

# simulator

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This file is part of CasADi.

CasADi -- A symbolic framework for dynamic optimization.  
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## 1 Simulator

```
[1]: from casadi import *  
     from numpy import *  
     from pylab import *
```

We will investigate the working of Simulator with the help of the parametrically excited Duffing equation:

$\ddot{u} + \dot{u} - \epsilon(2\mu\dot{u} + \alpha u^3 + 2ku \cos(\Omega t))$  with  $\Omega = 2 + \epsilon\sigma$ .

```
[2]: t = SX.sym('t')
```

```
[3]: u = SX.sym('u')  
     v = SX.sym('v')  
     states = vertcat(u,v)
```

```
[4]: eps = SX.sym('eps')
mu = SX.sym('mu')
alpha = SX.sym('alpha')
k = SX.sym('k')
sigma = SX.sym('sigma')
Omega = 2 + eps*sigma
```

```
[5]: params = vertcat(eps,mu,alpha,k,sigma)
rhs = vertcat(v,-u-eps*(2*mu*v+alpha*u**3+2*k*u*cos(Omega*t)))
```

We will simulate over 50 seconds, 1000 timesteps.

```
[6]: dae={'x':states, 'p':params, 't':t, 'ode':rhs}
ts = linspace(0, 50, 1000)
integrator = integrator('integrator', 'cvodes', dae, {'grid':ts, 'output_t0':
↳ True})
```

CasADi - 2023-04-24 21:30:19 WARNING("The options 't0', 'tf', 'grid' and 'output\_t0' have been deprecated.

The same functionality is provided by providing additional input arguments to the 'integrator' function, in particular:

- \* Call `integrator(..., t0, tf, options)` for a single output time, or
- \* Call `integrator(..., t0, grid, options)` for multiple grid points.

The legacy 'output\_t0' option can be emulated by including or excluding 't0' in 'grid'.

Backwards compatibility is provided in this release only.")

[.../casadi/core/integrator.cpp:499]

```
[7]: sol = integrator(x0=[1,0], p=[0.1,0.1,0.1,0.3,0.1])
```

Plot the solution

```
[8]: plot(array(sol['xf'])[0,:], array(sol['xf'])[1,:])
xlabel('u')
ylabel('u_dot')
show()
```

