**UMEÅ UNIVERSITY**
**Department of computer science**
**Lab report**

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Laboratory 5

# Modelling and Simulation 7.5hp

## ODE using GSL-library

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**Supervisor**
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# Contents

# 1 Exercise 1

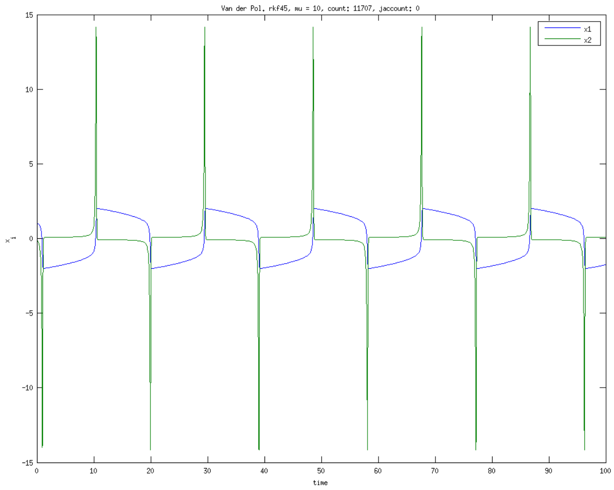


Figure 1: Van der Pol model. Solved using rkf45 with parameter $\mu = 10$.

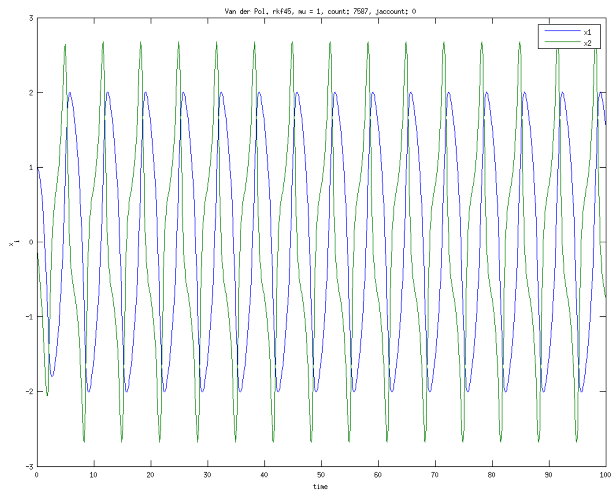


Figure 2: Van der Pol model. Solved using rkf45 with parameter $\mu = 1$.

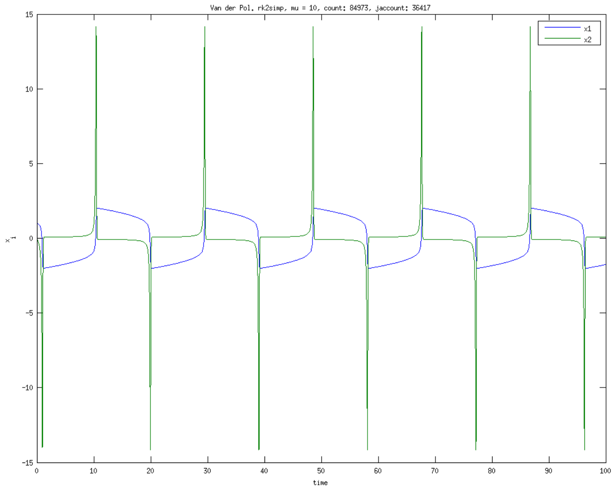


Figure 3: Van der Pol model. Solved using rk2simp with parameter $\mu = 10$.

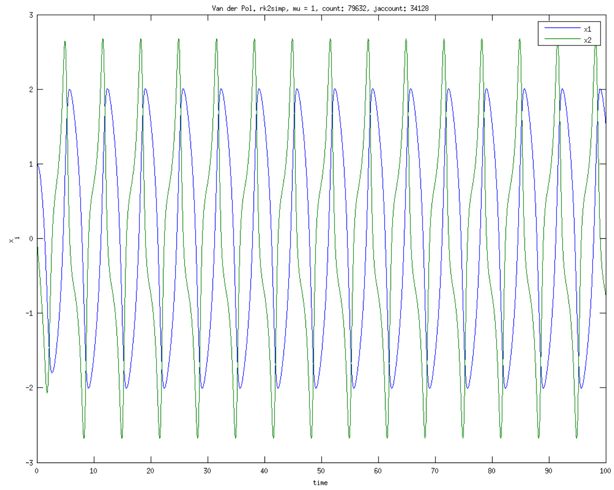


Figure 4: Van der Pol model. Solved using rk2simp with parameter $\mu = 1$.

