

OpenSim Simulation API

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Classes for running simulations

1. Integrator classes

2. Manager class

3. OpenSim Tools

OpenSim Integrators

- 1. Numerically solve equations of motion**
- 2. Use SimTK's integrator classes**
- 3. Different integrators work better on some systems of equations than others.**

Integrators

1. Merson

- Best for most simulations
- `SimTK::RungeKuttaMersonIntegrator`

2. Feldberg

- In previous versions of OpenSim
- `SimTK::RungeKuttaFeldbergIntegrator`

3. Cpodes

- Stiff systems
- `SimTK::CpodesIntegrator`

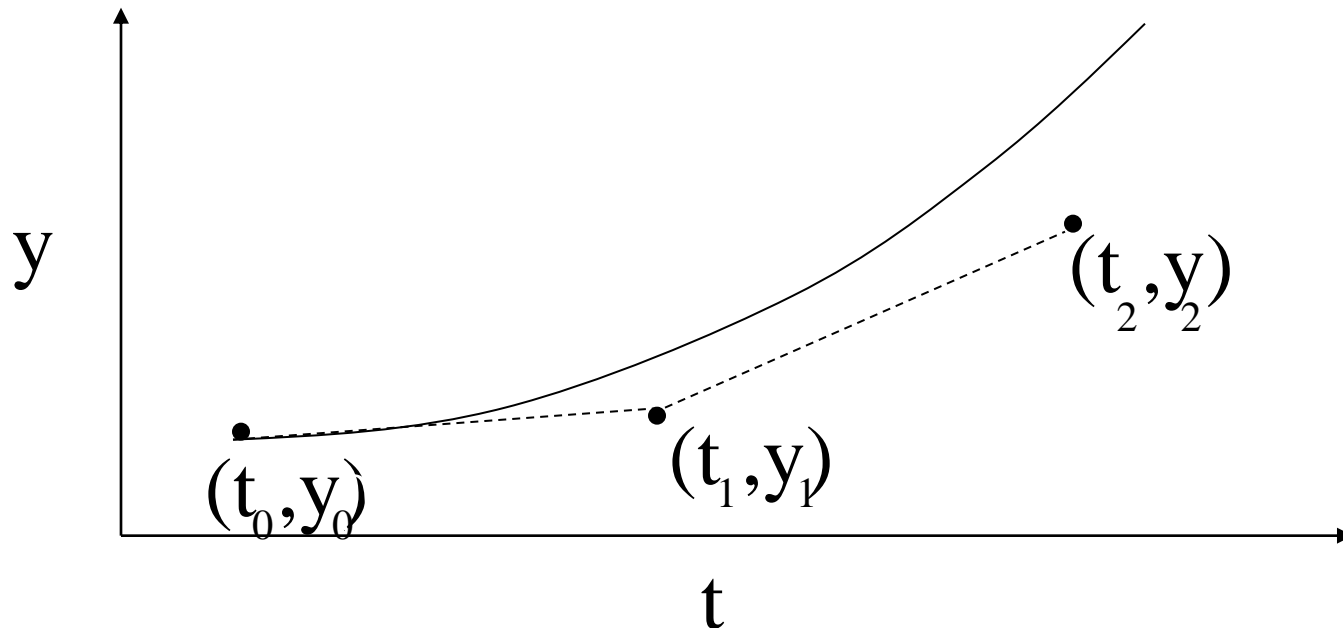
Stiff ODE Systems

- 1. System has two or more very different time scales.**
- 2. In order to maintain stability, step size is determined by shortest time scale and not by accuracy.**

