EDO's Task

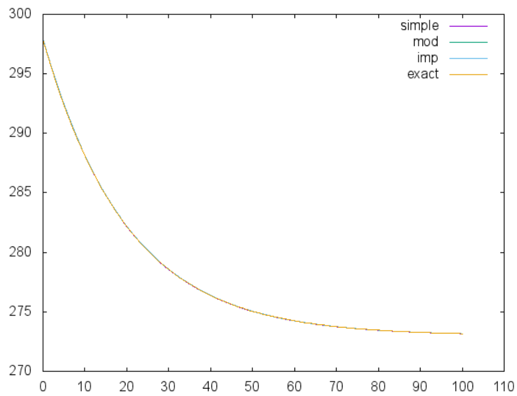
Author: Alexandre Sureda Croguennoc.
Departament de Química i Física, Universitat de Barcelona, Diagonal 645, 08028 Barcelona, Spain.[*]

I. NEWTON'S COOL DOWN LAW

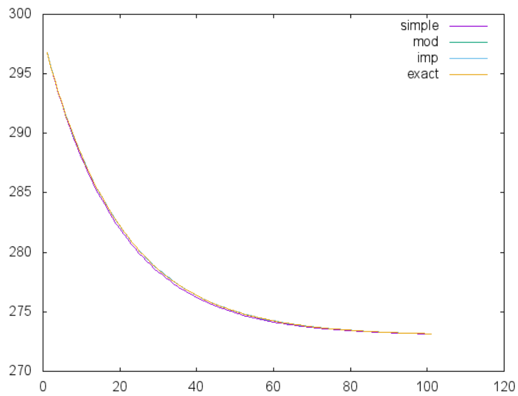
With boundary conditions we obtain the following temperature profile:

$$T(t) = (T_o - T_F)e^{-kx} - T_F$$

We solve the EDO with the following parameters: $k = 0.05$, $T_o = 298$, $T_F = 273$.



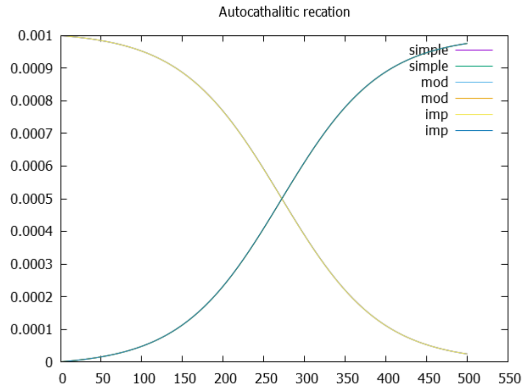
(a) $\Delta t = 0.1$



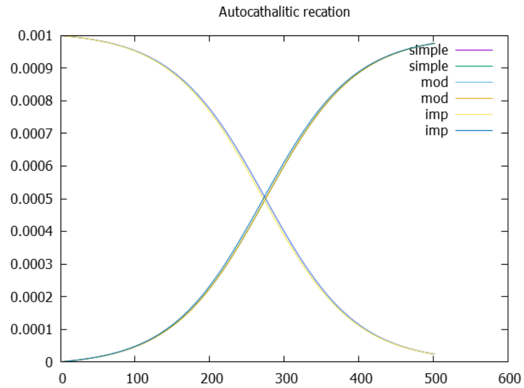
(b) $\Delta t = 1$

II. AUTOCATHALITIC REACTION

Using the following parameters: $k_1 = 0.0001$, $k_2 = 8$, $[Reac] = 0.001$, $[Prod] = 0.0$.



(a) $\Delta t = 0.01$

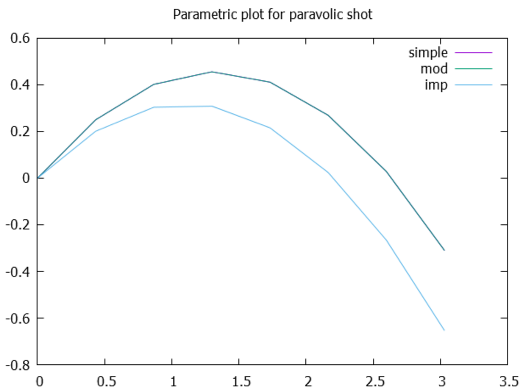


(b) $\Delta t = 2$

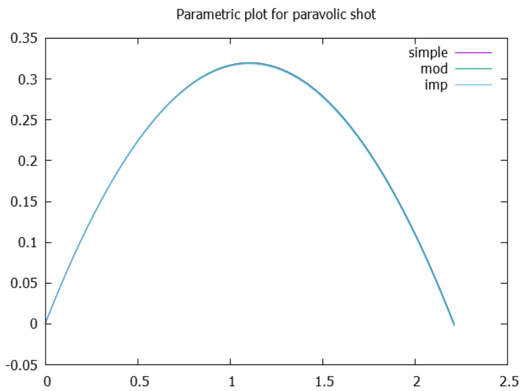
[*]Electronic address: `asuredcr7@alumnes.ub.edu`

III. PARAVOLIC SHOT

Using the following parameters: $v_o = 5m/s$, $\alpha = 30$, $x(0) = 0m$, $y(0) = 0m$.



