

Simulating spin magnons using Runge-Kutta methods

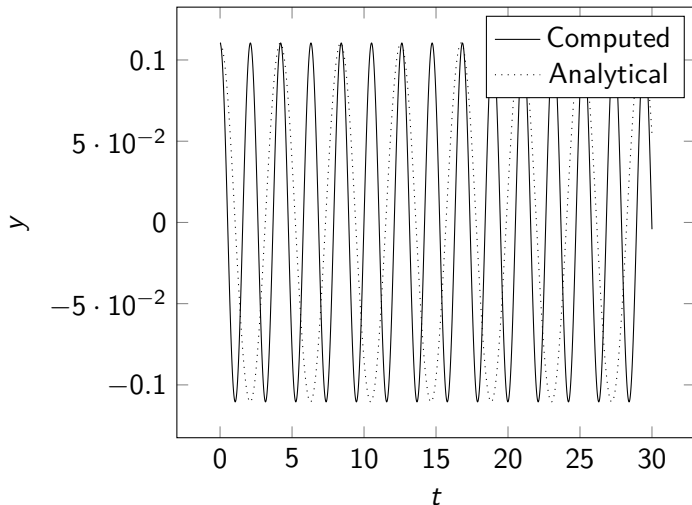
Jonas Bueie

May 7, 2021

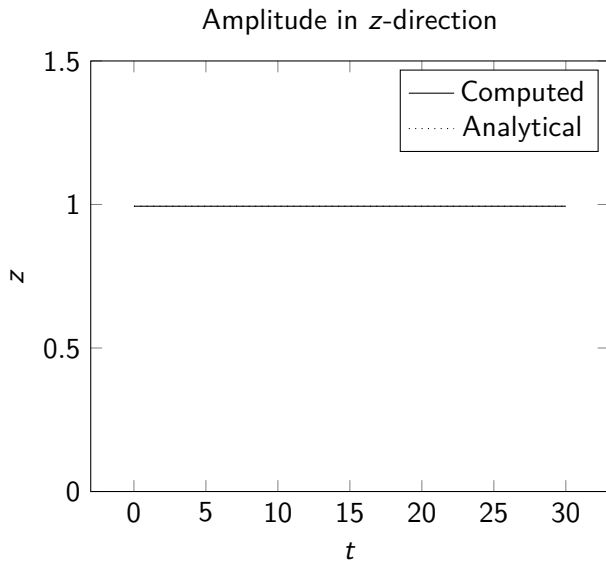
Part one: Single spin

Simplest case

Numerical vs. Analytical solution

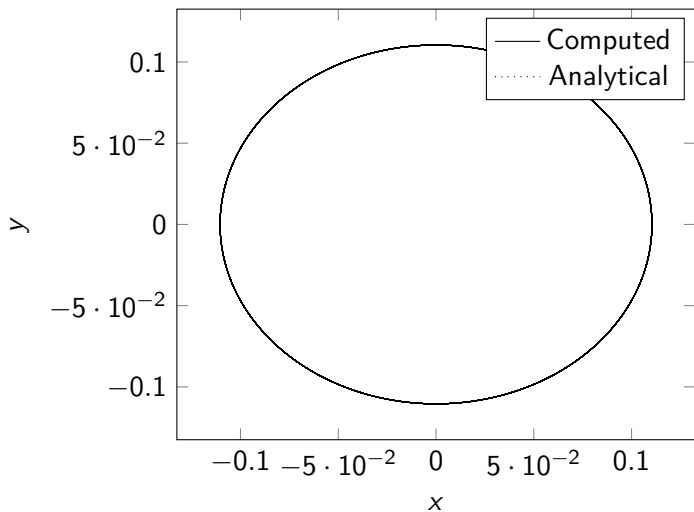


Simplest case

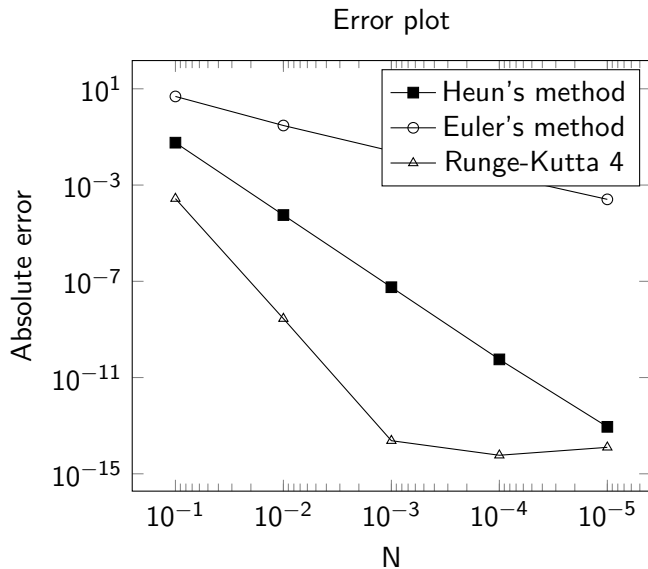


