Implementing Digital Reverberation Algorithms
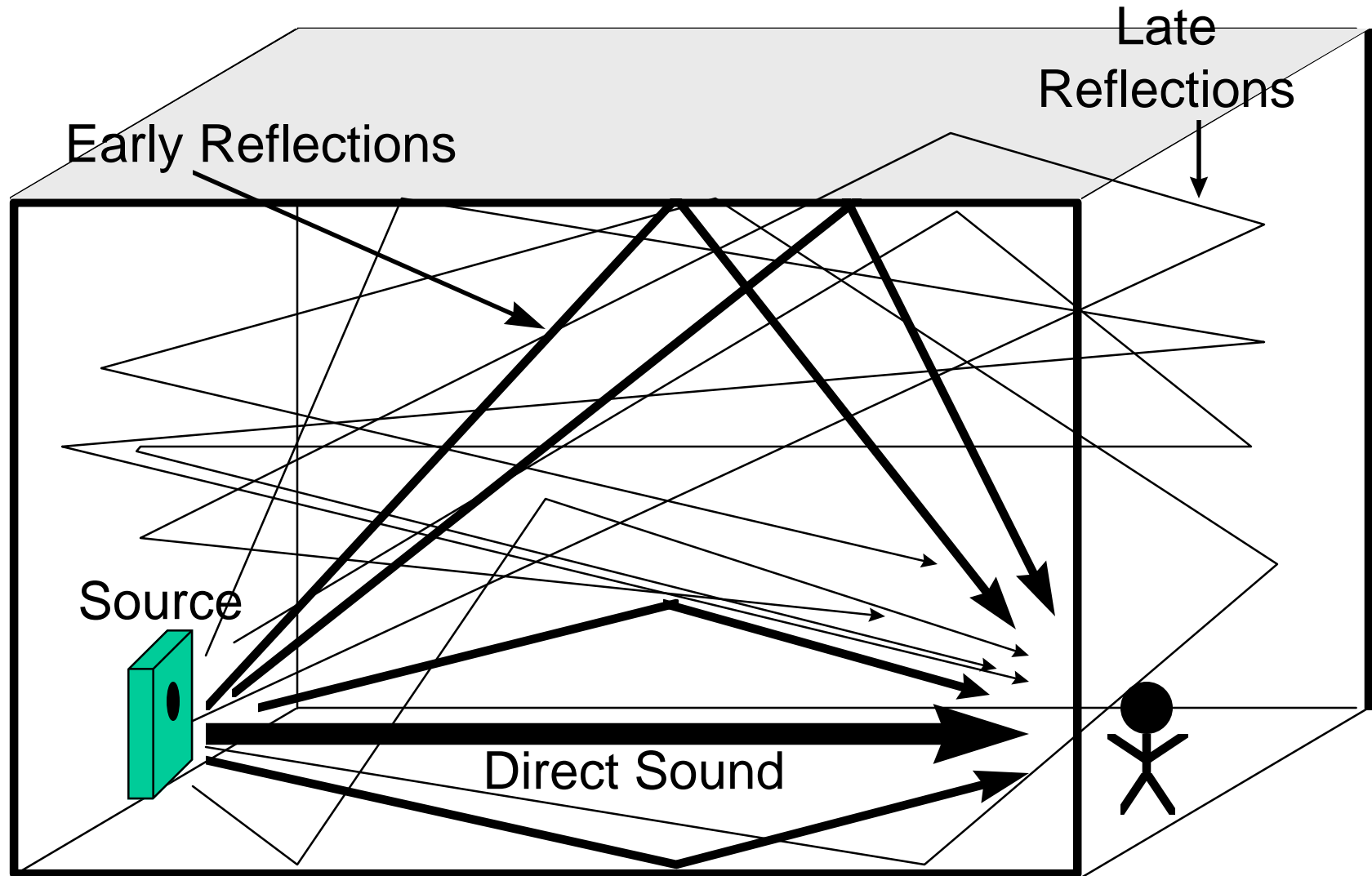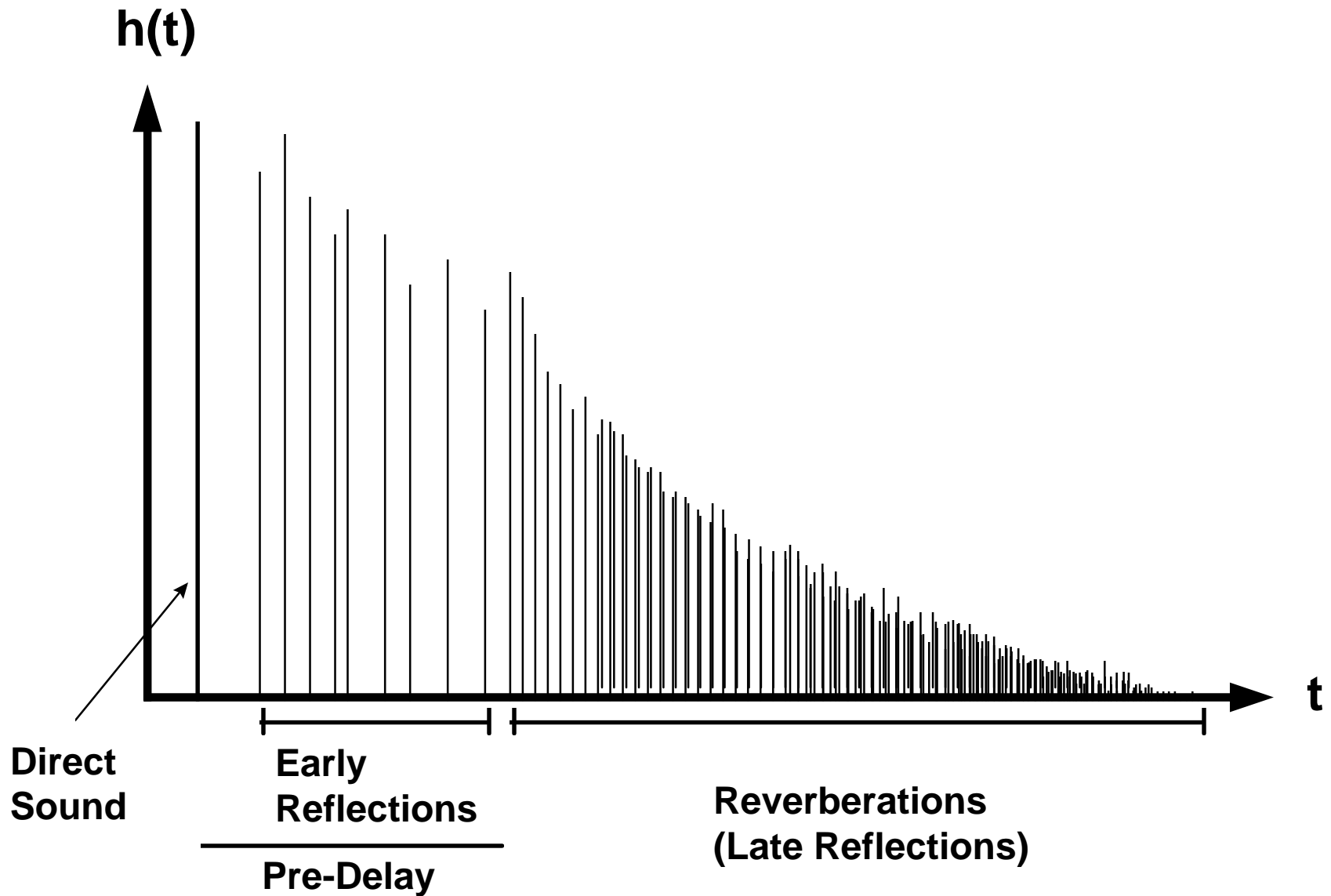
Reverb Building Blocks

