Using Matlab to Solve Ordinary Differential Equations

Using the van derpol oscillator example to illustrate different solvers

<https://en.wikipedia.org/wiki/Van_der_Pol_oscillator>

Different solver methods

Euler

Rk

Predictor corrector

Adams-moulton

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Solver | ode45 | ode23 | ode113 | ode15s | ode23s | ode23t | ode23tb |
| Problem Type | Nonstiff | Nonstiff | Nonstiff | Stiff | Stiff | Moderately Stiff | Stiff |
| Order of Accuracy | Medium | Low | Low to high | Low to medium | Low | Low | Low |
| When to Use | Most of the time. This should be the first solver you try. | For problems with crude error tolerances or for solving moderately stiff problems. | For problems with stringent error tolerances or for solving computationally intensive problems. | If ode45 is slow because the problem is stiff. | If using crude error tolerances to solve stiff systems and the mass matrix is constant. | For moderately stiff problems if you need a solution without numerical damping. | If using crude error tolerances to solve stiff systems. |

Stiff odes

Experiment wit vdp oscillator which solvers work best in what regions of the phase space?

Coupled ode

Using symbolic toolbox

Equations are set with

Alpha=3 beta=4

What happens when

Beta>>alpha

Beta->0

Alpha>>beta

Alpha->0