## 2 Exercise 2

The efficiency was about double as fast in the C implementation compared with the matlab implementation. And in the C implementation the rk4imp was better. The times were: 0.92 seconds from matlab using ode23s; 0.623 seconds in C using rk2imp; and 0.419 seconds in C using rk4imp.

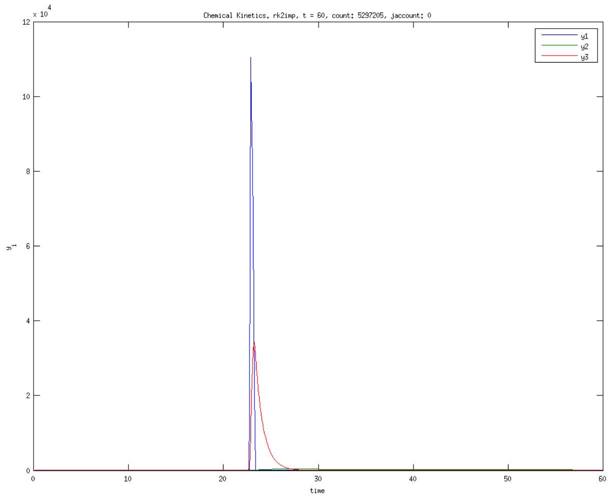


Figure 5: Chemical kinetics. Solved using rk2imp integrating from $t = 0$ to $t = 60$.

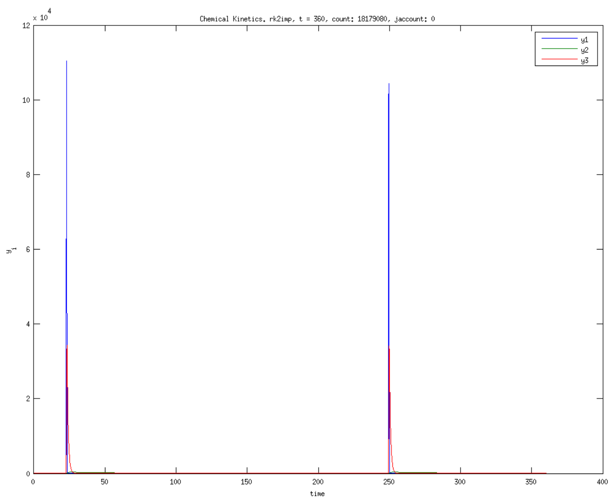


Figure 6: Chemical kinetics. Solved using rk2imp integrating from $t = 0$ to $t = 360$.

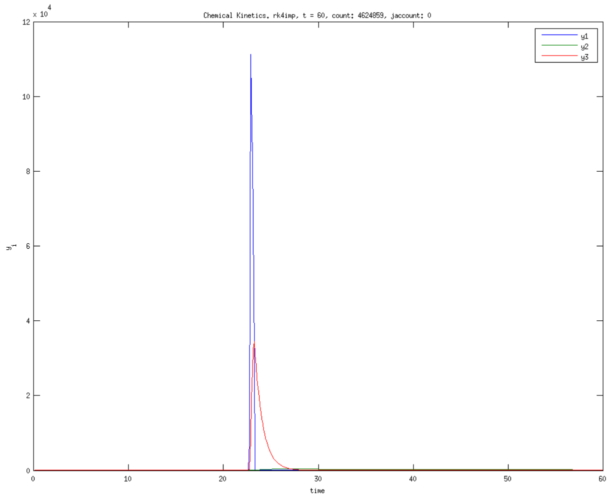


Figure 7: Chemical kinetics. Solved using rk4imp integrating from $t = 0$ to $t = 60$.

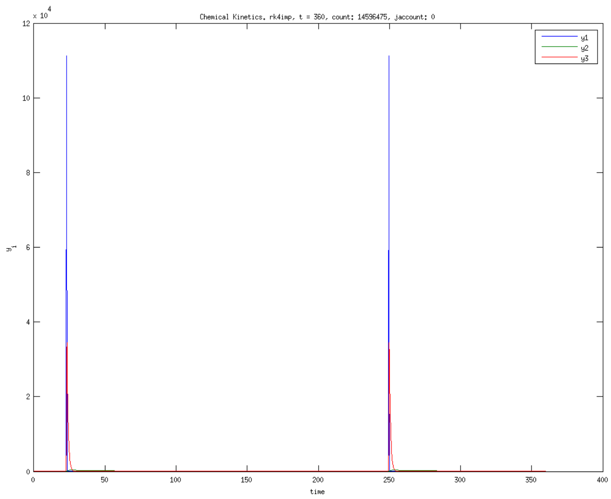


Figure 8: Chemical kinetics. Solved using rk4imp integrating from $t = 0$ to $t = 360$.

