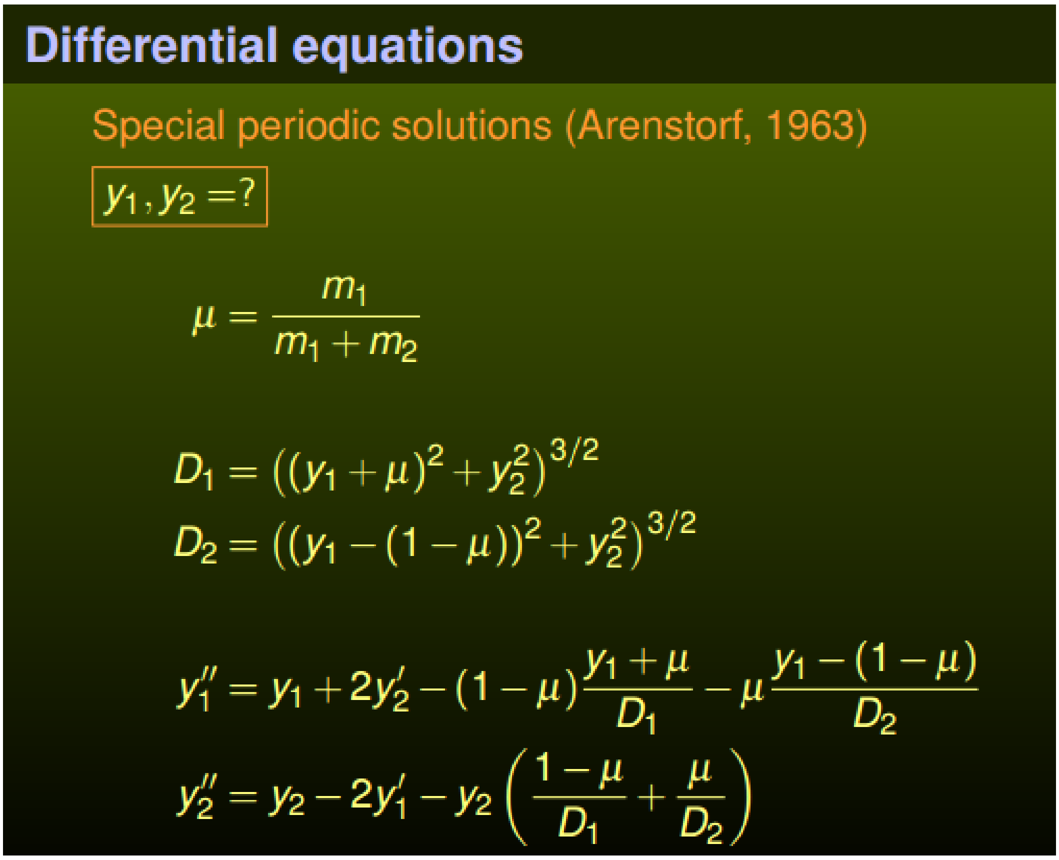
Arenstorf orbit

The Arenstorf orbits are closed trajectories of the restricted three-body problem. Two bodies of masses m and (1-m) moving in a circular rotation, and a third body of negligible mass moving in the same plane (such as a satellite-earth-moon system.)



$$D(t, y, \mu) :=
\begin{array}{|l}
\mu p := 1 - \mu \\
y1 := y_3 \\
y2 := y_4 \\
r1 := \left(y_1 + \mu\right)^2 + y_2^2 \\
r1 := r1 \cdot \sqrt{r1} \\
r2 := \left(y_1 - \mu p\right)^2 + y_2^2 \\
r2 := r2 \cdot \sqrt{r2} \\
y3 := y_1 + 2 \cdot y_4 - \frac{\mu p}{r1} \cdot \left(y_1 + \mu\right) - \frac{\mu}{r2} \cdot \left(y_1 - \mu p\right) \\
y4 := y_2 \cdot \left(1 - \frac{\mu p}{r1} - \frac{\mu}{r2}\right) - 2 \cdot y_3 \\
\mathrm{stack}(y1, y2, y3, y4)
\end{array}$$

```
4 loops:
Mass parameter:   m = 0.012277471

Coordinates:
y1(0)  = 0.994
y2(0)  = 0
y'1(0)  = 0
y'2(0)  = -2.00158510637908252240537862224

Period:
tper = 17.0652165601579625588917206249
```

$$Y := \begin{pmatrix} 0.994 \\ 0 \\ 0 \\ -2.00158510637908252240537862224 \end{pmatrix} \qquad \mu := 0.012277471$$

$t0 := 0 \quad n := 200 \qquad tmax := 17.0652165601579625588917206249$

res := gslrk2(Y , t0 , tmax , n , D(t , y , μ))

