

# Kuramoto Model

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## Abstract

The aim of this report is to present some results of solving the stochastic differential equation governing the time evolution of the phases of Kuramoto model oscillators with noise( $N = 3$ ).

## 1 Update rule

the update rule which I have used is:

$$\theta_i^{t_n+1} = \theta_i^{t_n} + dt(\omega_i + Kr^{t_n} \sin(\psi^{t_n} - \theta_i^{t_n})) + \alpha\mathcal{N}(0, \sqrt{dt}), \quad i \in \{1, \dots, N_{Osci}\} \quad (1)$$

Initial phases produced with a random uniform distribution in  $[0, 2\pi]$ .

Natural frequencies ( $\omega_i$ ) are all set to be  $2\pi$ .

$\alpha = 0.5$

$r$  and  $\psi$  are respectively the real and the imaginary part of the order parameter at each time step.  
And I have changed the coupling constant  $K$  to be 1, 2 and 5; stated at each plot.

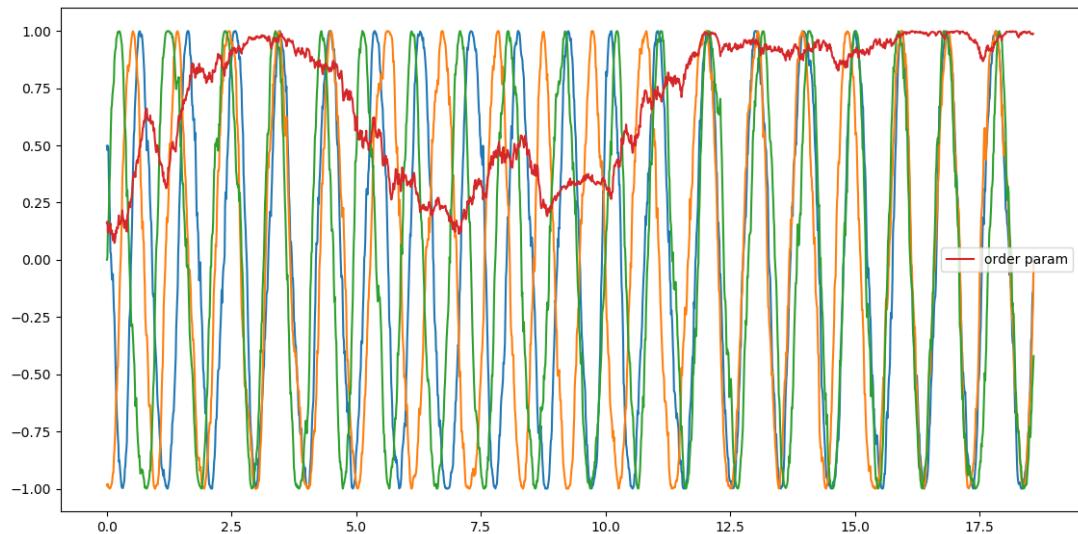


Figure 1:  $K = 1$

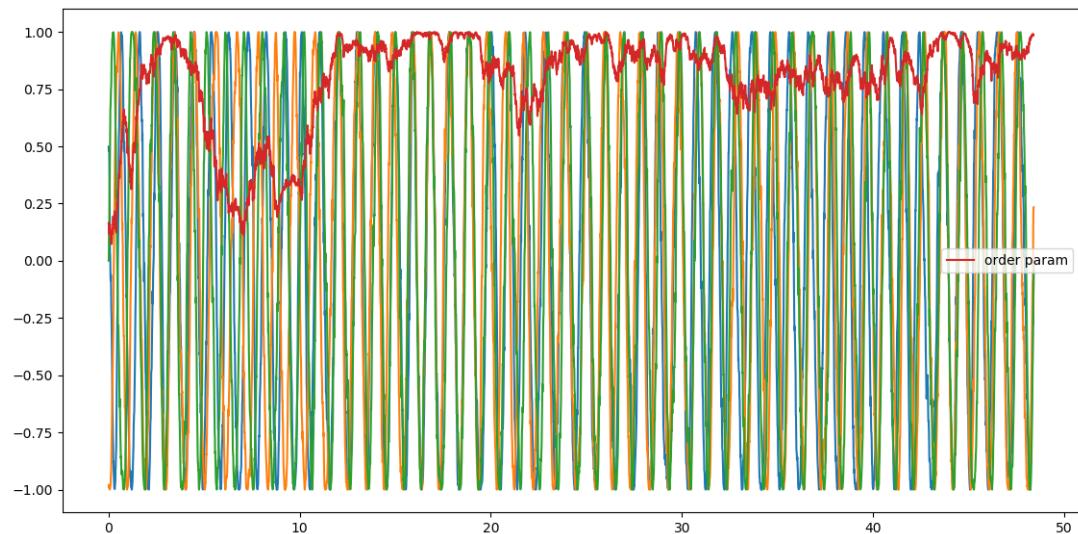


Figure 2:  $K = 1$

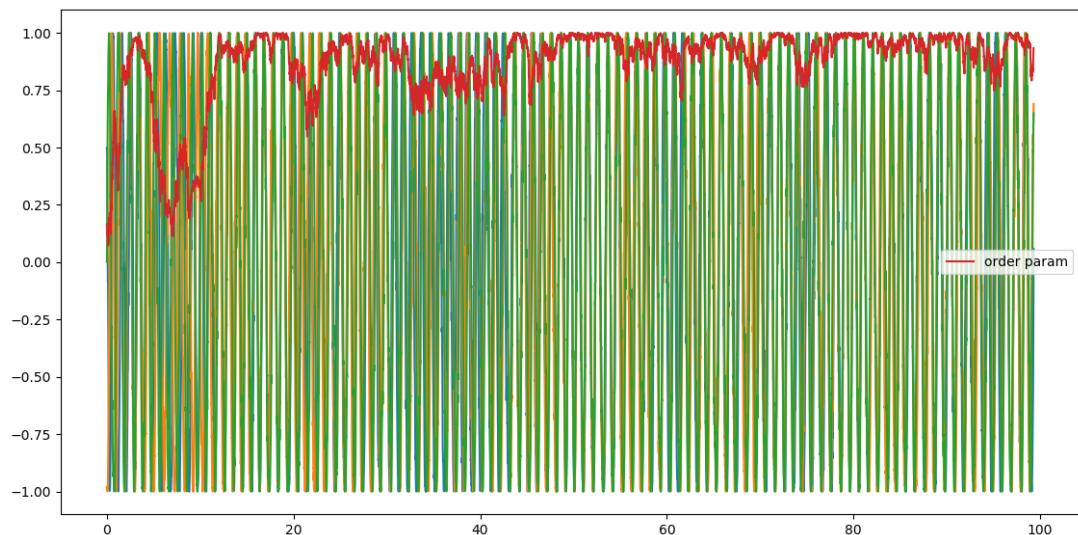


Figure 3:  $K = 1$

