Lorenz System

Fluxion Example Description

1 Background

The Lorenz system is a system of ordinary differential equations. The so-called Lorenz attractor is a set of chaotic solutions of these differential equations. Generally, this is also known as the "butterfly effect". Even if you know all the initial conditions perfectly, even the smallest change (air turbulence caused by the flight of a butterfly) can make the system completely different.

Originally, the system of differential equations is derived from a model for atmospheric convection. The equations describe the temporal change in the properties of a fluid layer, which is heated uniformly from below and uniformly cooled from above. The quantity x is proportional to the convection rate, y describes the horizontal variation in temperature, and z the vertical variation in temperature. They are constants which describe properties of the considered system. The equations are:

$$x' = \sigma \cdot (y - x) \tag{1}$$

$$y' = x \cdot (\rho - z) - y \tag{2}$$

$$z' = x \cdot y - \beta \cdot z \tag{3}$$

Lorenz used the values $\sigma = 10$, $\beta = 8/3$, and $\rho = 28$. For these and other special combinations of values, the system behaves chaotically.