

```

> des := {delta(t) = 0.01*t, delta(t0) = delta0, diff(phi(t), t) =
tan(delta(t))/l, diff(x(t), t) = V*cos(phi(t)), diff(y(t), t) =
V*sin(phi(t)), phi(t0) = phi0, x(t0) = x0, y(t0) = y0};
> desSol := dsolve(des, numeric, parameters = [V, l, t0, x0, y0,
phi0, delta0]);
> desSol(parameters = [109, 5, 0, 0, 0, 0, 0]);
> desSol(90);
> with(plots);
> odeplot(desSol, [[t, x(t)], [t, y(t)], [t, phi(t)]], 0 .. 300,
labels = ["t", "Trajectory"], legend = ["x(t) - Position in x",
"y(t) - Position in y", "phi(t) - Heading Angle"]);
> odeplot(desSol, [t, x(t), y(t)], 0 .. 300);
> odeplot(desSol, [x(t), y(t), phi(t)], 0 .. 150, labels = ["x -
Position", "y - Position", "phi - Heading Angle"]);

```

$$des := \left\{ \delta(t) = 0.01 t, \delta(t_0) = \delta_0, \frac{d}{dt} \phi(t) = \frac{\tan(\delta(t))}{l}, \frac{d}{dt} x(t) = V \cos(\phi(t)), \frac{d}{dt} y(t) = V \sin(\phi(t)), \phi(t_0) = \phi_0, x(t_0) = x_0, y(t_0) = y_0 \right\}$$

```

desSol := proc(x_rkf45_dae) ... end proc

```

```

[V = 109., l = 5., t0 = 0., x0 = 0., y0 = 0., phi0 = 0., delta0 = 0.]

