Stability (6A)

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Adding Poles

Adding poles in the open loop transfer function

Effect of shifting its root locus to the right

Decreasing relative stability

Increasing settling time

eg) PI controller

Adding poles at the origin

$$G(s)=\frac{K}{(s+a)}$$

Root Locus has 1 branch

$$G(s)=\frac{K}{(s+a)(s+b)}$$

Root Locus has 2 branch

$$G(s)=\frac{K}{(s+a)(s+b)(s+c)}$$

Root Locus has 3 branch

Adding Zeros

Adding zeros in the open loop transfer function

Effect of shifting its root locus to the left

Increasing relative stability

Decreasing settling time

eg) PD controller

Adding zeros

$$G(s)=\frac{K}{s(s+2)(s+4)}$$

$$G(s)=\frac{K(s+5)}{s(s+2)(s+4)}$$

$$G(s)=\frac{K(s+3)}{s(s+2)(s+4)}$$

$$G(s)=\frac{K(s+1)}{s(s+2)(s+4)}$$

Adding Poles and Zeros

Control Systems Engineering - Page 288 - Google Books Result
https://books.google.com/books?isbn=8131718204
S. K. Bhattacharya, Bhattacharya S. K. - 2008 - Automatic control
S. K. Bhattacharya, Bhattacharya S. K.. or s = ±j ... 9.5 EFFECTS OF **ADDING POLES AND ZEROS** TO G(S) H(Often the desired performance specifications of a ...

books.google.com

Search “adding poles and zeros Bhattacharya”

