List of Symbols

a_k	allpass filter coefficients
a	vector of allpass filter coefficients
A	cross-sectional area
$A(z)$	allpass transfer function
B	area ratio
c	speed of sound
c	vector of transfer functions or of cosine functions
C	scaling coefficient
$C(z)$	transfer function of a subfilter in the Farrow structure
d	fractional part of the total delay D
D	total delay to be approximated
$D(z)$	denominator of $A(z)$
e	vector of complex exponentials
$E(e^{j\omega})$	frequency-domain error function
f	frequency variable
f_0	fundamental frequency
f_N	Nyquist frequency ($f_\mathrm{N} = f_\mathrm{s} / 2$)
f_s	sampling frequency
F	square matrix
g	coefficient vector
$G(z)$	transfer function including the approximation error
$h(n)$	impulse response of an FIR filter
$h_\mathrm{id}(n)$	impulse response of the ideal interpolator
$h_\mathrm{r}(n)$	impulse response of the recursive part of an IIR filter
h	vector of FIR filter coefficients
$H(z)$	transfer function of a discrete-time filter
$H_\mathrm{id}(z)$	the ideal (desired) transfer function
j	imaginary unit ($j = \sqrt{-1}$)
k	wave number ($k = \omega / c$) or index variable
k_n	slope of a discrete-time sequence at time index n
ℓ	length in meters
L	length in meters or in samples (e.g., FIR filter length)
m	index variable
M	integer constant
n	discrete time index

n_c	time index of change in time-varying filters
N	order of a digital filter or an integer constant
N_a	advance time (in samples) in the transient elimination method
p	sound pressure
u	volume velocity
r	reflection coefficient or radius
$\mathbf{q}$	column vector (e.g., a column of matrix $\mathbf{Q}$)
$\mathbf{Q}$	inverse matrix of Vandermonde matrix $\mathbf{U}$
$R(\omega)$	reflection function
$\mathbf{s}$	vector of sine functions
t	time variable
t_k	transmission coefficient of the kth branch in a junction of waveguides
T	sampling interval $(T = 1 / f_s)$
$T(z)$	transmission function
$\mathbf{T}$	transformation matrix
$\mathbf{U}$	Vandermonde matrix
$v_k(n)$	state variables of a discrete-time filter
$\mathbf{v}$	column vector
$\mathbf{v}(n)$	state variable vector
$\mathbf{V}$	Vandermonde matrix
$w(n)$	discrete-time sequence (e.g., a window function)
$W(z)$	transfer function of $w(n)$
$W(\omega)$	frequency response (e.g., a frequency-domain weighting function)
$x(n)$	input sequence of a discrete-time system
$x_c(t)$	input signal of a continuous-time system
X	spatial sampling interval ($X = cT$)
$X(z)$	z-transform of the input sequence $x(n)$
$y(n)$	output sequence of a discrete-time system
$y_c(t)$	output signal of a continuous-time system
Y	acoustic admittance
$Y(z)$	z-transform of the output sequence $y(n)$
z	z-transform variable
$\mathbf{z}$	column vector of powers of z^{-1}
Z	acoustic impedance

α	real parameter (e.g., passband width parameter)
$\beta(\omega)$	phase error function in allpass filter design
δ	complementary fractional delay $(\delta = 1 - d)$
$\delta(k)$	Kronecker delta function
Δ	complementary total delay $(\Delta = N - D)$
ε	mass density of a string
$\Theta(\omega)$	phase response
$\Theta_{\text{id}}(\omega)$	phase response of the ideal interpolator
τ	delay
$\tau_{\text{g}}(\omega)$	group delay
$\tau_{\text{p}}(\omega)$	phase delay
ρ	density of air
ω	angular frequency
ω_{s}	sampling frequency in radians $(\omega_{\text{s}} = 2\pi f_{\text{s}})$
Ω	analog angular frequency $(\Omega = 2\pi f)$