

Simulation of Volterra series model

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Exercise 1

We simulate three different kinds of Nonlinear function. Firstly, the sigmoid function is shown in Figure 1.

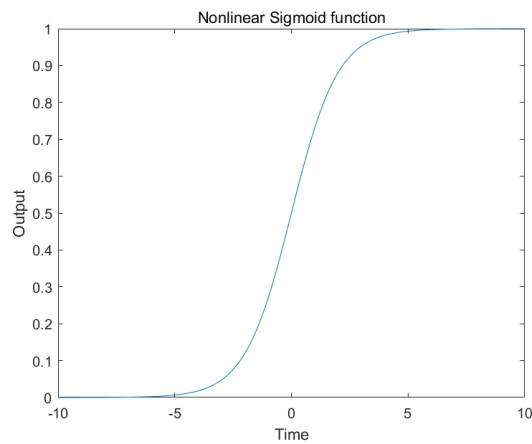


Figure 1: Sigmoid nonlinear function

And then, the Gaussian nonlinear function has been plotted in Figure 2.

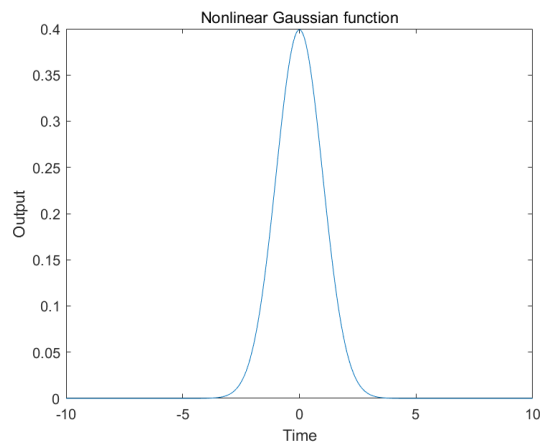


Figure 2: Gaussian nonlinear function

Finally, We also simulate the Gaussian mixture model (GMM), the GMM is shown in Figure 3.

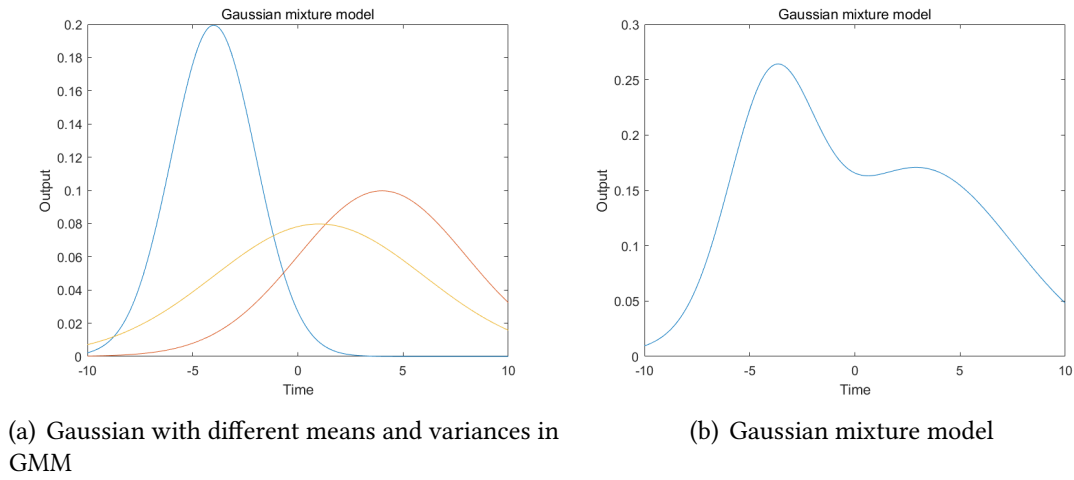


Figure 3: Gaussian mixture model and its components

Exercise 2

In this section, we show the result of the Volterra series model, we try to get the same nonlinear function just like we show in Figure 1 to 3 by using Volterra series, and we use first and second order Volterra model respectively. The iteration number is 1000 in this example, and the memory depth of these volterra series are both 15.

