Memory Filter

$H_{mem} = 1 / [(K-1)-k*z^{-N}]$ --> $yn = (1/K)[x_n + (K-1)y_{n-N}]$

Sinewave Generator

$$singen(M,N) := \left| \begin{array}{l} \text{for } n \in 0..M-1 \\ \quad x_n \leftarrow 100 \cdot \cos\left(n \cdot \frac{2 \cdot \pi}{N}\right) \\ \text{return } x \end{array} \right.$$

Zero vector generator

$$zerogen(M,N) := \left| \begin{array}{l} \text{for } n \in M-1 \\ \quad x_n \leftarrow 0 \\ \text{return } x \end{array} \right.$$

$K := 15$ Filter time constant

$N := 16$ Samples per cycle

$M := 30 \cdot N$ Sample in signal

$Zn := (1 \;\; 0 \;\; 0 \;\; 0 \;\; 0 \;\; 0 \;\; 0 \;\; 0 \;\; 0)^T$ Memory filter - Numerator

$Zd := [K \;\; 0 \;\; 0 \;\; 0 \;\; 0 \;\; 0 \;\; 0 \;\; 0 \;\; (K-1)]^T$ Memory filter - denominator

$RZd := polyroots(Zd)$

Generate input signal

$Vin := singen(M,N)$ Sinewave signel

$x0 := zerogen\left(\frac{M}{4}, N\right)$ Appended zero value vector

$Vin := stack(Vin, x0)$ Input - Output Array (required to make vectors equal size)

$NN := rows(Vin)$ Size of arrays

$n := 0..NN$ Sample array (for plotting)

$$RZd = \begin{pmatrix} -0.932 + 0.386i \\ -0.932 - 0.386i \\ -0.386 + 0.932i \\ -0.386 - 0.932i \\ 0.386 - 0.932i \\ 0.386 + 0.932i \\ 0.932 - 0.386i \\ 0.932 + 0.386i \end{pmatrix}$$

Roots on numerator all at zero

Roots of denominator are equally spaced around and inside the unit circle.

Digital Filtering Subroutine

"x" is an array of real numbers containing the input data.

Zn is a vector of coefficients for the filter numerator polynomial in assending powers of 1/z.

Zd is a vector of coefficients for the filter denominator polynomial in assending powers of 1/z.

Returned vector is the filtered data.

$$\text{digitalfilter}(x, Zn, Zd) :=$$

$Nd \leftarrow \text{rows}(Zd)$

$Nn \leftarrow \text{rows}(Zn)$

$Nx \leftarrow \text{rows}(x)$

$jn \leftarrow 0$

$jd \leftarrow 0$

for $n \in 0 .. Nx - 1$

  $y_n \leftarrow 0$

  $z_0 \leftarrow x_n$

  for $k \in 0 .. jn$

    $y_n \leftarrow y_n + x_{n-k} \cdot Zn_k$

  for $k \in 1 .. jd$

    $y_n \leftarrow y_n - Zd_k \cdot y_{n-k}$ if $jd > 0$

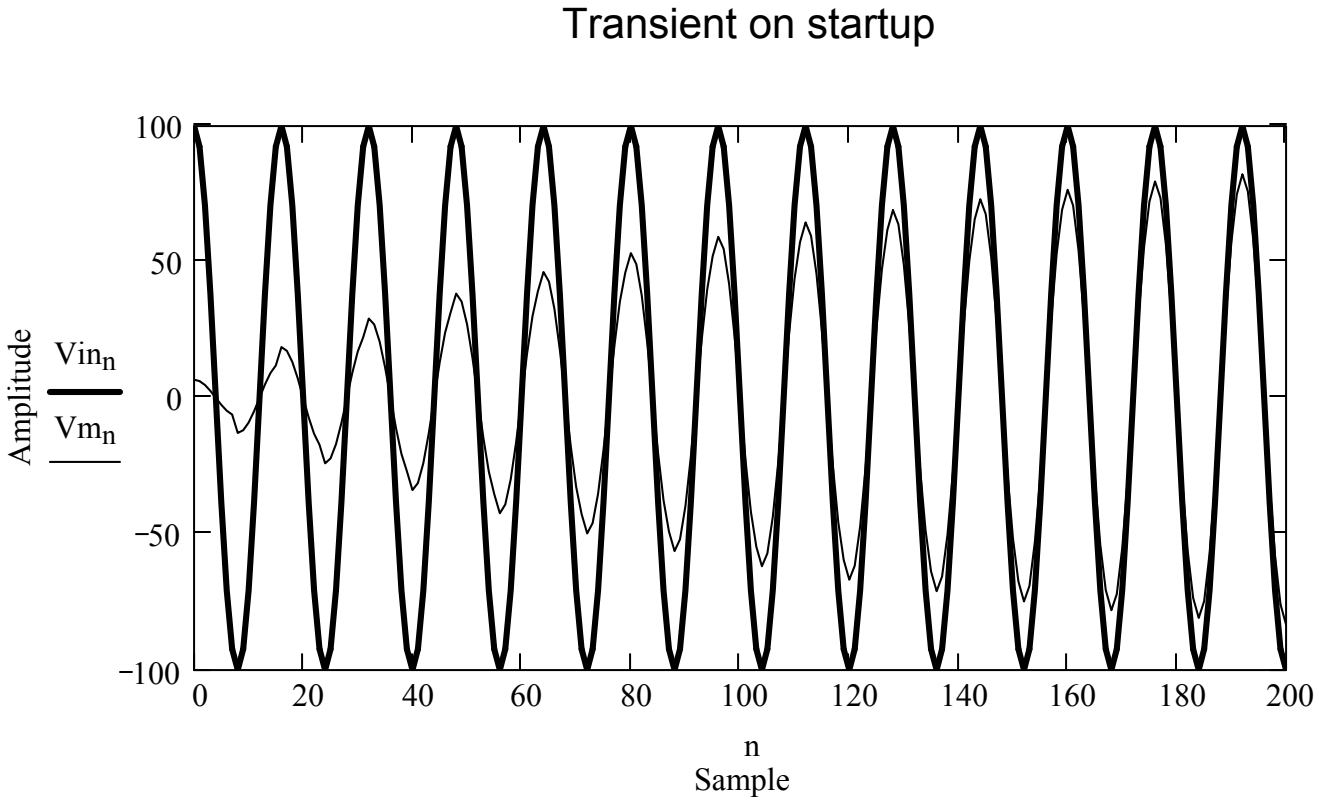
  $jn \leftarrow jn + 1$ if $jn < Nn - 1$