Phase space

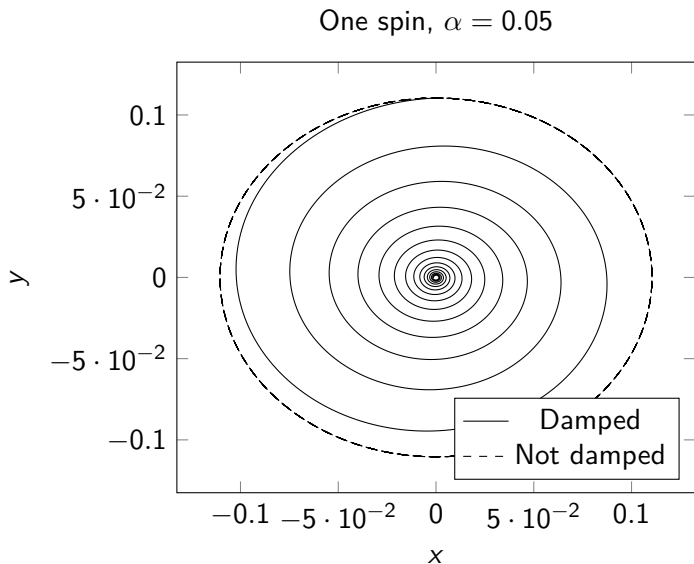
One spin, seen from above



Convergence plot

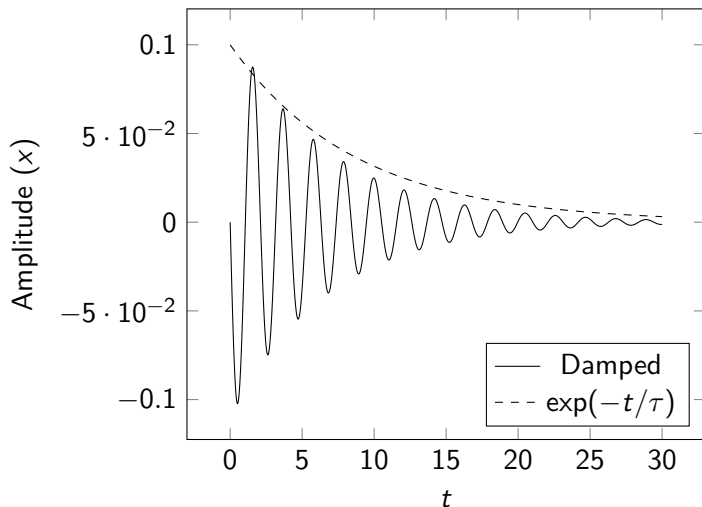


With damping

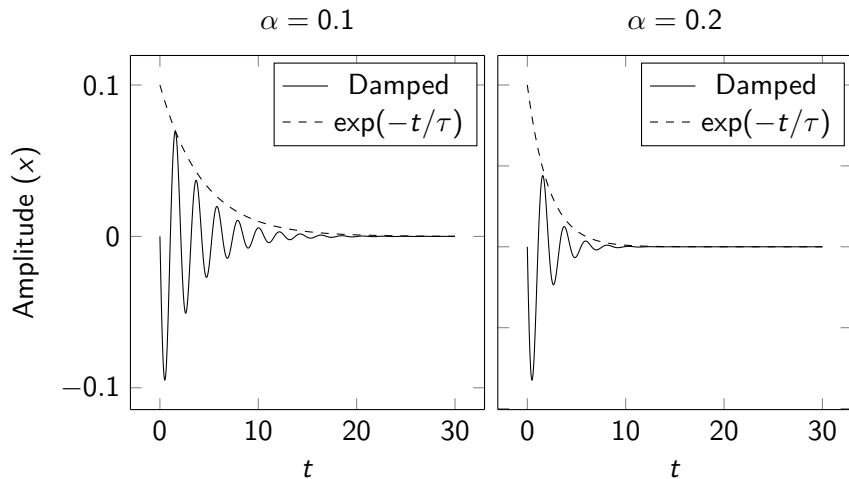


Analyzing the damping

One spin, $\alpha = 0.05$, $\omega = 30/13 \approx 2.3$



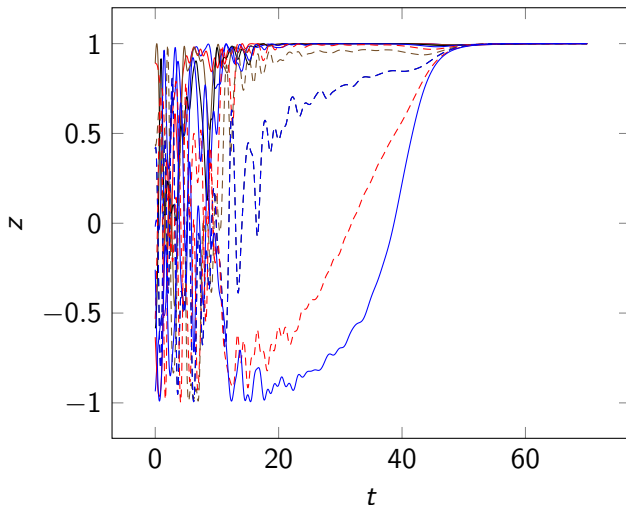
