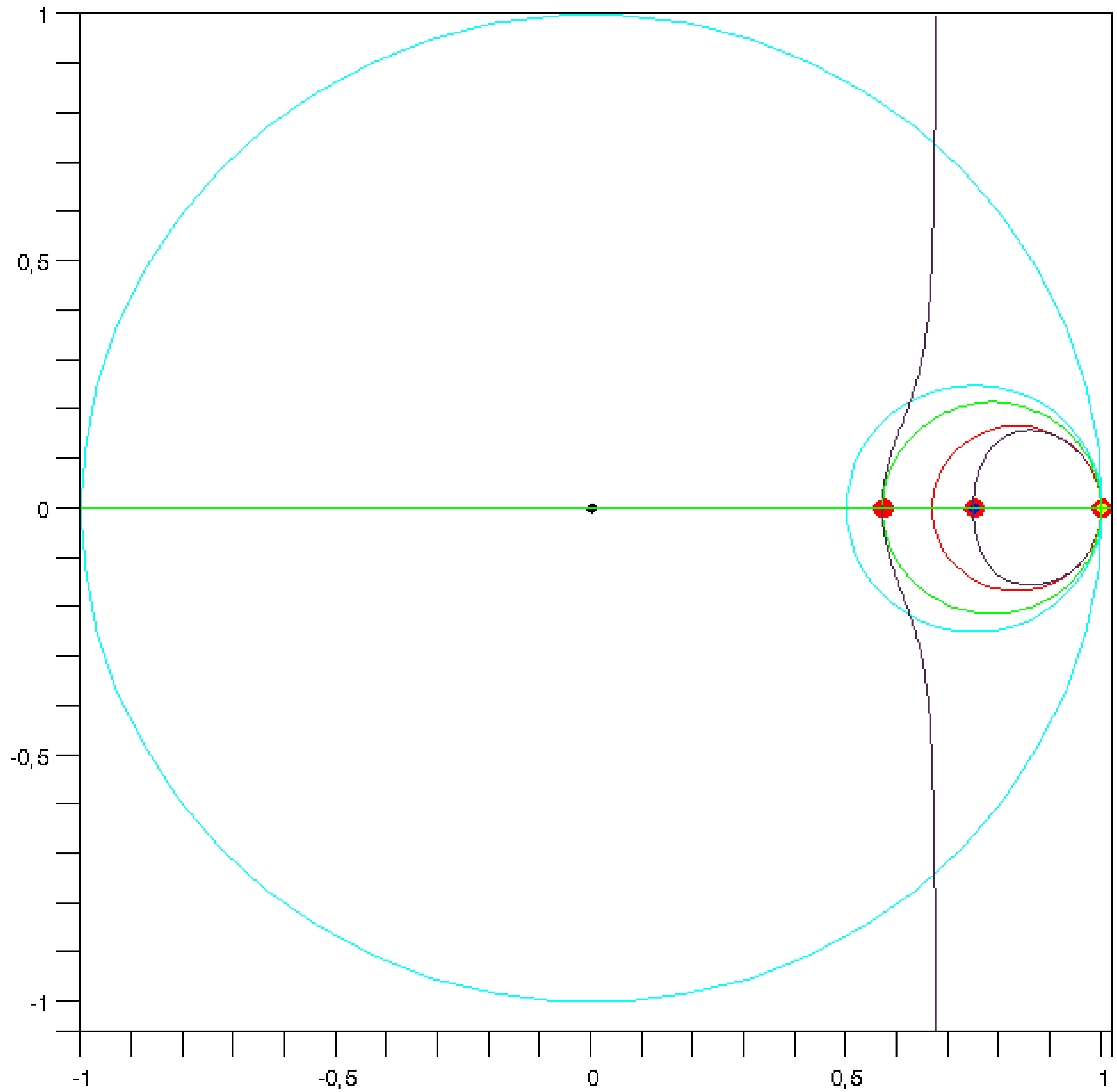
$$cucu2\_p = -0.3333333333\,x^2 + 0.1111111111\,y + 1.037037036\,y\,x^2 - 0.7037037037\,y^2 + 1.037037036\,y^3$$



DETERMINAZIONE DEI PUNTI DI BURMESTER

$Burmester := \{x = 0., y = 0.\}, \{x = 0., y = 0.2499999996\}, \{x = 0., y = 0.4285714297\}, \{x = -0.00003401680279\, I, y = 0.4285714313\}, \{y = 0.4285714313, x = 0.00003401680279\, I\}$

$Bur\_punti := \{\}$


1
0,5
0
-0,5
-1
-1
-0,5
0
0,5
1

$$1$$
$$0.25$$
$$1.00$$
$$0.$$
$$0.7500000004$$
$$0.$$
$$0.5714285703$$
$$0.$$
$$0.5714285687 - 0.\,I$$
$$0. - 0.00003401680279\,I$$
$$0.5714285687 + 0.\,I$$
$$0. + 0.00003401680279\,I$$
$$0.5714285703$$
$$0.$$
$$0.$$
$$0.4285714297$$
$$X := Ox + x\cos(q) - y\sin(q)$$
$$Y := Oy + x\sin(q) + y\cos(q)$$
$$t := -0.3333333333\,q$$
$$Ox := 0.75\cos(0.3333333333\,q)$$
$$Oy := -0.75\sin(0.3333333333\,q)$$
$$x := -.1785714297$$
$$y := 0.$$
$$0.75\cos(0.3333333333\,q) - 0.1785714297\cos(q)$$
$$-0.75\sin(0.3333333333\,q) - 0.1785714297\sin(q)$$
$$\rho2 := 1.928571416$$
$$\Omega_{B2\_x} := 2.499999986$$
$$\Omega_{B2\_y} := 0.$$
$$OmegaB2$$
$$i := 1$$
$$ang := 0.01745329252$$
$$x\_pol := 0.5714430753$$
$$y\_pol := -0.007479799686$$
$$Ball\_Y := 0$$
$$ball\_retta := -0.3333333333\,\eta + \eta^2$$
$$Ball\_X := 0.6666666667$$