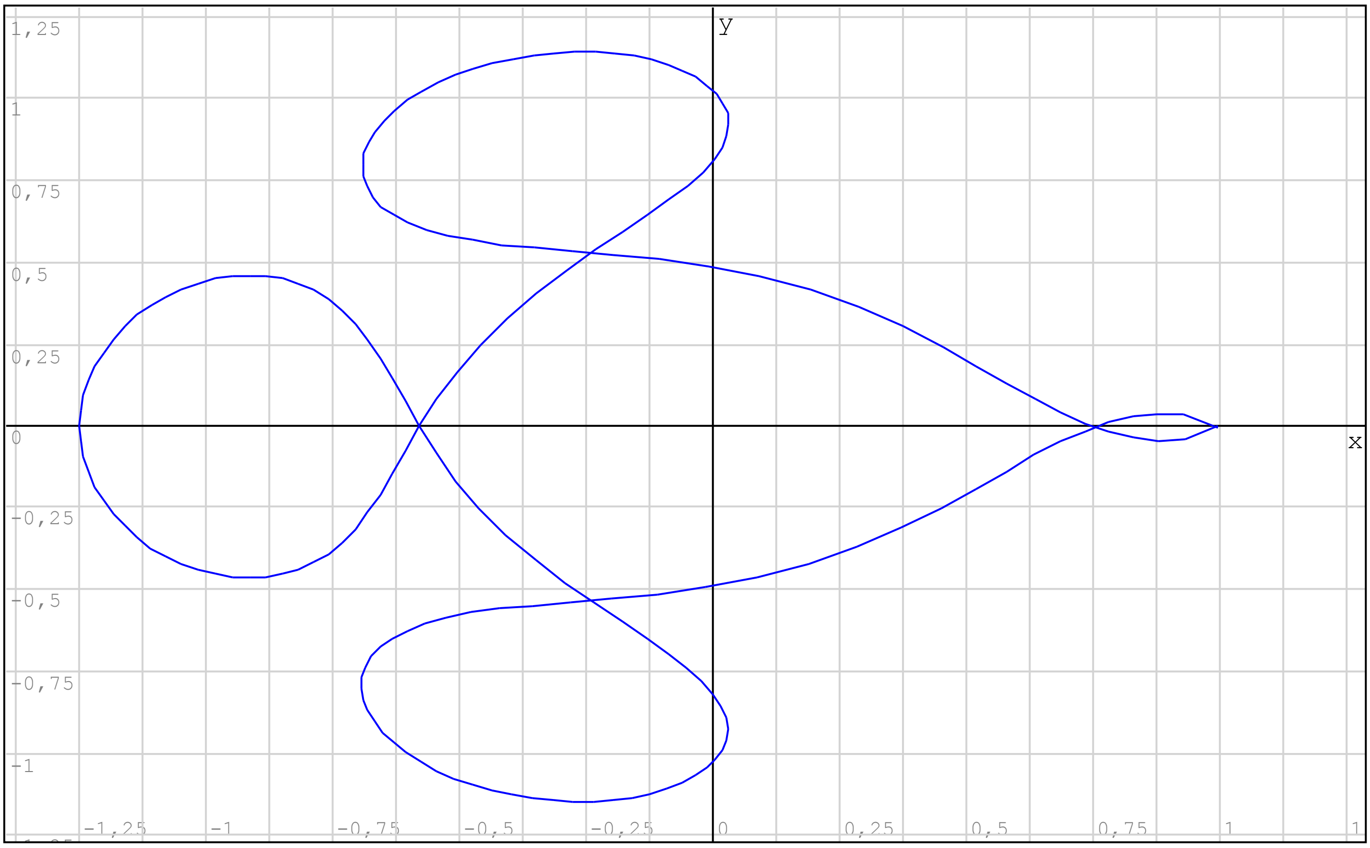
res := gslrk4(Y , t0 , tmax , n , D(t , y , μ))

res := gslrkf45(Y , t0 , tmax , n , D(t , y , μ))

res := gslrkck(Y , t0 , tmax , n , D(t , y , μ))

res := gslrk8pd(Y , t0 , tmax , n , D(t , y , μ))

T := col(res , 1)   Y11 := col(res , 2)   Y12 := col(res , 3)