Varying α



Part two: Spin chain

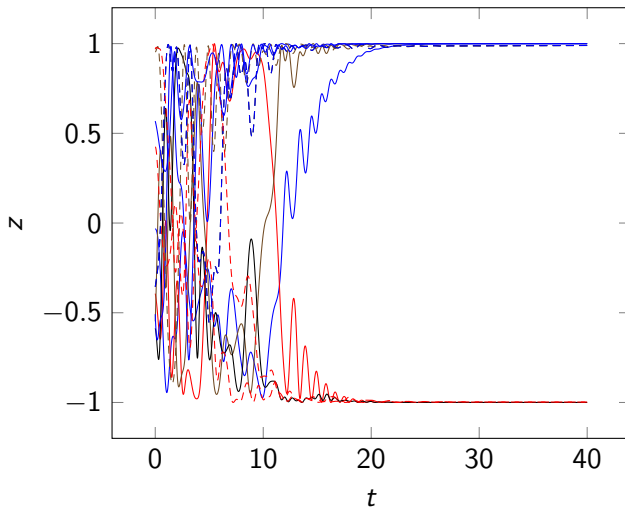
Ferromagnetic coupling

Random initial directions, $J = +1$



Antiferromagnetic coupling

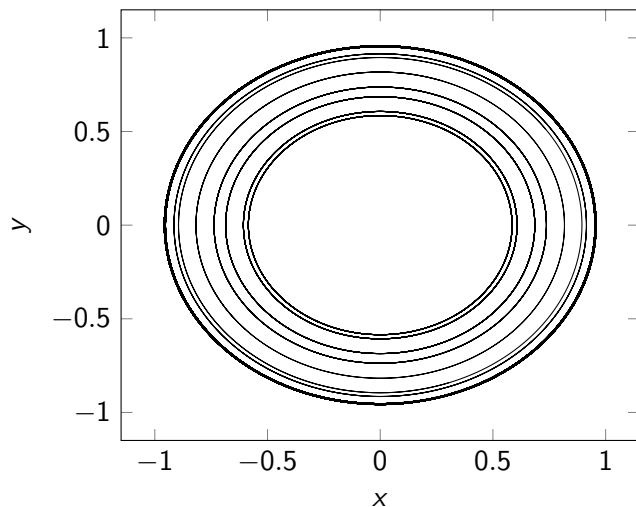
Random initial directions, $J = -1$



Magnons

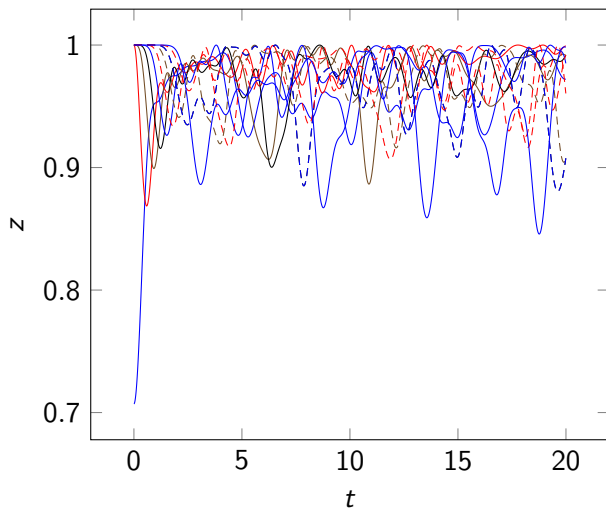
No coupling