```

```

[t = 90., delta(t) = 0.9000000000000000, phi(t) = 9.50884887136091, x(t) = 2184.94156683081, y(t) = 2561.96008935270]

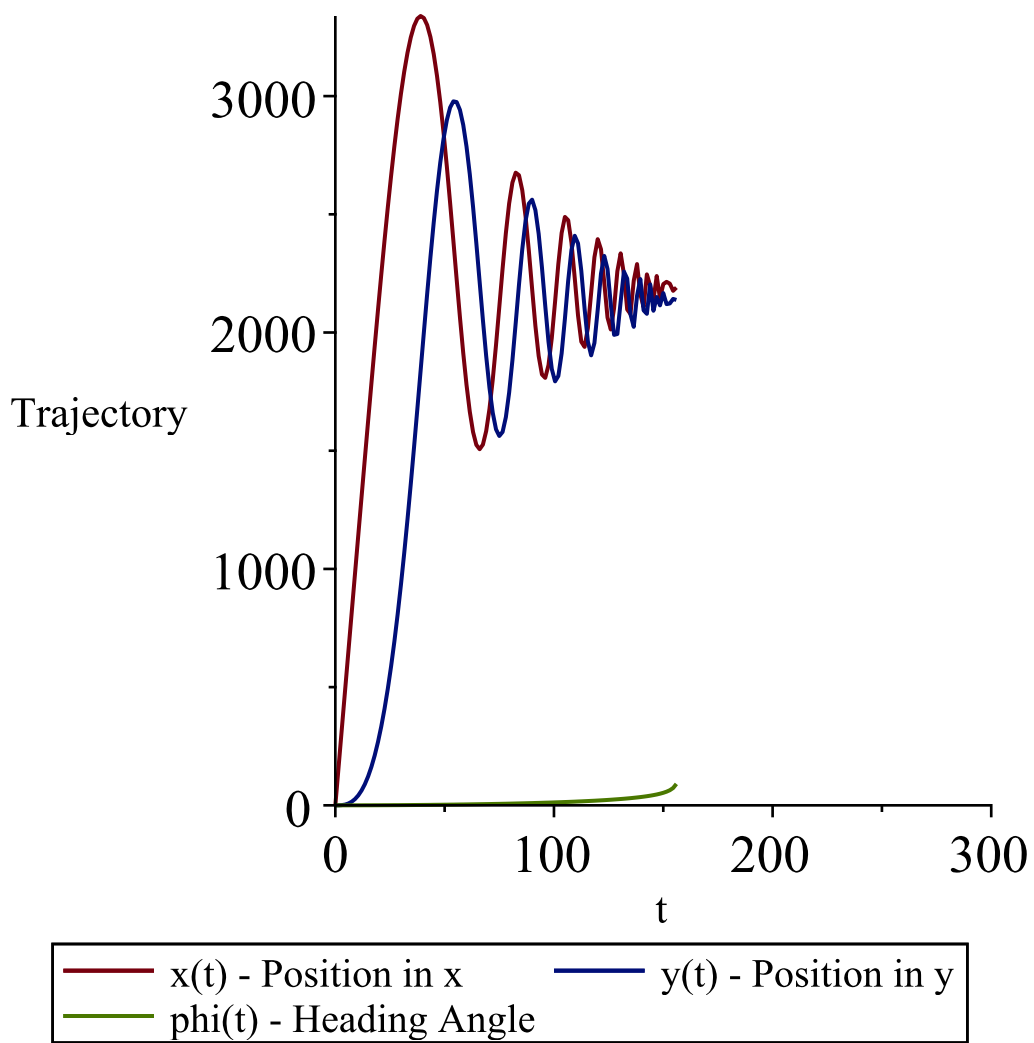
```

```

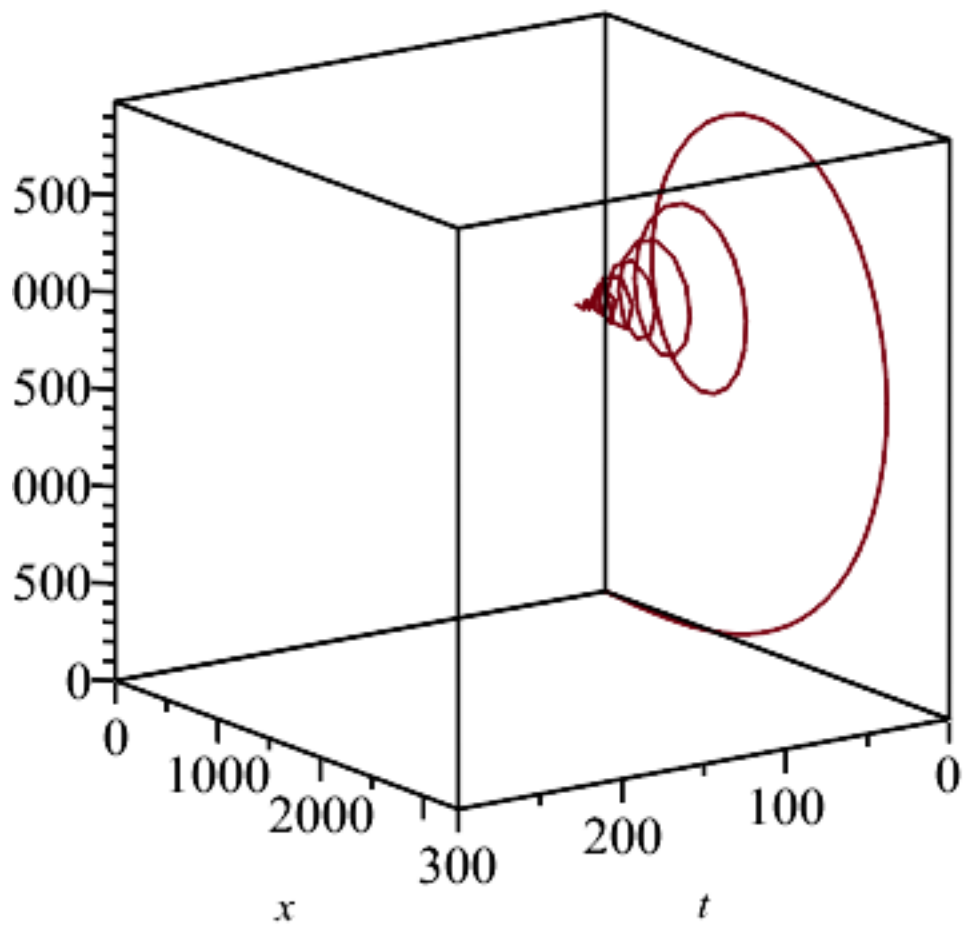
[animate, animate3d, animatecurve, arrow, changecoords, complexplot, complexplot3d,
conformal, conformal3d, contourplot, contourplot3d, coordplot, coordplot3d, densityplot,
display, dualaxisplot, fieldplot, fieldplot3d, gradplot, gradplot3d, implicitplot,
implicitplot3d, inequal, interactive, interactiveparams, intersectplot, listcontplot,
listcontplot3d, listdensityplot, listplot, listplot3d, loglogplot, logplot, matrixplot, multiple,
odeplot, pareto, plotcompare, pointplot, pointplot3d, polarplot, polygonplot, polygonplot3d,
polyhedra_supported, polyhedraplot, rootlocus, semilogplot, setcolors, setoptions,
setoptions3d, shadebetween, spacecurve, sparsematrixplot, surfdata, textplot, textplot3d,
tubeplot]

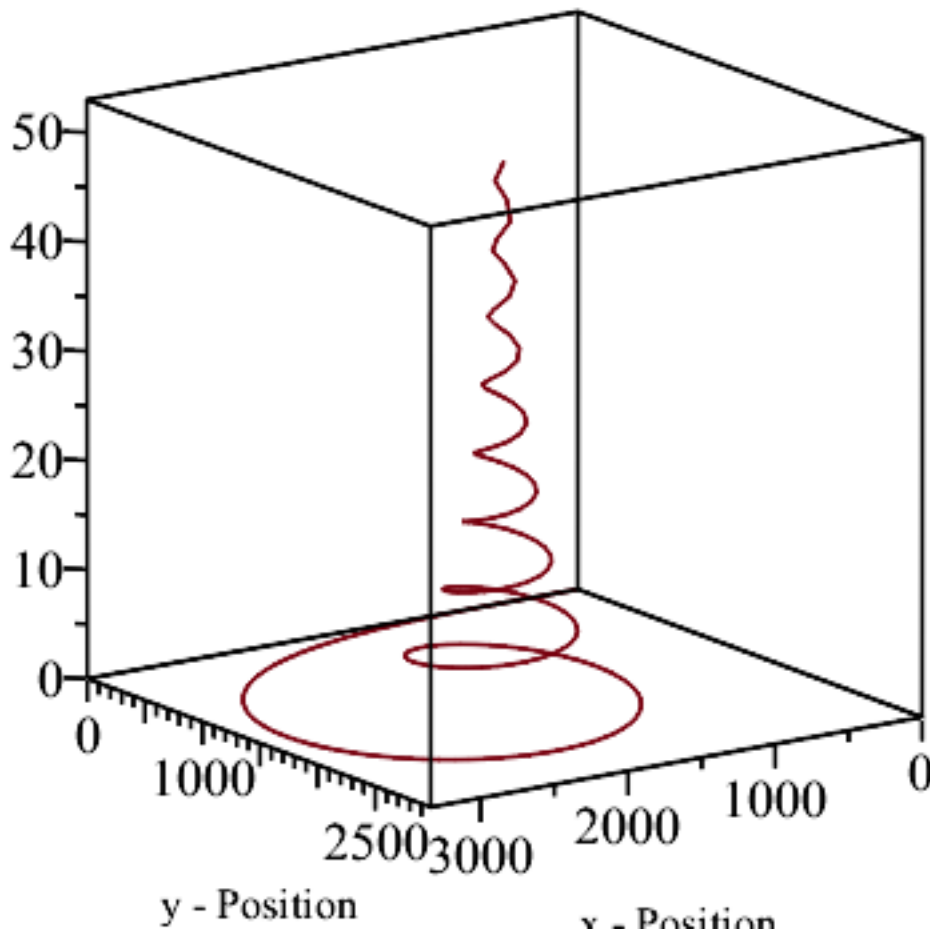
```

