ASSIGNMENT No. 6
Due Date: 8 March 2019

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). Whether $R_e$ and $L_e$ should be in series or in parallel will depend on the rule.

   (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 of the rule from the nature of the equivalent circuit parameters.

4. General comments.