First, we train the one order Volterra series model in the system like Figure 4

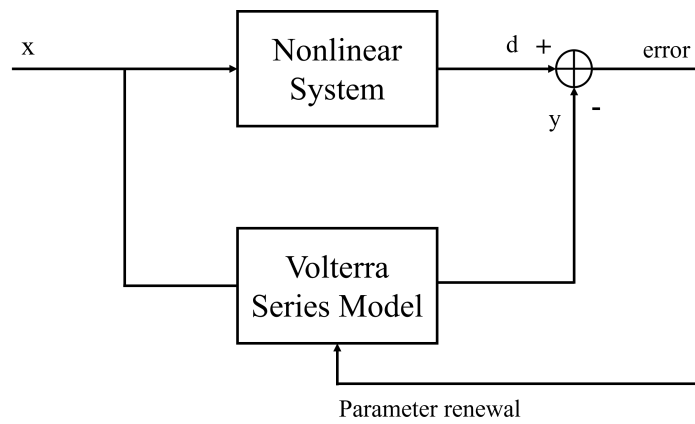
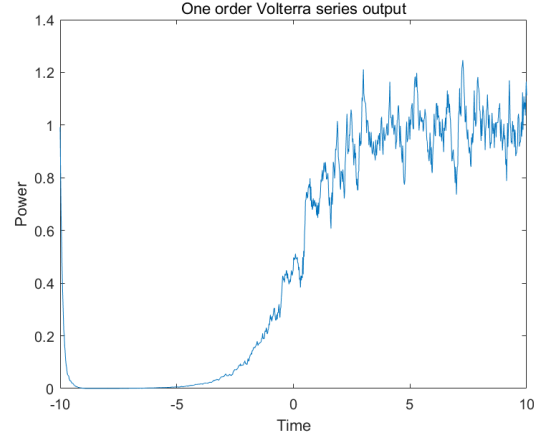
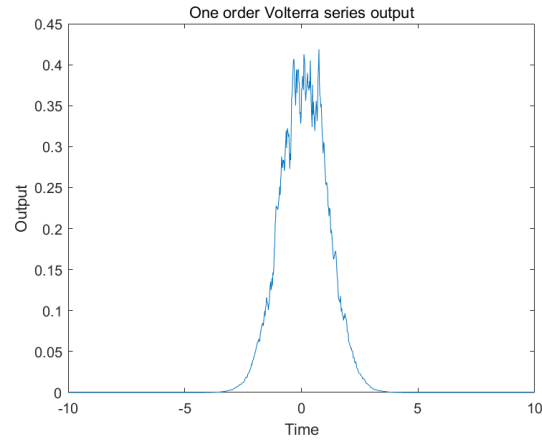


Figure 4: Volterra series model in nonlinear systems

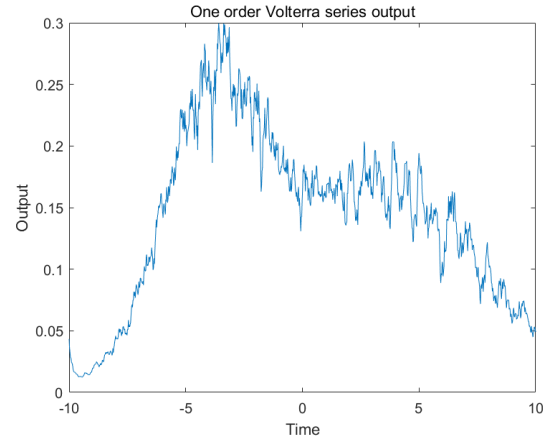
The result after training one order Volterra series is shown in Figure 5.



(a) Training result of Volterra series when nonlinear system is Sigmoid function



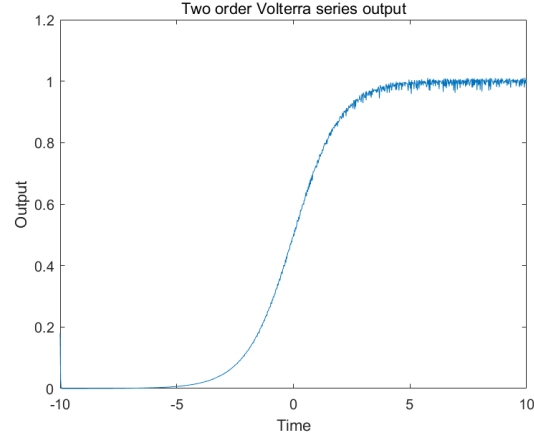
(b) Training result of Volterra series when nonlinear system is Gaussian function



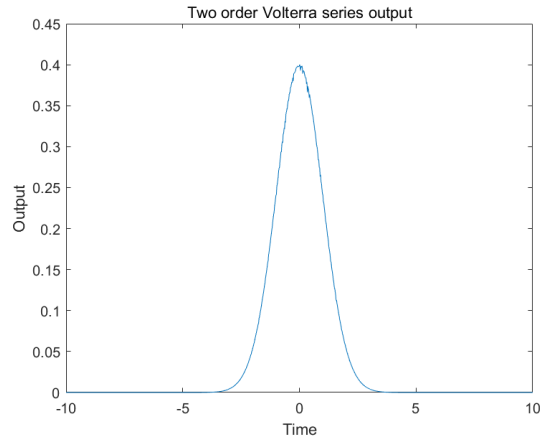
(c) Training result of Volterra series when nonlinear system is GMM

Figure 5: Results of first order Volterra series model

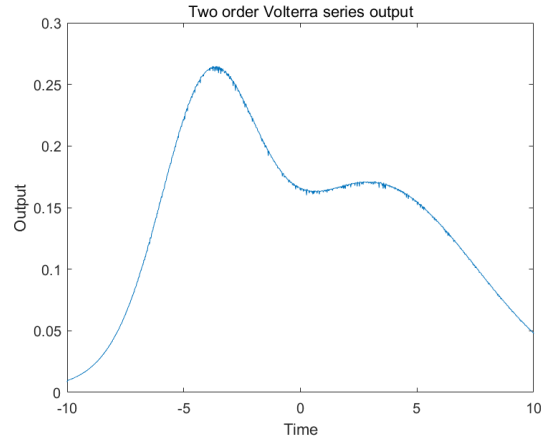
The result of Volterra series with second order is shown in Figure 6.



(a) Training result of Volterra series when nonlinear system is Sigmoid function



(b) Training result of Volterra series when nonlinear system is Gaussian function



(c) Training result of Volterra series when nonlinear system is GMM

Figure 6: Results of first order Volterra series model