Structured Electronic Design

Introduction to Frequency Compensation

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Contents

Introduction

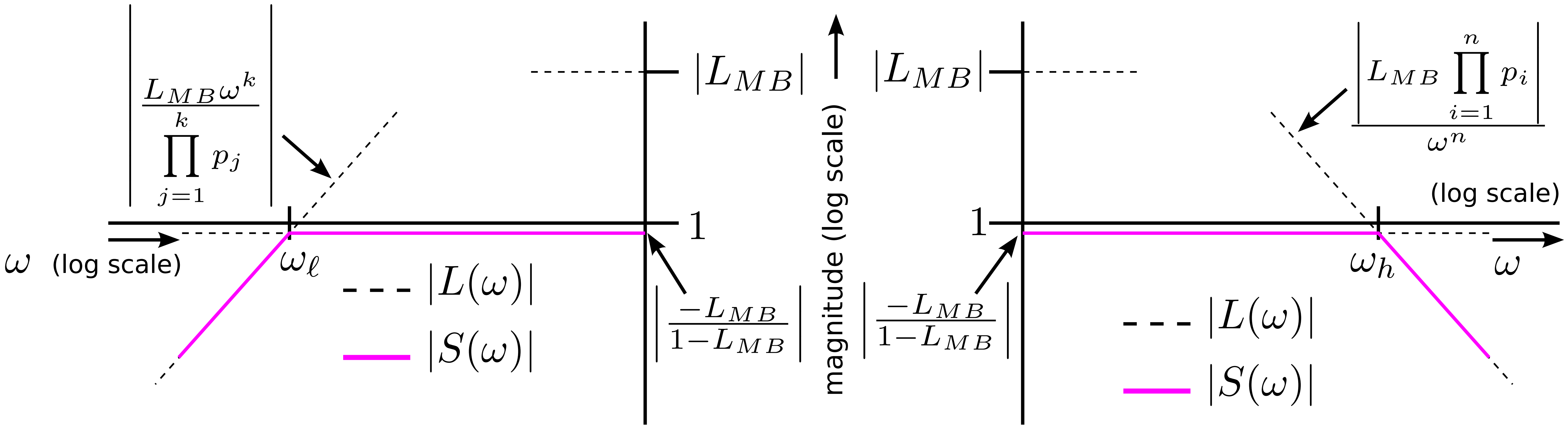
Frequency compensation?

Frequency compensation is the application of techniques to correct the frequency response of an amplifier

Structured design: without unintentionally degrading performance aspects that have been designed earlier

Design approach

Independent correction of high-pass and low-pass cut-off behavior



$$A_f(s) = \underbrace{A_i(s)}_{\text{Ideal gain}} \underbrace{\frac{-L_{MB}}{1-L_{MB}}}_{\text{midband accuracy}} \underbrace{\frac{b_k s^k}{1+b_1 s+b_2 s^2+\cdots b_k s^k}}_{\text{high-pass cut-off}} \underbrace{\frac{1}{1+a_1 s+a_2 s^2+\cdots a_n s^n}}_{\text{low-pass cut-off}}$$

Techniques

✓ 1. Insertion of phantom zeros

✗ 2. 'Pole-splitting' by increasing the interaction between two poles

✗ 3. 'Pole-splitting' through pole-zero canceling

✗ 4. 'Resistive broadbanding' by exchanging a pole frequency with midband loop gain

Strategies

✓ 1. Maintain the bandwidth designed at an ealier stage

  a. The obtained bandwidth is adequate

  b. There is no margin to reduce it

✗ 2. Exchange bandwidth of ideal transfer with that of servo function

  a. The obtained bandwidth is much more than required

  b. The bandwidth of the ideal gain can be reduced

✗ 3. Reduce the bandwidth of the loop gain

  a. The obtained bandwidth is more than required

  b. The number of dominant poles is too large to deal with