See section 9.5 of that book

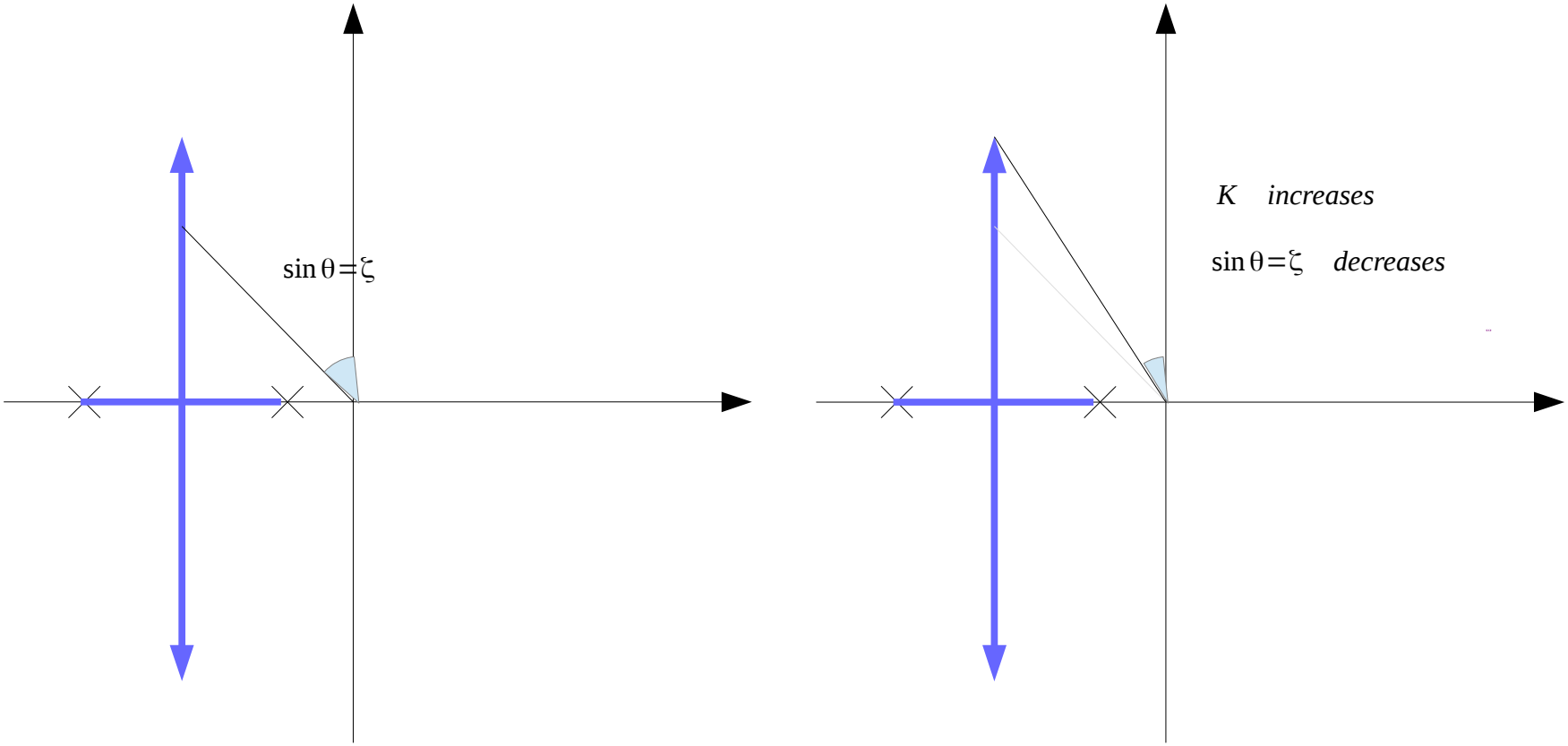
Critically Stable

http://www.atp.rub.de/rt1/syscontrol/node38.html

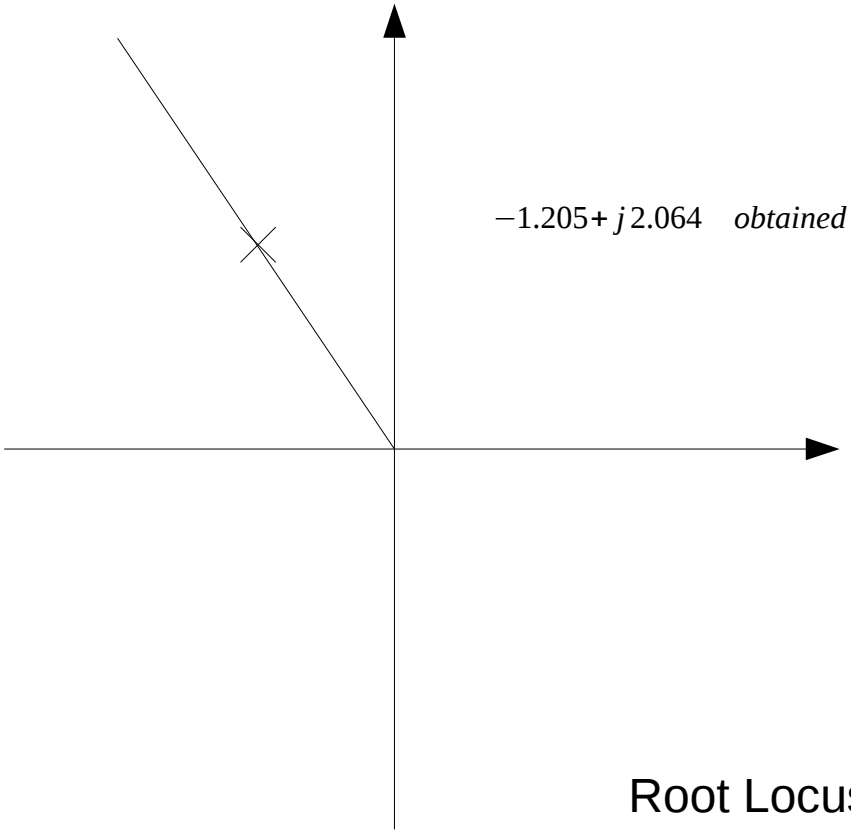
G(s) has one pole at the origin : critically stable
G(s) has two poles at the origin : unstable

log(ω)

Damping Factor zeta



Ex 6-10



$-1.205 + j\,2.064$ *obtained by matlab programs*

Root Locus software finds the intersection point

References

[1] http://en.wikipedia.org/
[2] M.L. Boas, “Mathematical Methods in the Physical Sciences”
[3] E. Kreyszig, “Advanced Engineering Mathematics”
[4] D. G. Zill, W. S. Wright, “Advanced Engineering Mathematics”