Solving ODE's Numerically

Euler's Method

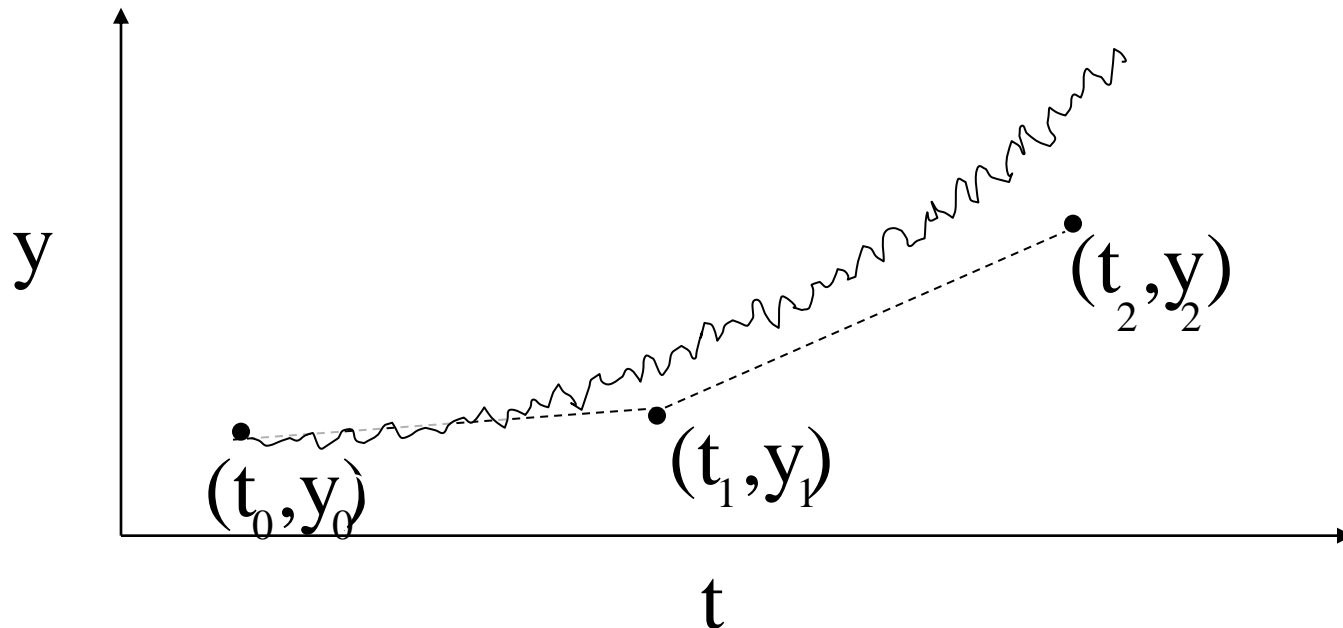
$$y_1 = y_0 + h f(t_0, y_0) \quad \text{where} \quad h = t_1 - t_0$$



Stiff system of ODE's

Euler's Method

$$y_1 = y_0 + h f(t_0, y_0) \quad \text{where} \quad h = t_1 - t_0$$



Integrator API

```
SimTK::RungeKuttaMersonIntegrator integrator(model.getSystem());  
  
integrator.setAccuracy( 1.0e-4 );
```


Manager

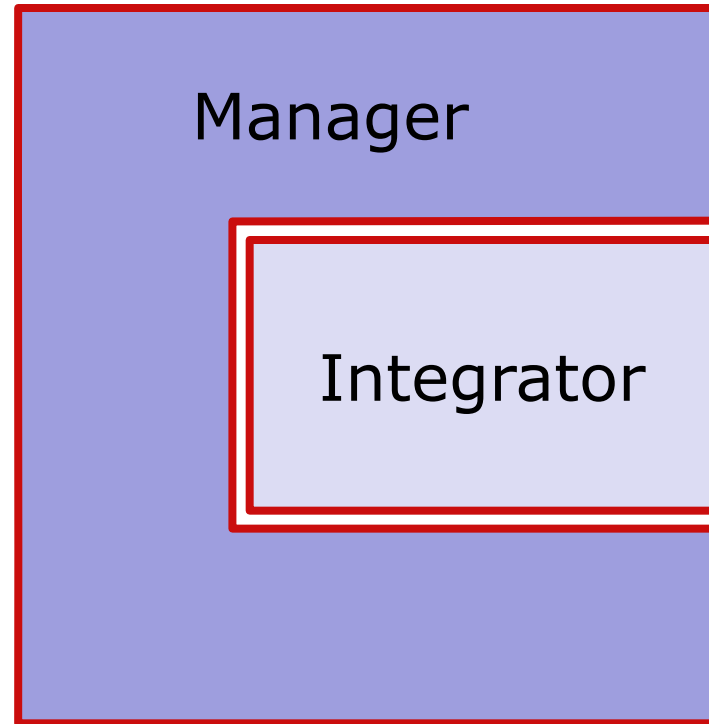
Interface between OpenSim and Integrator