10 spins with random directions. $\alpha = 0$, $J = 0$

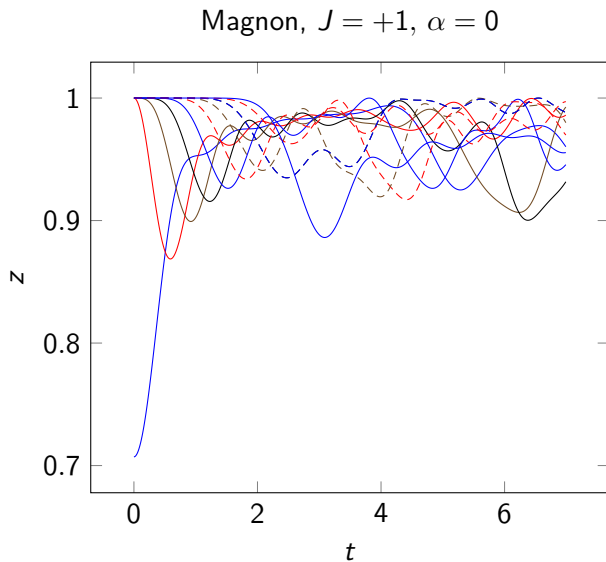


No damping

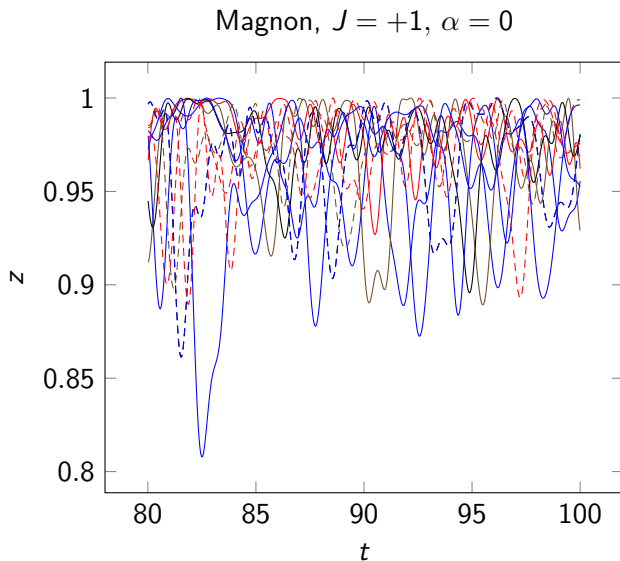
Magnon, $J = +1$, $\alpha = 0$



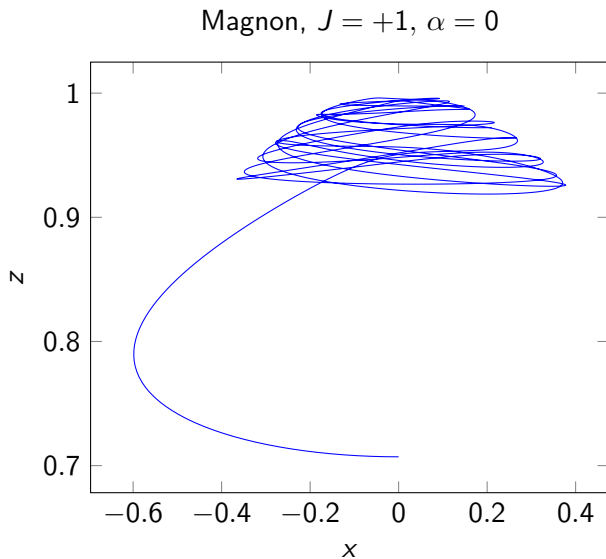
For small t



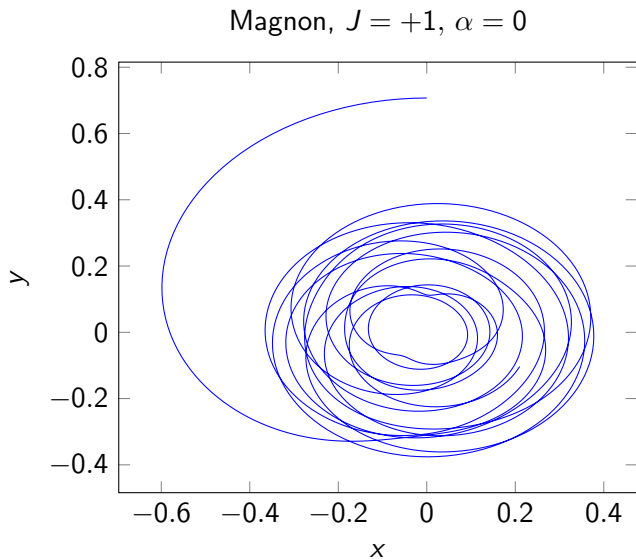
For large t



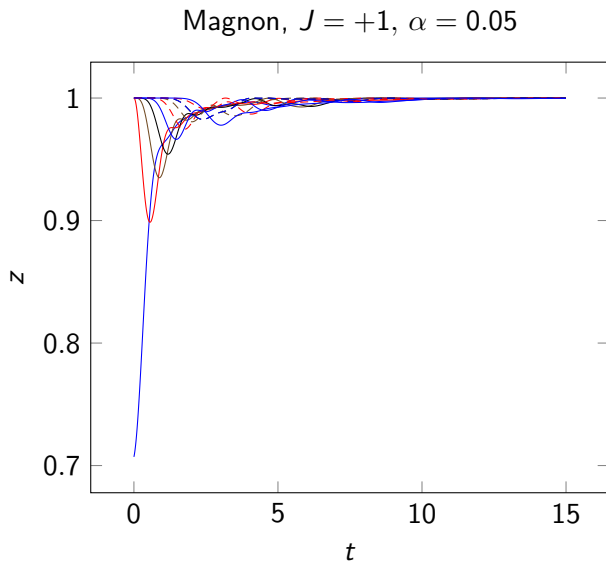