Reverb Example - J.A. Moorer's Reverb

Reverberation of Large Acoustic Spaces
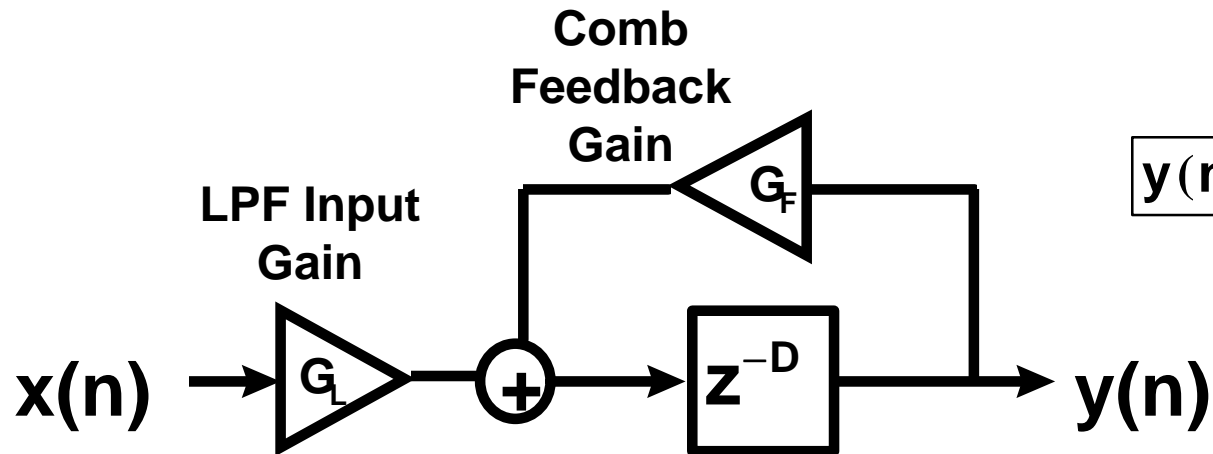
Late
Reflections

