



RBE 2004

ระบบอัตโนมัติ (Automatic System)

สาขาวิศวกรรมหุ่นยนต์

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มหาวิทยาลัยราชภัฏสวนสุนันทา

Chapter 6 The Root Locus Method

Lecture 8

- Concept of Stability
- Root Locus Method
- Controller Design Using Root Locus Method
- Computer Simulation (Matlab/Simulink)

Table 7.2 Seven Steps for Sketching a Root Locus

Step	Related Equation or Rule
1. Prepare the root locus sketch.	
(a) Write the characteristic equation so that the parameter of interest, K , appears as a multiplier.	$1 + KP(s) = 0.$
(b) Factor $P(s)$ in terms of n poles and M zeros.	$1 + K \frac{\prod_{i=1}^M (s + z_i)}{\prod_{j=1}^n (s + p_j)} = 0.$
(c) Locate the open-loop poles and zeros of $P(s)$ in the s -plane with selected symbols.	$\times = \text{poles}, \circ = \text{zeros}$ Locus begins at a pole and ends at a zero.
(d) Determine the number of separate loci, SL .	$SL = n$ when $n \geq M$; $n = \text{number of finite poles},$ $M = \text{number of finite zeros}.$
(e) The root loci are symmetrical with respect to the horizontal real axis.	
2. Locate the segments of the real axis that are root loci.	Locus lies to the left of an odd number of poles and zeros.
3. The loci proceed to the zeros at infinity along asymptotes centered at σ_A and with angles ϕ_A .	$\sigma_A = \frac{\sum(-p_j) - \sum(-z_i)}{n - M}.$ $\phi_A = \frac{2k + 1}{n - M} 180^\circ, k = 0, 1, 2, \dots (n - M - 1).$
4. Determine the points at which the locus crosses the imaginary axis (if it does so).	Use Routh-Hurwitz criterion (see Section 6.2).
5. Determine the breakaway point on the real axis (if any).	a) Set $K = p(s).$ b) Determine roots of $dp(s)/ds = 0$ or use graphical method to find maximum of $p(s).$
6. Determine the angle of locus departure from complex poles and the angle of locus arrival at complex zeros, using the phase criterion.	$\angle P(s) = 180^\circ + k360^\circ$ at $s = -p_j$ or $-z_i.$
7. Complete the root locus sketch.	