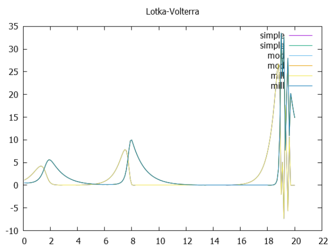
(a) $\Delta t = 0.1$



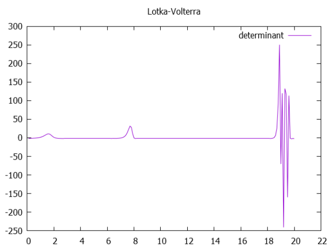
(b) $\Delta t = 0.001$

IV. PRAY PREDATOR

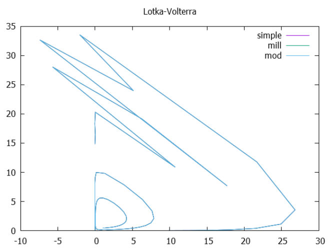
Using the following parameters: $\alpha = 2.0$,$\beta = 1.1, 0$,$\gamma = 1.0$,$\delta = 0.9$,$prey = 1.0$,$predator = 0.5$, .



(a) Number of prey and predator

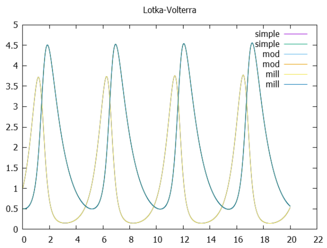


(b) Determinant of the matrix system

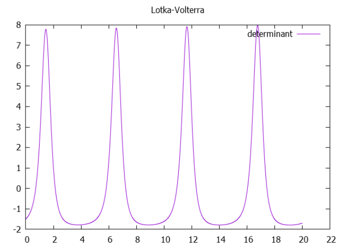


(c) Parametric plot

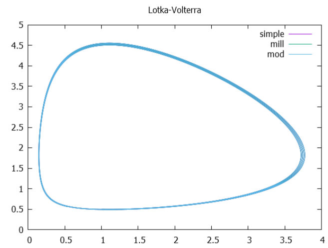
FIG. 4: $\Delta t = 0.1$.1.Instability.



(a) Number of prey and predator



(b) Determinant of the matrix system



(c) Parametric plot

FIG. 5: $\Delta t = 0.001.1$.Stable.

V. STEEPEST DESCENT

1. *Descent directions*

The following plot shows the Runge-Kuta path for the Steepest Descent and Reaction Path. The initial step is done by getting the eigenvector associated to the negative eigenvalue. There are two paths for each method as we have to descent directions.

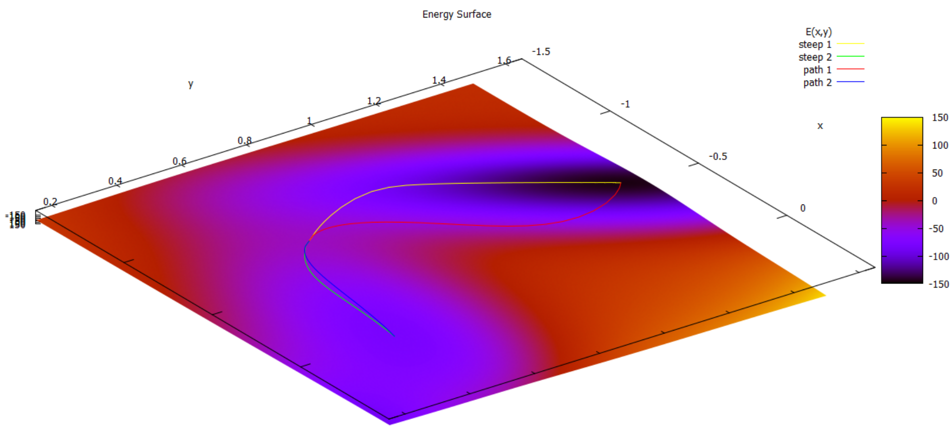


FIG. 6: Steepest descent and Reaction path methods. Negative eigenvalue

2. Perpendicular Descent directions

This is the same simulation as the last section but now we pick the direction of the positive eigenvalue.

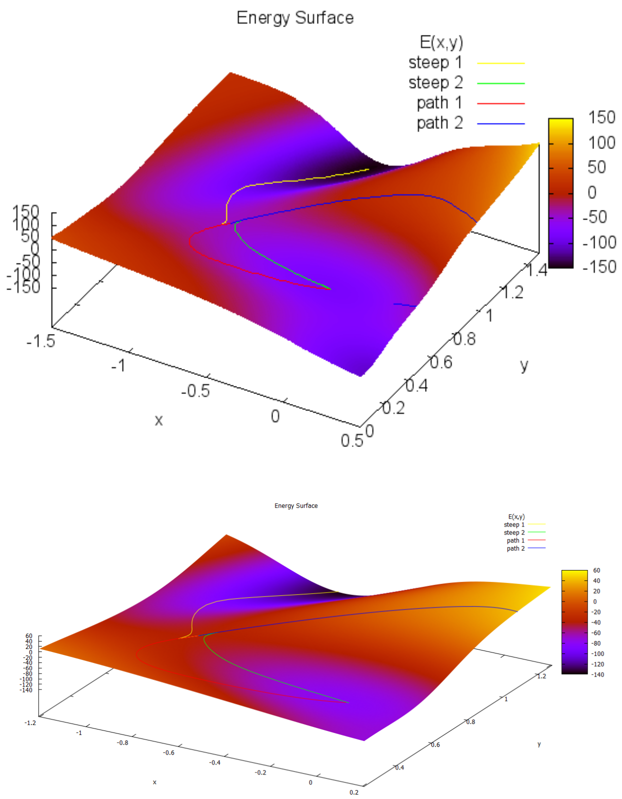


FIG. 7: Steepest descent and Reaction path methods. Positive eigenvalue