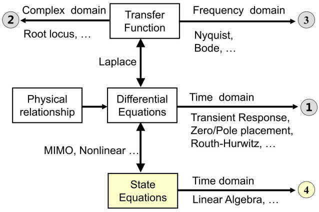
§9.1 Introduction



§9.2 状态空间与状态方程

State（状态）：Time domain, variables to describe system motion, movement information

State variable（状态变量）： a minimal-number of variables that describe the "state" of a dynamical system.

A nth-order differential equations ←→ n state variables.

State space（状态空间）: the n dimension space based on the state-variable $x_1(t)$, $x_2(t)$, … , $x_n(t)$.

State vector（状态向量）: a vector consists of n state variables.

$$X(t)=[x_1(t),x_2(t),\cdots,x_n(t)]^T$$

State locus（状态轨迹）: at each specified time t_0, state $X(t_0)$ is a point in the state-space; therefore, the state $X(t)$ can be draw as a trajectory/locus along t.

State equation（状态方程）: A 1st-order differential /difference equation which describes the mathematical relationship between system state and system input:

$$\dot{x}(t)=f[x(t),u(t)]$$
$$x(t_{k+1})=f[x(t_k),u(t_k)]$$

$\dot{x}(t)=Ax(t)+Bu(t)$

Output equation: An algebraic equation which describes the relationship among system output、system state and system input.

$$y(t)=g[x(t).u(t)]$$
$$y(t_k)=g[x(t_k),u(t_k)]$$

$y(t)=Cx(t)$

State-space Representation: A system model described with state equation and output equation.

$$\begin{cases}\dot{x}(t)=f[x(t),u(t)] \\ y(t)=g[x(t).u(t)]\end{cases}$$

一阶微分/差分方程

代数方程

$$\begin{cases}x(t_{k+1})=f[x(t_k),u(t_k)] \\ y(t_k)=g[x(t_k),u(t_k)]\end{cases}$$

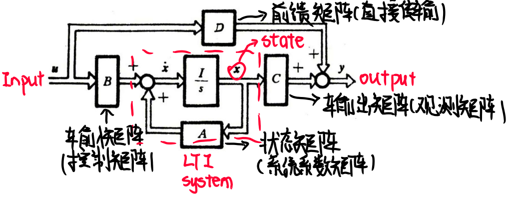
f，g为线性方程时，对线性系统

单/多输入

$$\begin{cases}\dot{X}(t)=A(t)x(t)+B(t)u(t) \\ Y(t)=C(t)x(t)+D(t)u(t)\end{cases}$$

多维输出　　状态　　输入

如时不变系统 $\begin{cases}\dot{x}(t)=Ax(t)+Bu(t) \\ Y(t)=Cx(t)+Du(t)\end{cases}$



* 状态空间方程表示非唯一，随状态变量选取变化

不同状态变量可通过非奇异阵进行转化