Spatial movement of the spin



Spatial movement of the spin



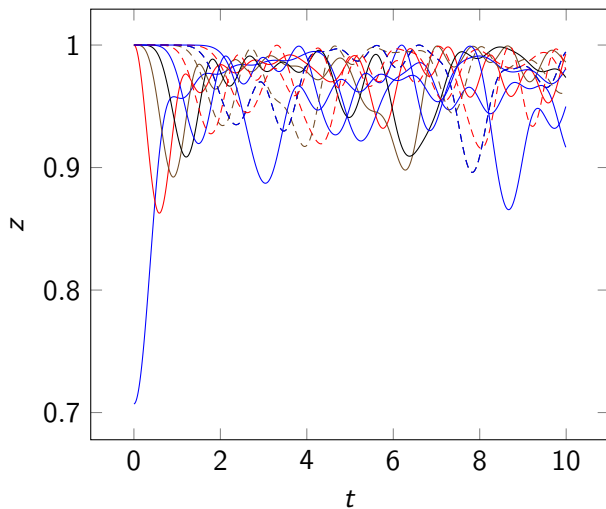
With damping



Magnons in antiferromagnetic chain

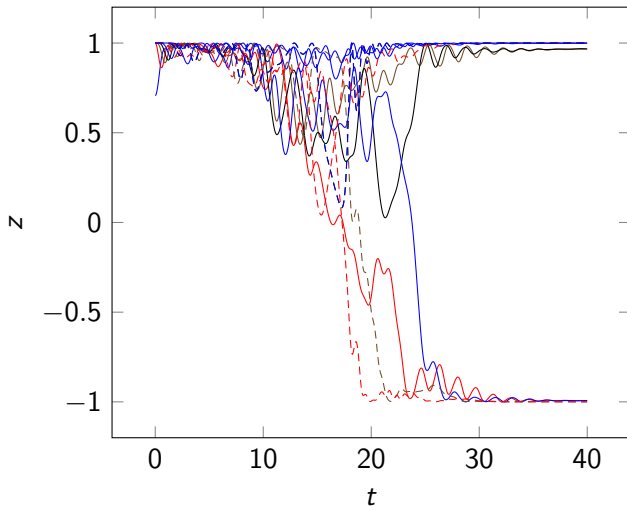
No damping

Magnon, $J = -1$, $\alpha = 0$



With damping

Magnon, $J = -1$, $\alpha = 0.05$



Magnetization