Ball

$$x := -0.0833333333$$

$$y := 0$$

$$X := 0.75 \cos(0.3333333333\, q) - 0.0833333333 \cos(q)$$

$$Y := -0.75 \sin(0.3333333333\, q) - 0.0833333333 \sin(q)$$

$$i := 1$$

$$ang := 0.01745329252$$

$$x\_pol := 0.6666666665$$

$$y\_pol := -0.005817665719$$

$$x := 4\ 10^{-10}$$

$$y := 0.$$

$$X := 0.75 \cos(0.3333333333\, q) + 4\ 10^{-10} \cos(q)$$

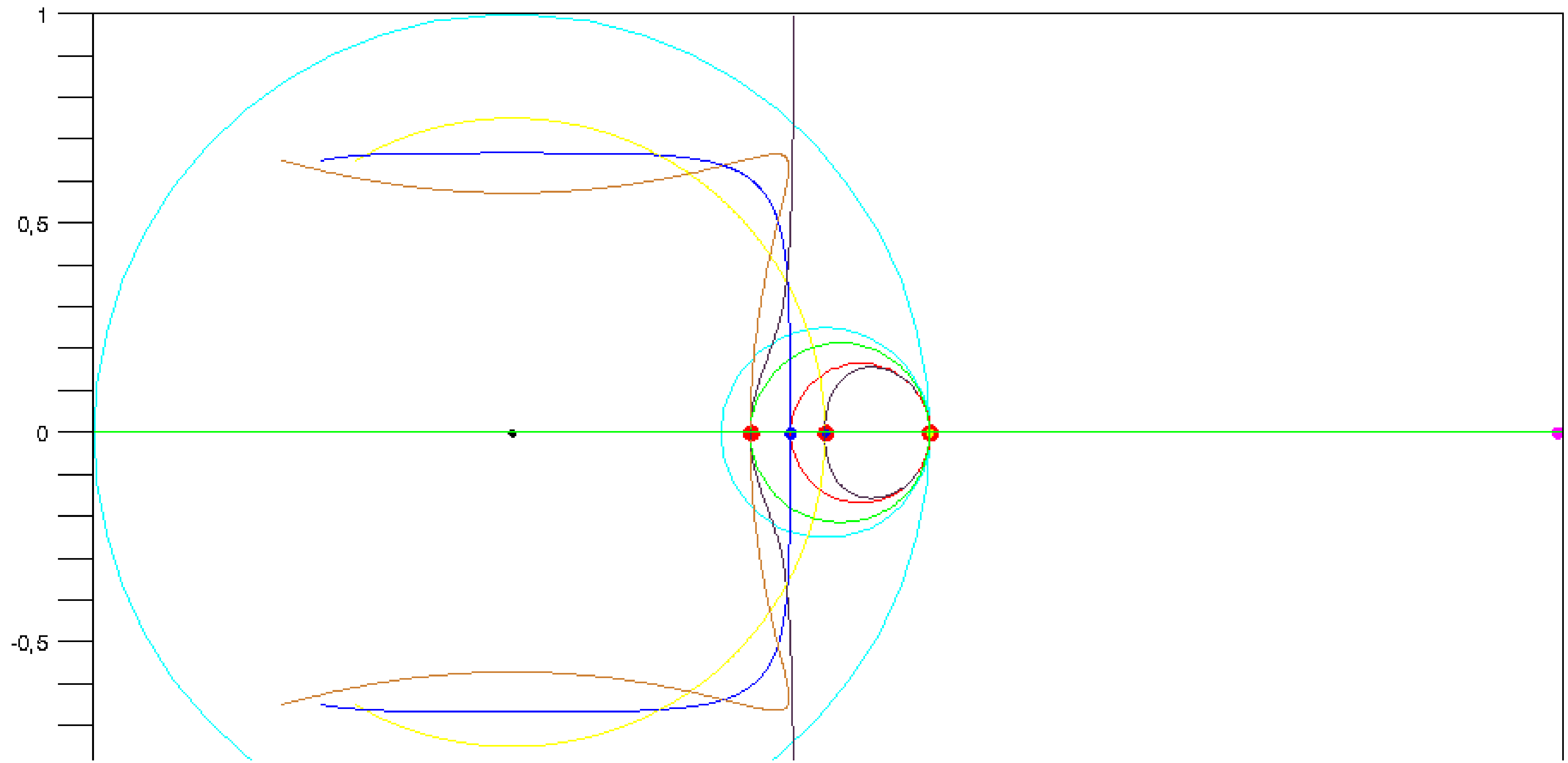
$$Y := -0.75 \sin(0.3333333333\, q) + 4\ 10^{-10} \sin(q)$$

$$i := 1$$

$$ang := 0.01745329252$$

$$x\_pol := 0.7499873081$$

$$y\_pol := -0.004363298509$$



1
0,5
0
-0,5