Integrator

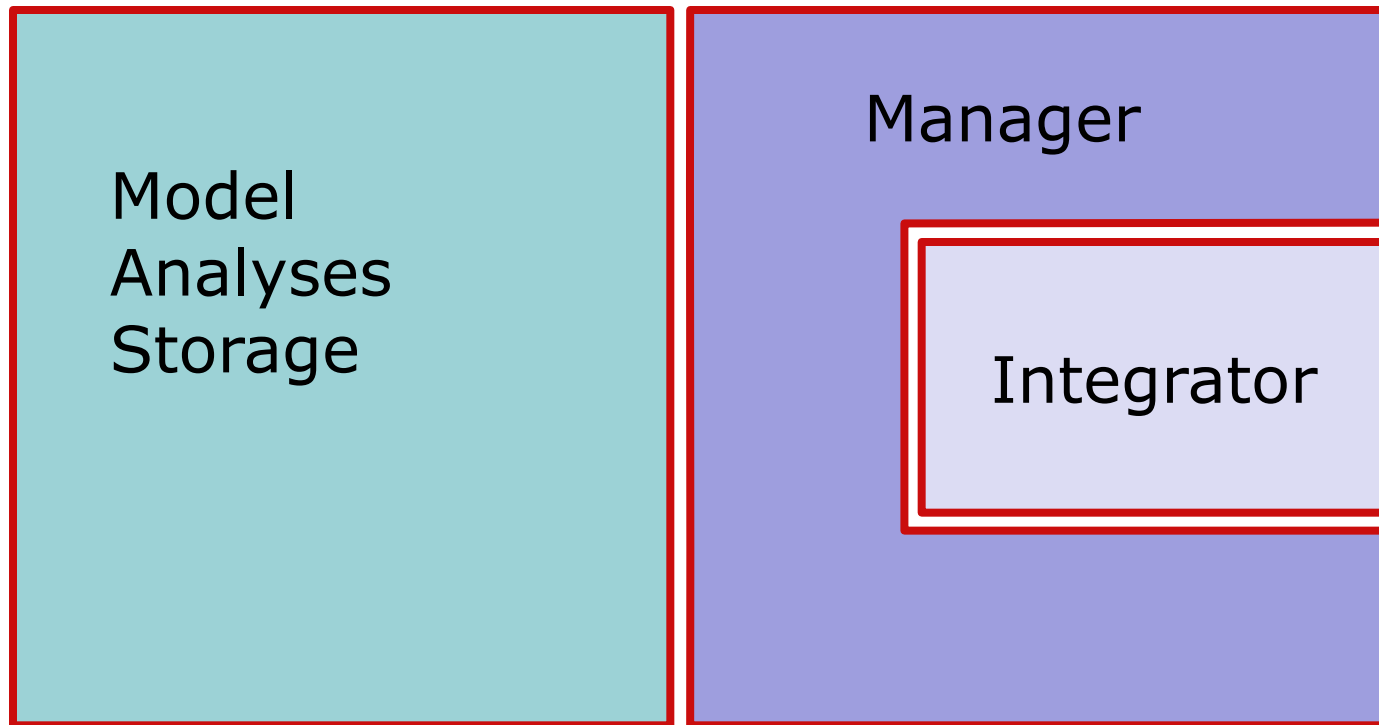
Manager

Interface between OpenSim and Integrator



Manager

Interface between OpenSim and Integrator



Manager

API:

```
Manager manager( osimModel, osimModel.getSystem(), integrator);  
manager.setInitialTime( initialTime);  
manager.setFinalTime( finalTime);  
manager.integrate( state);
```

OpenSim Tools

1. Tool classes

- OpenSim tools: forward, cmc, perturb, scale, ik, analyze
- Subclass AbstractTool

2. Implementation

- ForwardTool.run() similar to main() in examples
- Load model and parameters from XML files
- Warning: can be complex!