Early Reflections

Source

Direct Sound

Impulse Response For Large Auditorium Reverberations

h(t)

Direct
Sound

Early
Reflections

Pre-Delay

Reverberations
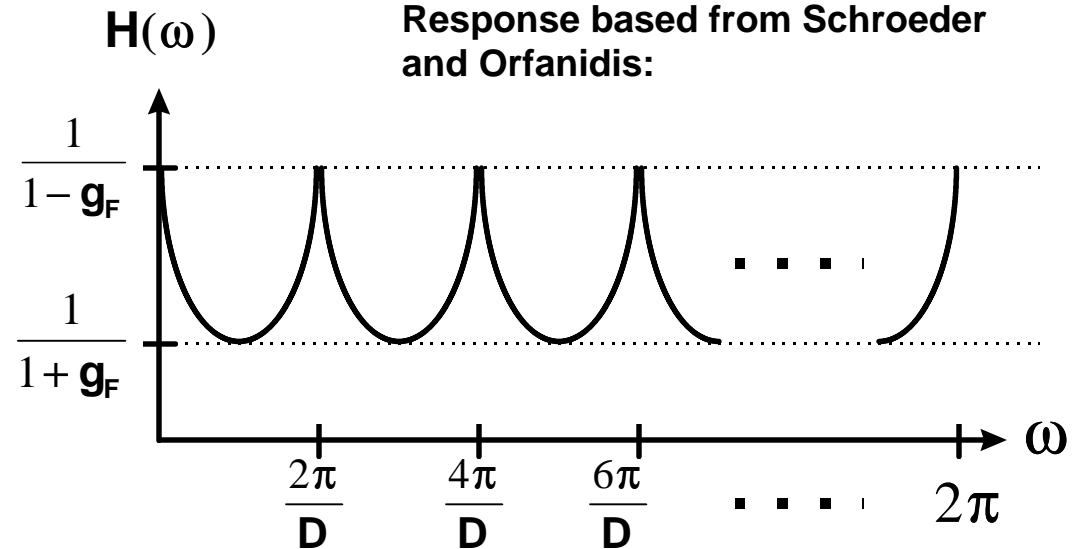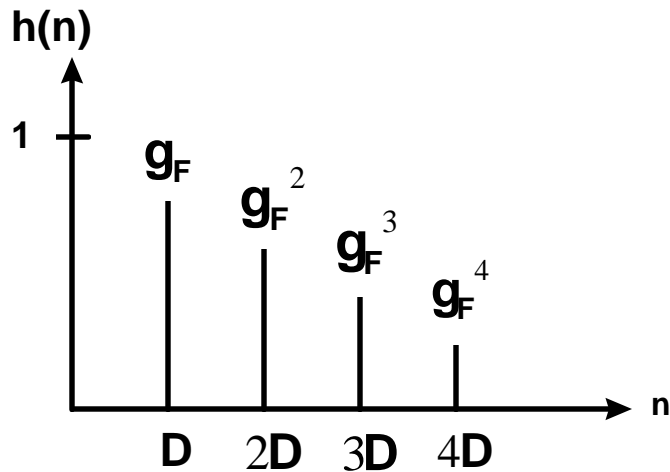(Late Reflections)