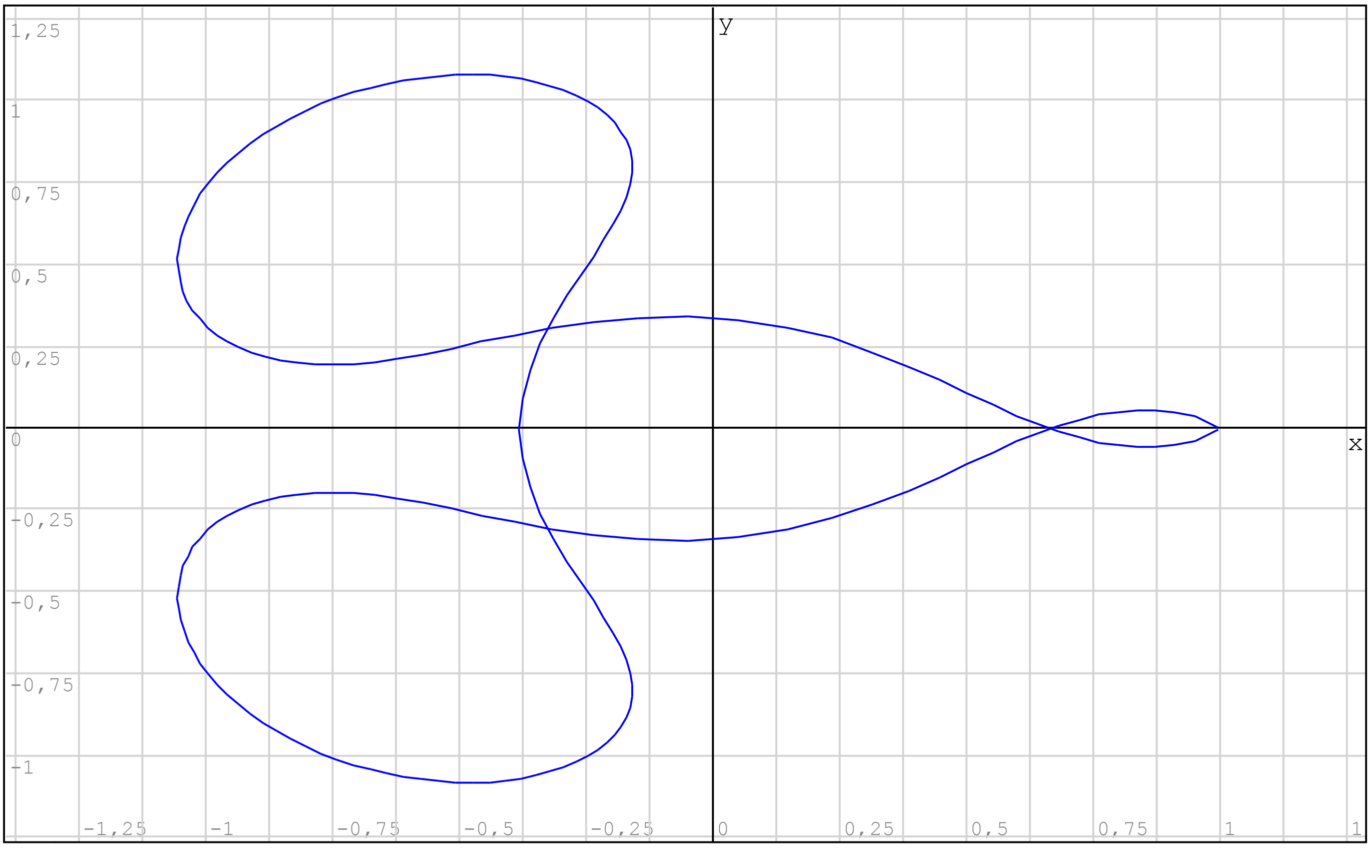
augment(Y11 , Y12)

```
3 loops:
Mass parameter:   m = 0.012277471

Coordinates:
y1(0)  = 0.994
y2(0)  = 0
y'1(0)  = 0
y'2(0)  = -2.0317326295573368357302057924

Period:
tper = 11.124340337266085134999734047
```

$$Y := \begin{pmatrix} 0.994 \\ 0 \\ 0 \\ -2.0317326295573368357302057924 \end{pmatrix} \qquad \mu := 0.012277471$$

$t0 := 0 \quad n := 200 \qquad tmax := 11.124340337266085134999734047$

```
res := gslrk2( Y , t0 , tmax , n , D(t , y , μ))
res := gslrk4( Y , t0 , tmax , n , D(t , y , μ))
res := gslrkf45( Y , t0 , tmax , n , D(t , y , μ))
res := gslrkck( Y , t0 , tmax , n , D(t , y , μ))
res := gslrk8pd( Y , t0 , tmax , n , D(t , y , μ))

T := col( res , 1)   Y11 := col( res , 2)   Y12 := col( res , 3)
```



augment(Y11 , Y12)