Warning, cannot evaluate the solution further right of 157.07963, probably a singularity



[Warning, cannot evaluate the solution further right of 157.07963, probably a singularity](#)





```

> A(k) = <<1 | 0 | -V*sin(phi(t))*dt>, <0 | 1 | V*cos(phi(t))*dt>,
<0 | 0 | 1>>;
B(k) = <<cos(phi(t))*dt | 0>, <sin(phi(t))*dt | 0>, <tan(0.01*t)*
dt/l | V*dt/(l*cos(0.01*t)^2)>>;
C = <<1 | 0 | 0>, <0 | 1 | 0>, <0 | 0 | 1>>;
X(t, k) = <<x(t)>, <y(t)>, <phi(t)>>;
U(t) = <<V>, <0.01*t>>;
X(t, k + 1) = A(k)*X(t, k) + B(k)*U(t);
Y(t) = C*X(t, k);
dt = 0.01;

```

$$A(k) = \begin{bmatrix} 1 & 0 & -V \sin(\phi(t)) dt \\ 0 & 1 & V \cos(\phi(t)) dt \\ 0 & 0 & 1 \end{bmatrix}$$

$$B(k) = \begin{bmatrix} \cos(\phi(t)) dt & 0 \\ \sin(\phi(t)) dt & 0 \\ \frac{\tan(0.01 t) dt}{l} & \frac{V dt}{l \cos(0.01 t)^2} \end{bmatrix}$$

$$C = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$X(t, k) = \begin{bmatrix} x(t) \\ y(t) \\ \phi(t) \end{bmatrix}$$

$$U(t) = \begin{bmatrix} V \\ 0.01 t \end{bmatrix}$$

$$X(t, k + 1) = A(k) X(t, k) + B(k) U(t)$$

$$Y(t) = C X(t, k)$$

$$dt = 0.01$$

(1)