t

Components for Making Reverb Algorithms

- **Delay-Lines**

- **Comb Filters**

- **All-Pass Filters**

- **FIR Filters**

- **Two-Multiply Ladder Filters**

Low Pass Comb Filters
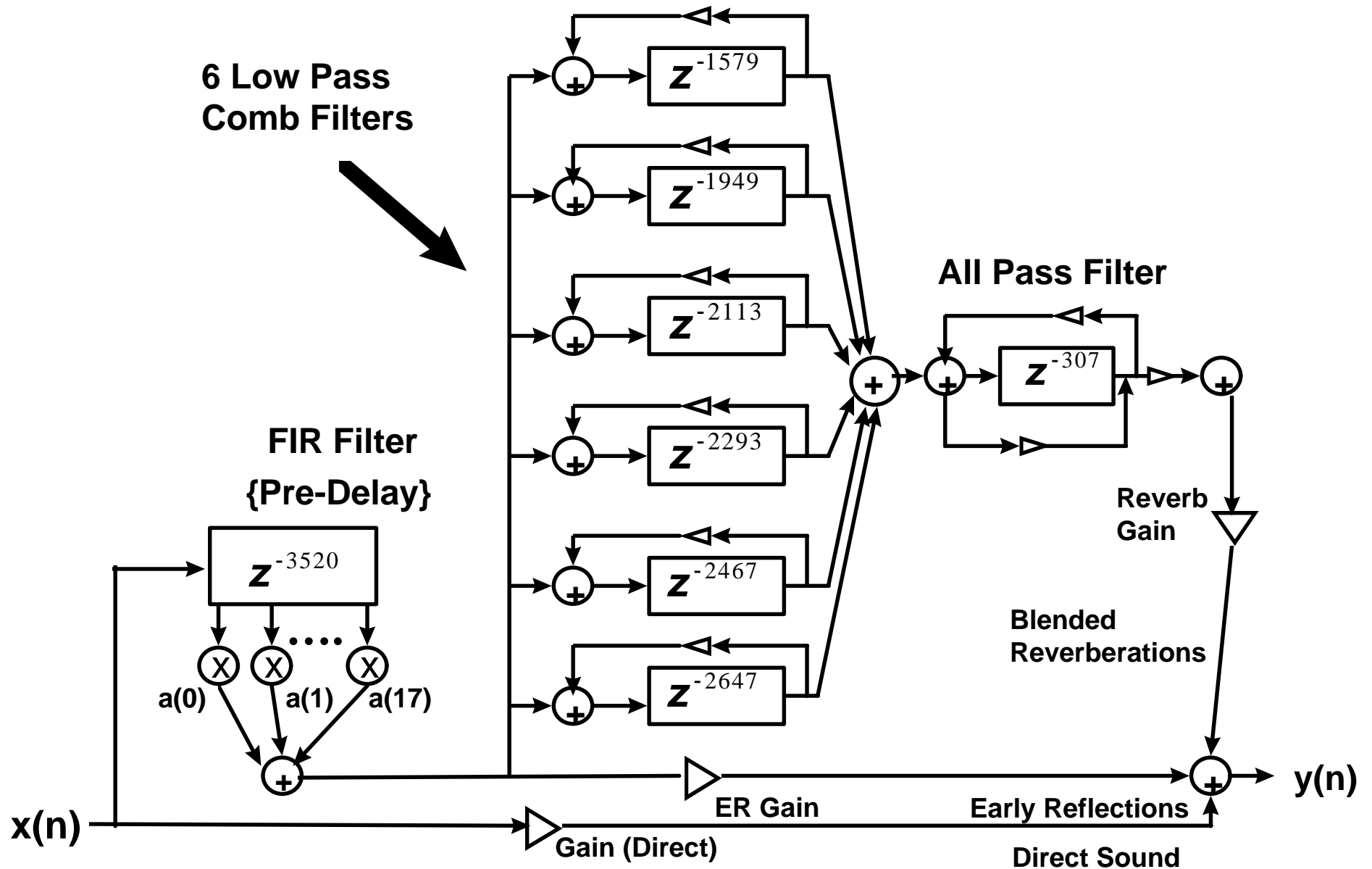

Comb Feedback Gain

LPF Input Gain

$$y(n) = g_L x(n) + g_F y(n-D)$$

$$H(z) = \frac{G_L}{1 - G_F z^{-D}}$$

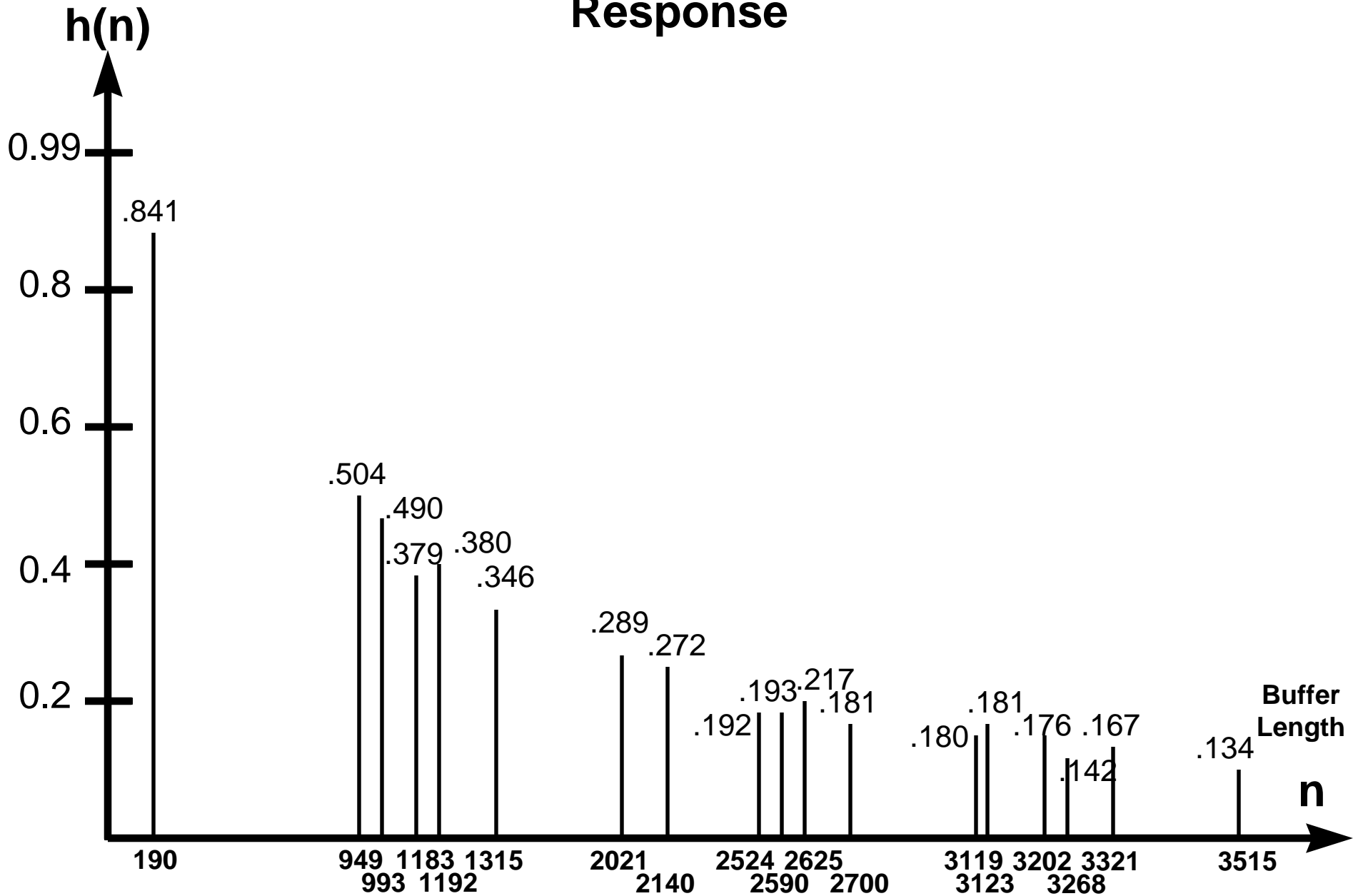Equations, Impulse/Frequency Response based from Schroeder and Orfanidis:

James A. Moorer's Digital Reverberation Structure

Example Early Reflection FIR Filter Tap Lengths and Tap Gain Parameters

Tap Lengths	Gain Parameters
-190	0.841
-759	0.504
-44	0.490
-190	0.379
-9	0.380
-123	0.346
-706	0.289
-119	0.272
-384	0.192
-66	0.193
-35	0.217
-75	0.181
-419	0.180
-4	0.181
-79	0.176
-66	0.142
-53	0.167
-194	0.134

Example Early Reflections FIR Filter Impulse Response

h(n)

0.99 — .841
0.8 —
0.6 —
.504
.490
.379 .380
0.4 — .346
.289
.272
.193 .217
.192 .181
0.2 — .180 .181
.176 .167
.142
.134

Buffer Length

n

190   949 1183 1315   2021   2524 2625   3119 3202 3321   3515
993 1192   2140   2590 2700   3123 3268

Example Reverb Specifications for a Large Auditorium response at 44.1 kHz Sampling Rate

Delay Line Buffer Length		Time Delay
Comb 1	1759	40 ms
Comb 2	1949	44 ms
Comb 3	2113	48 ms
Comb 4	2293	52 ms
Comb 5	2467	56 ms
Comb 6	2647	60 ms
Early Reflections	3520	80 ms
All-Pass Filter	307	7 ms