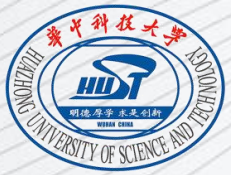

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Non-linear Analysis

Devices Classification

(1) Linear — Resistor, Capacitor, Air Core Inductor

No relationship with Voltage/Current

(2) Non-linear — Diode, Transistor, Core Inductor

No relationship with Voltage/Current

(3) Linear Time-varying — Mixer (Trans-Conductance)

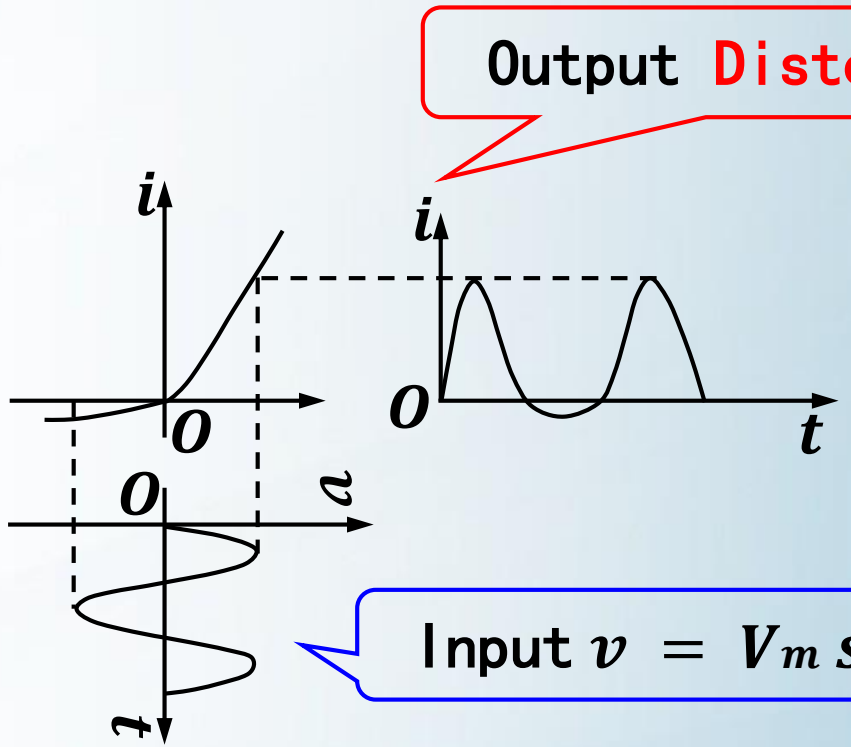
Time-varying papameters, no relationship with Voltage/Current

Non-linear Devices

- Frequency Conversion
- Absolute vs. Relative

Non-linear Device → Linear Network

Frequency conversion



Diode Example

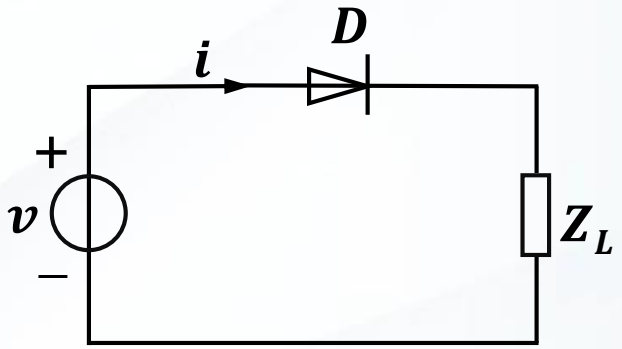
Non-linear Analysis

1. Power Series Analysis
2. Polygonal Line Analysis
3. Linear Time-varying Analysis

(1) Power Series Analysis

- Eg. Diode,

$$i = a_0 + a_1(v - V_0) + a_2(v - V_0)^2 + a_3(v - V_0)^3 + \cdots$$



- Cons

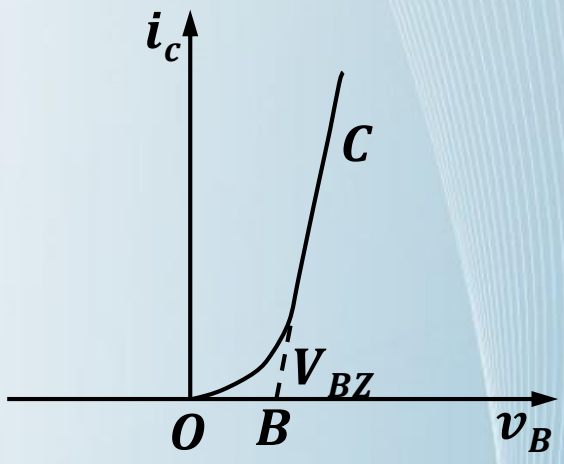
Signal is big, it will be complicated

(2) Polygonal Line Analsis

- Curve ≈ Multiple Line Segment

  Example: OC Curve ≈ $OB + BC$

$$\begin{cases} i_c = 0 & (vB < V_{BZ}) \\ i_c = g_c(v_B - VBZ) & (vB \geq V_{BZ}) \end{cases}$$



Transfer Curve

- Pros

  Simplify

- Cons

  Big sinals, Eg, Power amplifier

(3) Linear Time-varying Anaylysis

- Big v_1: Quiescent Point Change

  Small v_2, Linear

- Example:

  Mixer=Time-varying Transconductance