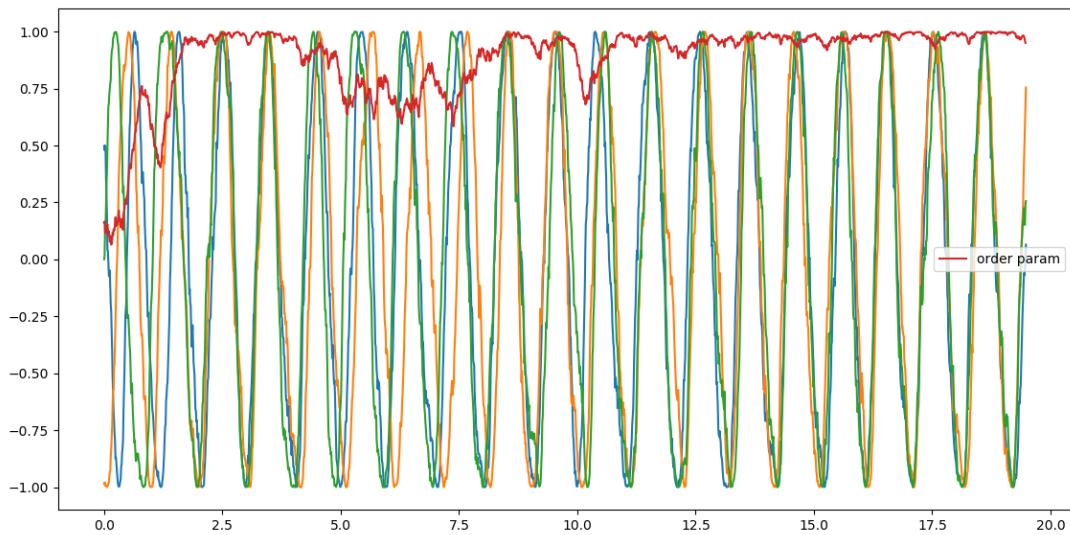


Figure 4:  $K = 2$

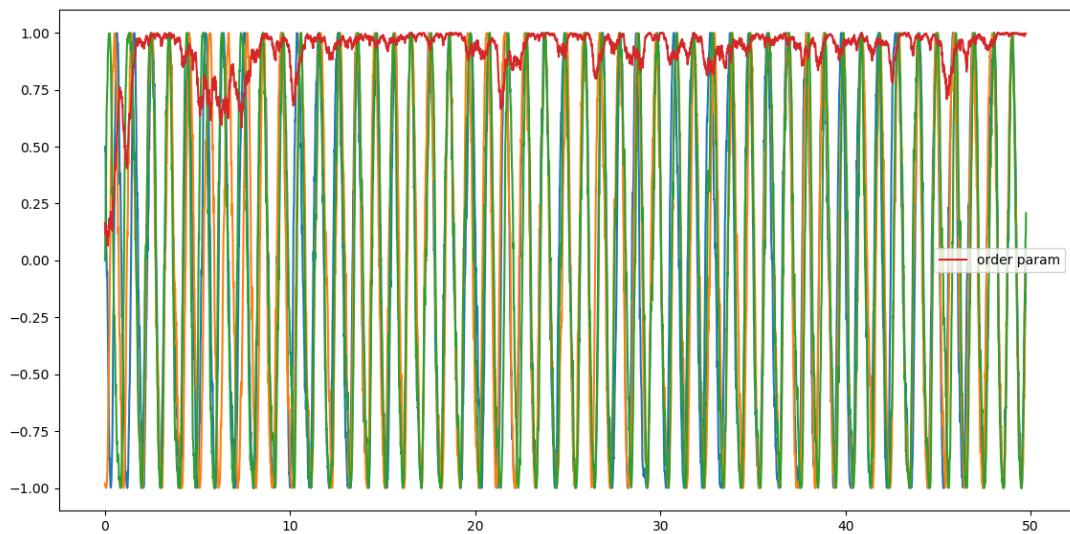


Figure 5:  $K = 2$

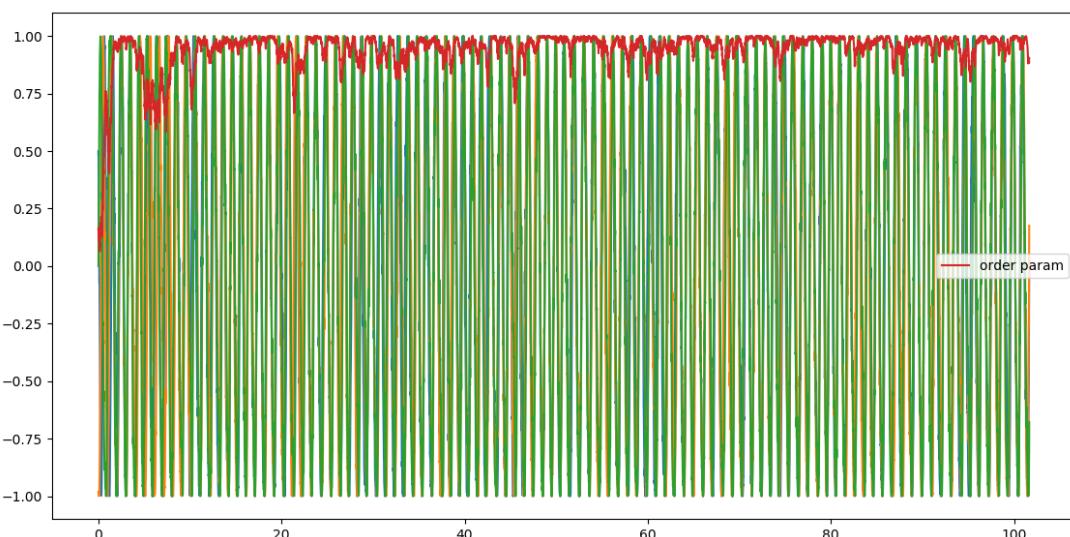


Figure 6:  $K = 2$

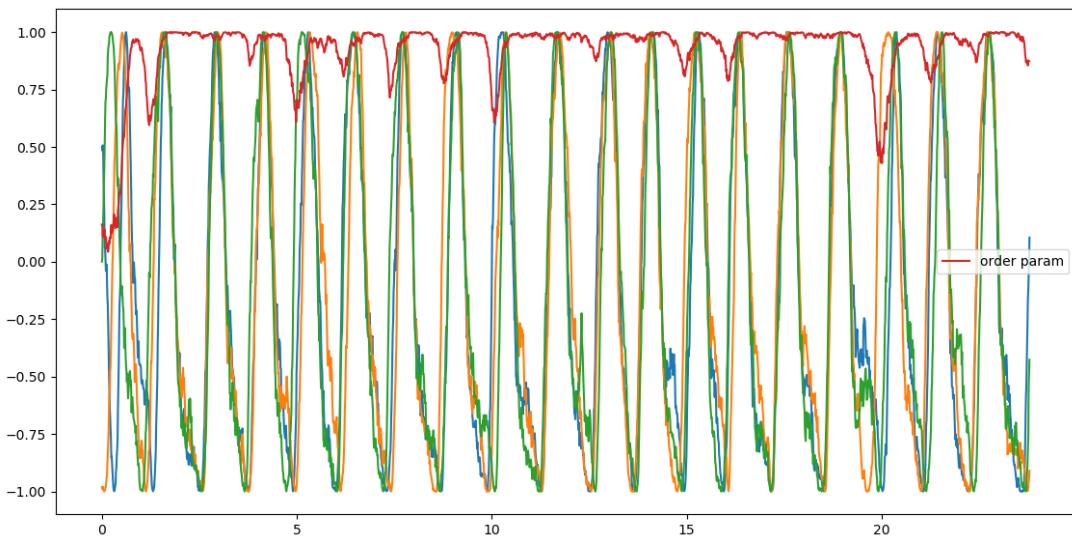


Figure 7:  $K = 5$

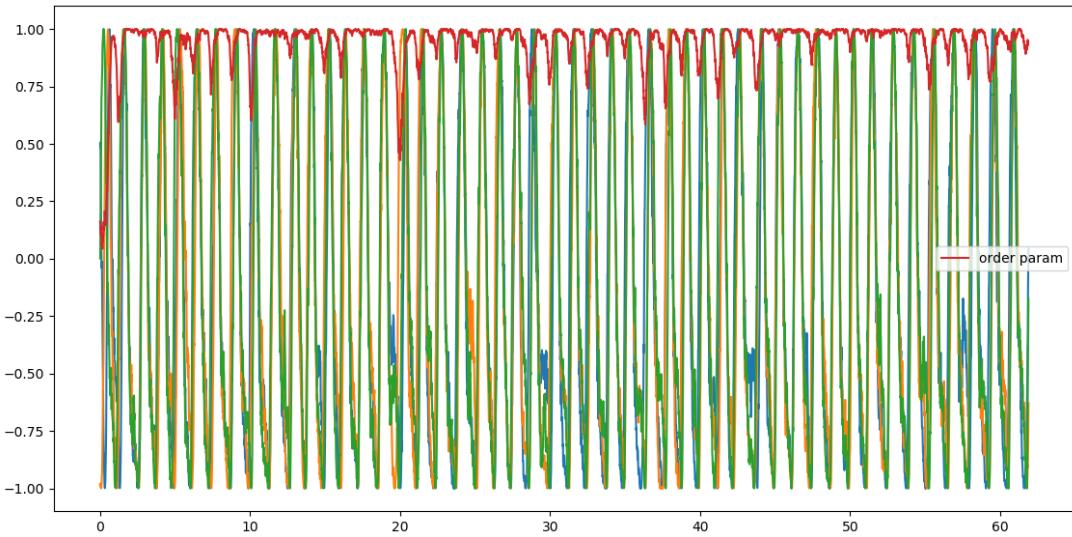


Figure 8:  $K = 5$

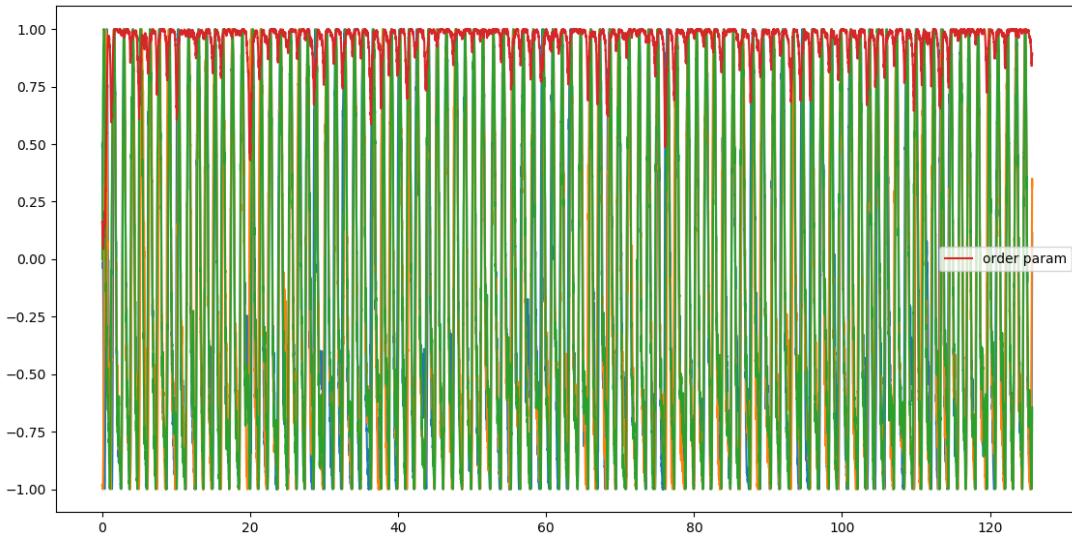


Figure 9:  $K = 5$