isol

Coupled ODE

$$D_1 := (x+\mu)^2 + y^2 \qquad D_2 := (x-\mu p)^2 + y^2$$

$$x''_{eq} := x + 2\cdot y' - \frac{\mu p}{D_1\cdot\sqrt{D_1}}\cdot(x+\mu) - \frac{\mu}{D_2\cdot\sqrt{D_2}}\cdot(x-\mu p)$$

$$y''_{eq} := y\cdot\left(1 - \frac{\mu p}{D_1\cdot\sqrt{D_1}} - \frac{\mu}{D_2\cdot\sqrt{D_2}}\right) - 2\cdot x'$$

Push y'' into x''

$$x''_{eq} := isol\left(x'' = x''_{eq}\,\middle|\, y'' = y''_{eq}, x''\right)$$

Now x''.eq is free of y''. We use that in D

ODE System

$$D(t,u) := \left|\begin{array}{l} [\,x\ x'\ y\ y'\,] := [\,u_1\ u_2\ u_3\ u_4\,] \\ x'' := x''_{eq} \\ [\,x'\ x''\ y'\ y''_{eq}\,]^{T} \end{array}\right.$$

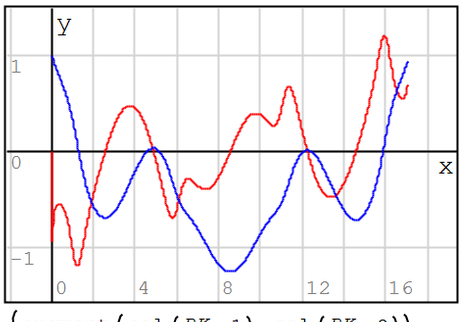
Numerical example

$$ic := \text{stack}(0.994,\ 0,\ 0,\ -2.001585106) \qquad steps := 1000$$

$$\mu := 0.012277471 \qquad \mu p := 1-\mu \qquad t_{max} := 17$$

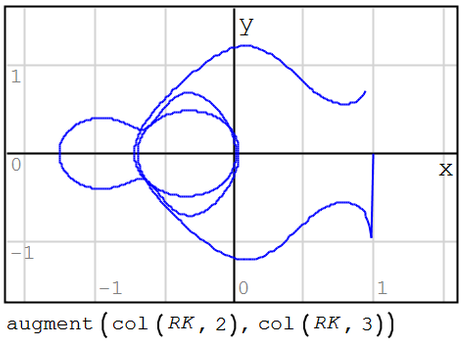
$$RK := \text{Rkadapt}(ic,\ 0,\ t_{max},\ steps,\ D)$$

x(t) & y(t)



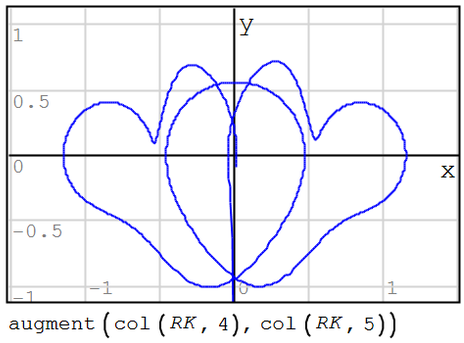
$$\begin{cases} \text{augment}(\text{col}(RK,1),\ \text{col}(RK,2)) \\ \text{augment}(\text{col}(RK,1),\ \text{col}(RK,3)) \end{cases}$$

x'' vs x'



$$\text{augment}(\text{col}(RK,2),\ \text{col}(RK,3))$$

y'' vs y'



$$\text{augment}(\text{col}(RK,4),\ \text{col}(RK,5))$$

Checking that x''.eq is free of y''

$$\text{Clear}(\mu,\ \mu p) = 1$$

$$\frac{d}{d\,y''} x''_{eq} = 0$$

$$D := D\left(t,\ \begin{bmatrix} x \\ x' \\ y \\ y' \end{bmatrix}\right)$$

$$D = \begin{bmatrix} x' \\ -\dfrac{-\sqrt[2]{(x-\mu p)^2+y^2}^{\,3}\cdot\left(\sqrt[2]{(x+\mu)^2+y^2}^{\,3}\cdot(x+2\cdot y') - \mu p\cdot(x+\mu)\right) + \mu\cdot(x-\mu p)\cdot\sqrt[2]{(x+\mu)^2+y^2}^{\,3}}{\sqrt[2]{(x-\mu p)^2+y^2}^{\,3}\cdot\sqrt[2]{(x+\mu)^2+y^2}^{\,3}} \\ y' \\ \dfrac{y\cdot\left(\left(-\mu p + \sqrt[2]{(x+\mu)^2+y^2}^{\,3}\right)\cdot\sqrt[2]{(x-\mu p)^2+y^2}^{\,3} - \mu\cdot\sqrt[2]{(x+\mu)^2+y^2}^{\,3}\right) - 2\cdot x'\cdot\sqrt[2]{(x-\mu p)^2+y^2}^{\,3}\cdot\sqrt[2]{(x+\mu)^2+y^2}^{\,3}}{\sqrt[2]{(x-\mu p)^2+y^2}^{\,3}\cdot\sqrt[2]{(x+\mu)^2+y^2}^{\,3}} \end{bmatrix}$$

Alvaro