Dept. Electrical and Computer Engineering
The University of British Columbia
EECE560 Network Analysis and Simulation January 2021
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ASSIGNMENT No. 6

Due Date: 22 March 2021

Frequency Response of Discretization Rules

A way to gain insight into the behaviour of different discretization rules is to look at the distortion in magnitude and phase angle introduced by the rule on the representation of a simple first-order system, such as an inductance, as a function of frequency.

1. With the rules listed below find the frequency-domain equivalent-circuit of the discretized L. Express this equivalent circuit in terms of an R_e (equivalent resistance) and an L_e (equivalent inductance). Find the simplest representation: Should R_e and L_e be in series or in parallel?

   (a) Trapezoidal (class notes)

   (b) Backward Euler (class notes)

   (c) Forward Euler (derive)

   (d) Gear's second order (derive)

2. Plot the magnitude and phase distortion of the discretizations in 1) for $f_{pu} = 0 \rightarrow 0.5$

3. Comment on the expected numerical stability based on the equivalent circuit parameters.