# 3 Exercise 3

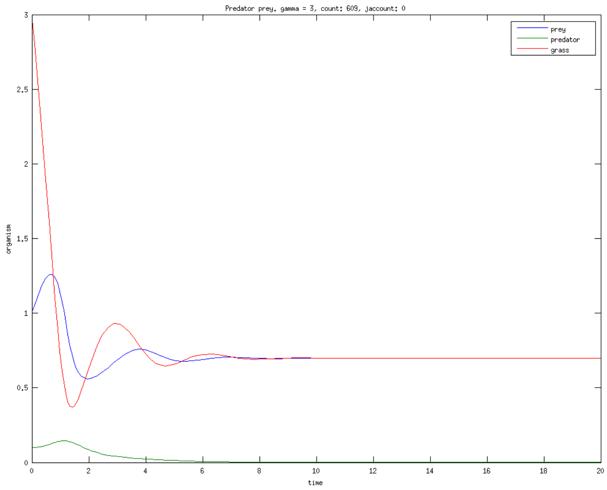


Figure 9: Predator prey. Solved using rkf45 with parameter $\gamma = 3$.

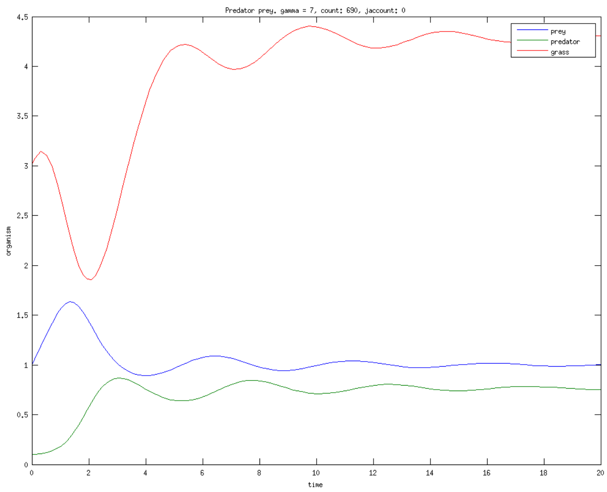


Figure 10: Predator prey. Solved using rkf45 with parameter $\gamma = 7$.

Lower gamma reaches steady state faster. Higher gamma increases predator population more than prey. At gamme=3 the predator population actually dies out. This is using the extra term with gmax.

If we leave out the gmax term in the grass equation. The grass will grow without bounds for large enough gamma, see fig. 11

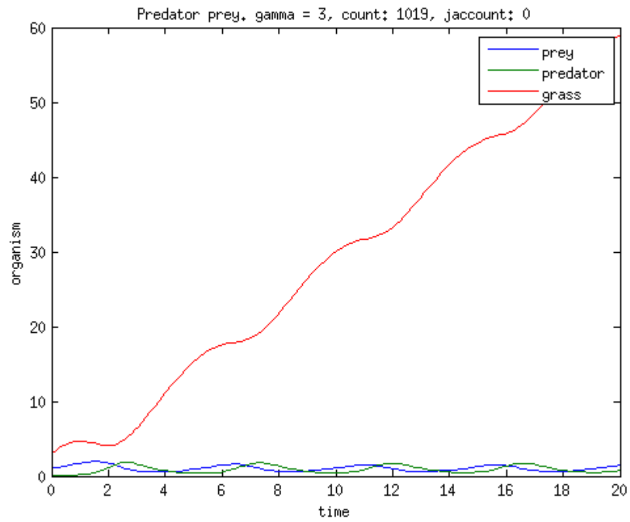


Figure 11: Predator prey. Solved using rkf45 with parameter $\gamma = 7$ but without gmax term in the grass equation.

# 4 Exercise 4

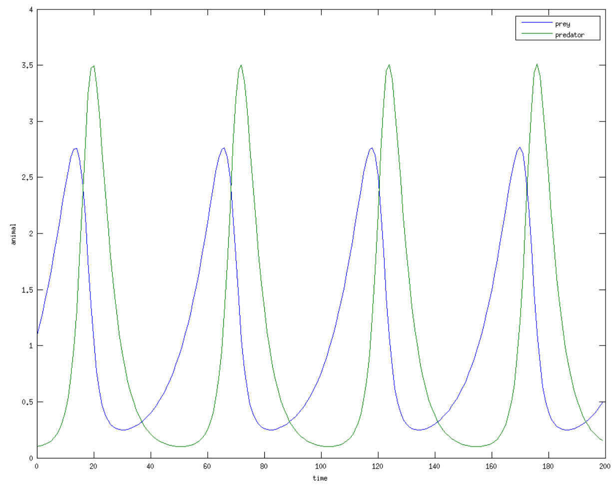

Figure 12: A predator-prey model. Solved using symplectic Euler A.