Applying Echo State Networks to Lorenz 63, Lorenz 96, and Colpitts Systems

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1 Lorenz 63

$$\frac{dx}{dt} = \sigma(y - x)$$
$$\frac{dy}{dt} = x(\rho - z) - y$$
$$\frac{dz}{dt} = xy - \beta z$$

I use parameters $\sigma = 10.0$, $\rho = 28.0$, and $\beta = 8.0/3.0$. Initial condition is $(1.0, 1.0, 1.0)$.

2 Colpitts

$$\frac{dx}{dt} = \alpha y$$
$$\frac{dy}{dt} = -\gamma(x + z) - qy$$
$$\frac{dz}{dt} = \eta(y + 1 - e^{-x})$$

I use parameters $\alpha = 5.0$, $\gamma = 0.08$, and $\eta = 6.3$. Initial condition is $(0.1, 0.1, 0.1)$.

3 Lorenz 96

$$\frac{dx_i}{dt} = (x_{i+1} - x_{i-2})x_{i-1} - x_i + F$$

where i is an integer such that $i\epsilon[1, N]$ and $i = 1 = N + 1$ and $i = 0 = N$ (periodicity in i). I use forcing $F = 8$ and vary number of dimensions N. Initial condition is $x_i = F$ for all i except $i = 2$ when $N = 4$ or 5 or $i = 19$ when $N = 36$, in which case x_2 or $x_19 = F + 0.01$.