

Model Documentation of the Lorentz Attractor

1 Nomenclature

1.1 Nomenclature for Model Equations

- x is proportional to convection motions
- y is proportional to temperature difference between ascending and descending currents
- z is proportional to distortion of vertical temperature profile from linearity
- σ Prandtl Number
- r quotient of Raileigh Number and a critical value (see [?])
- b parameter

2 Model Equations

State Vector and Input Vector:

$$\underline{x} = (x_1 \ x_2 \ x_3)^T = (x \ y \ z)^T$$
$$\underline{u} = \emptyset$$

Model Equations:

$$\dot{x} = -\sigma x + \sigma y \tag{1a}$$

$$\dot{y} = -xz + rx - y \tag{1b}$$

$$\dot{z} = xy - bz \tag{1c}$$

Parameters: σ , r , b

Outputs: *(not defined)*

2.1 Exemplary parameter values

Parameter Name	Symbol	Value	Range
Raileight coeff	r	28	(24.74, 99)
Parameter	b	2.667	-
Prandtl Number	σ	10	-

3 Derivation and Explanation

The Lorenz Attractor is derived from the dynamic of convection currents. It is based on a model of convection currents formulated by Lord Rayleigh.

4 Simulation

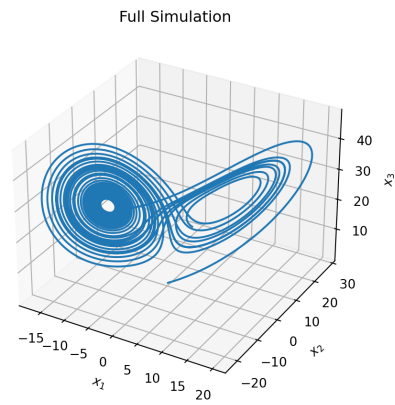


Figure 1: Simulation of the Lorenz System.

References

- [1] Lorenz, E. N.: *Deterministic Nonperiodic Flow*, p. 135, *Journal of Atmospheric Sciences* 1963.