2 loops:
Mass parameter: m = 0.012277471

Coordinates:
y1(0) = 1.2
y2(0) = 0
y'1(0) = 0
y'2(0) = -1.049357510
Period:
tper = 6.192169331

$$Y := \begin{pmatrix} 1.2 \\ 0 \\ 0 \\ -1.049357510 \end{pmatrix}$$

t0 := 0   n := 200   tmax := 6.192169331

μ := 0.012277471

res := gslrk2(Y , t0 , tmax , n , D(t , y , μ))

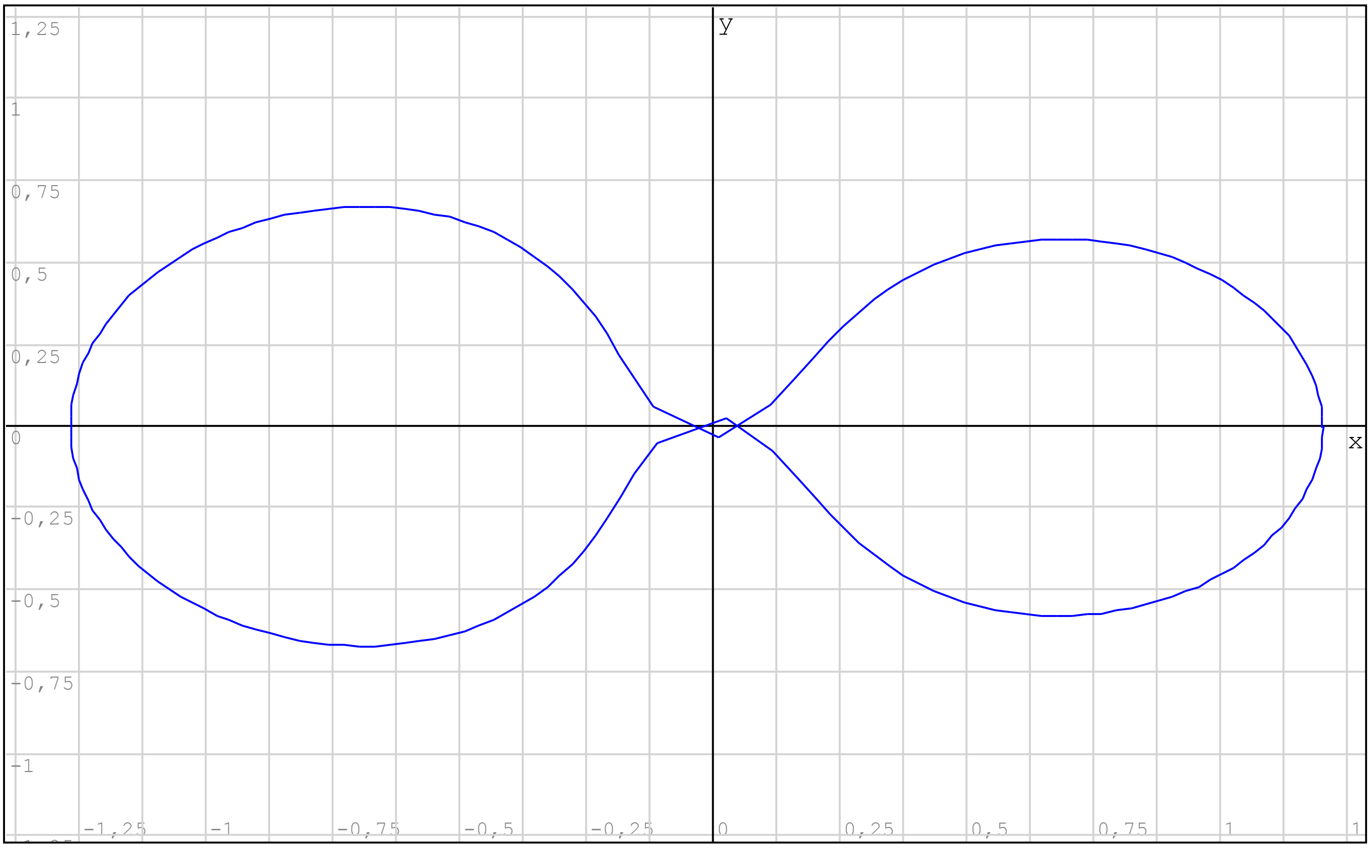
res := gslrk4(Y , t0 , tmax , n , D(t , y , μ))

res := gslrkf45(Y , t0 , tmax , n , D(t , y , μ))

res := gslrkck(Y , t0 , tmax , n , D(t , y , μ))

res := gslrk8pd(Y , t0 , tmax , n , D(t , y , μ))

T := col(res , 1)   Y11 := col(res , 2)   Y12 := col(res , 3)



augment(Y11 , Y12)