2. Exercise sheet

Exercise 1. Implement the numerical model from the Lorenz-63 example with step-size $\delta t = 0.01$ and store the resulting reference trajectory in time intervals of $\Delta t_{\text{out}} = 0.05$ over 4000 cycles (i.e. between t=0 and $t = 200$) in a file for later use in other examples. Do not store the system state from every single timestep as this becomes very inefficient, even for low dimensional problems; it is much better to overwrite the state vector on each timestep, and take a copy of the vector when you need to store it. The resulting data set should be stored in a matrix of size 3×4001. Do not forget to use the modified iteration in g_i^n and check that your numerical results reproduce the Lorenz attractor.

Exercise 2. Implement the numerical observation process as defined for the Lorenz-63 example using the reference trajectory generated in Exercise 1. Store the numerically generated observation values $y_{\text{obs}}(\mathfrak{t}_k) = \mathrm{x}_{\text{obs}}(\mathfrak{t}_k)$ for $k = 1, \ldots, N_{\text{obs}} = 4000$, in a file for later use. Hint: You might obtain a trajectory different from the one displayed in the lecture notes. Differences can arise even for mathematically identical implementations due to round-off errors.

Exercise 3. Follow the example from the lecture notes and use linear extrapolation in order to produce forecasts for forecast intervals $\Delta t_{\text{out}} = 0.05$ and $3\Delta t_{\text{out}} = 0.15$, respectively, from the observations produced in Exercise 2. Compute the time averaged RMSE and discuss your findings.