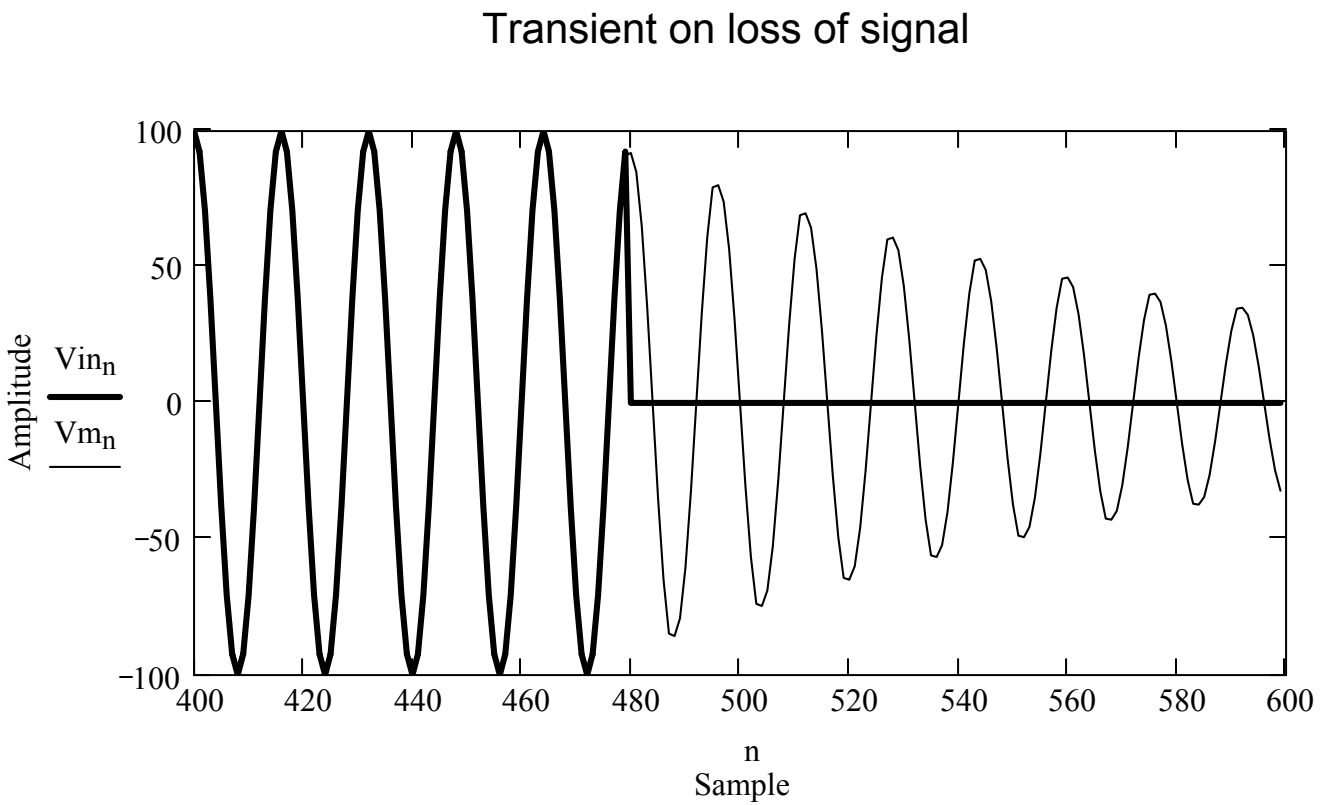
  $jd \leftarrow jd + 1$ if $jd < Nd - 1$

  $y_n \leftarrow \dfrac{y_n}{Zd_0}$

return y

Vm := digitalfilter(Vin , Zn , Zd)




Transient on loss of signal
100
50
0
−50
−100
Amplitude
Vin_n
Vm_n
400
420
440
460
480
500
520
540
560
580
600
n
Sample