The impulse invariance method is another approach to the design of a causal IIR digital filter based on the transformation of a prototype causal analog transfer function. If is the impulse response of, in the impulse invariance method, we require that the unit sample responseof be given by the sampled version ofsampled at uniform intervals of *T* seconds; that is



Reference:

L. B. Jackson. A correction to impulse invariance. *IEEE signal Processing Letters*, 7:273-275. Oct. 2000.

W. F. G. Mecklenbraüker. Remarks on and correction to the impulse invariance method for the design of IIR digital filters. *Signal Processing*, 80:1687-1690. Aug. 2000.

Mission A

For the given method

* 1. Show thatandare related through



* 1. Show that the transformation



has the desirable properties enumerated in Section 9.3 (Hint: the mapping from s-Domain to the z-Domain).

* 1. Develop the condition under which the frequency responseofwill be a scaled replica of the frequency responseof.
  2. Show that the normalized digital angular frequencyis related to the analog angular frequencyas



Mission B

1. Design an IIR Lowpass digital filter with a maximally flat magnitude response and meeting the specifications given by





using the impulse invariance method.

1. How does this filter compare with that designed via the bilinear transformation method (in detail)?

Mission C

Specify the detailed steps to design a desirable IIR digital filter  (may be lowpass, highpass, bandpass and bandstop) from a Lowpass FIR analog filter. Is your approach unique?