

Nonlinear Systems

Nonlinear systems exhibit several peculiar dynamic characteristics, which cannot be observed in linear systems. Some examples are

- Multiple isolated equilibrium points
 - Linear systems described by state equation $\dot{x} = Ax + Bu$ have only one equilibrium point at $x = 0, u = 0$.
- Limit cycles
 - A fixed periodic response regardless of which initial conditions the system starts from.
- Finite escape time
 - The response of one or more system states tends towards infinity within finite time interval.
- Subharmonic, harmonic or almost periodic oscillations
 - An input composed of a signal with single frequency may result in output which is a combination of multiple frequencies. The response may not have the same frequency components during different time intervals.
- Chaos
 - The response may look very different, even though the system starts from almost similar initial conditions.
- Multiple modes of behavior
 - The system may behave in (finite but) different ways, based on its initial conditions.

[State-Space Models](#)

[Jacobian Linearization](#)

[Lyapunov's Stability Theory](#)