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P&D Week 3 - Audio Processing

GSC

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1. Delay and Sum Beamforming
2. Generalized Sidelobe Canceller (GSC)

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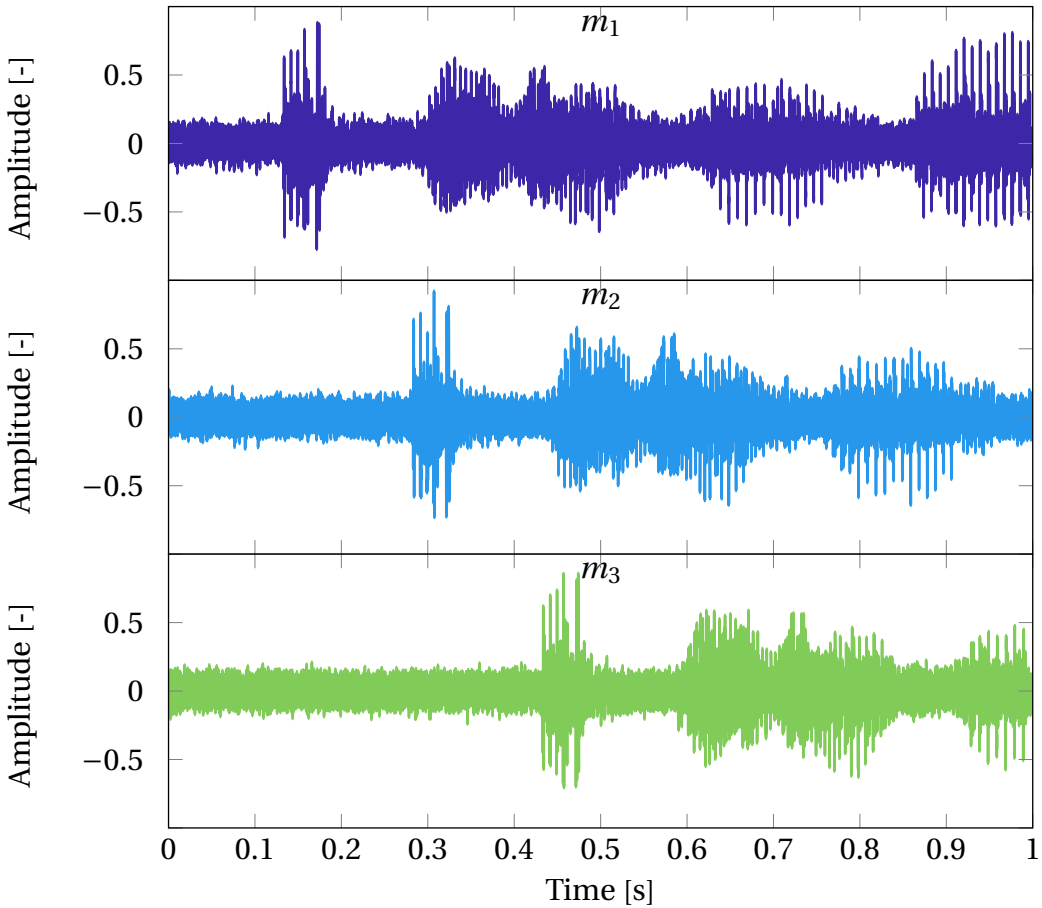
1 – Delay and Sum (DAS) Beamforming: Received Signals 3/11



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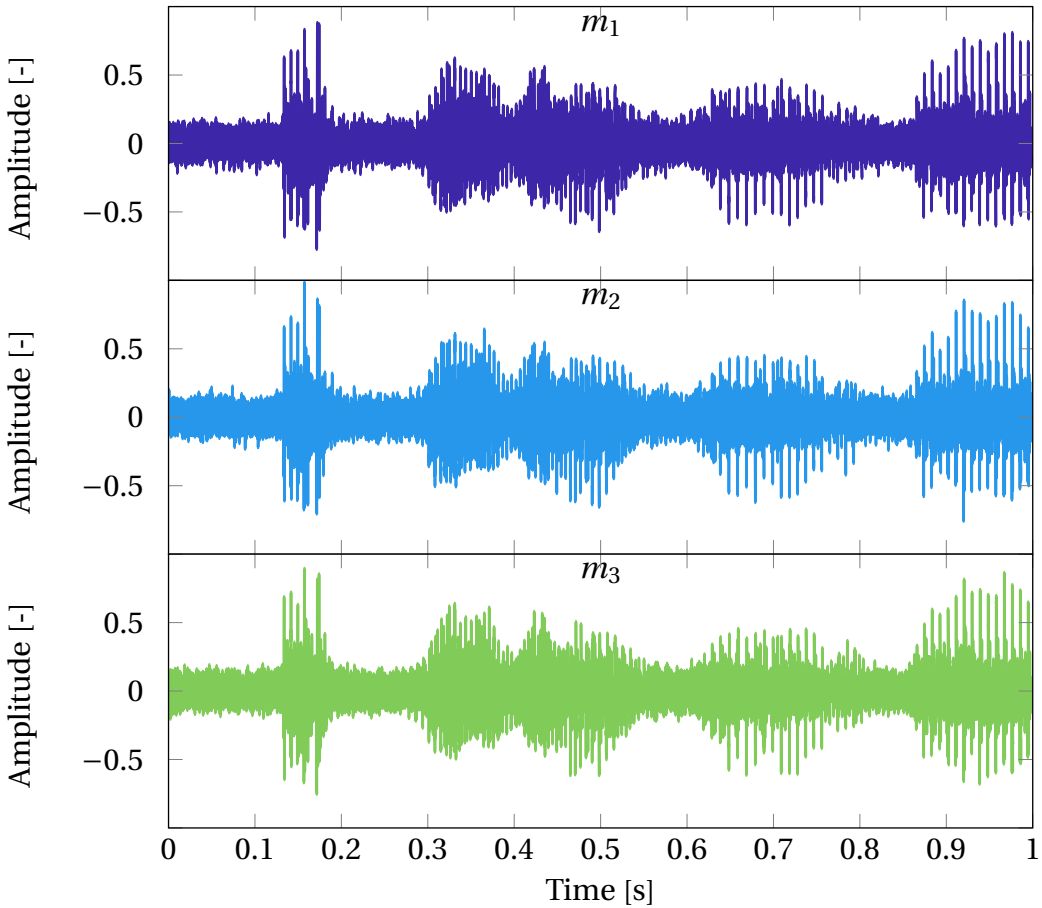
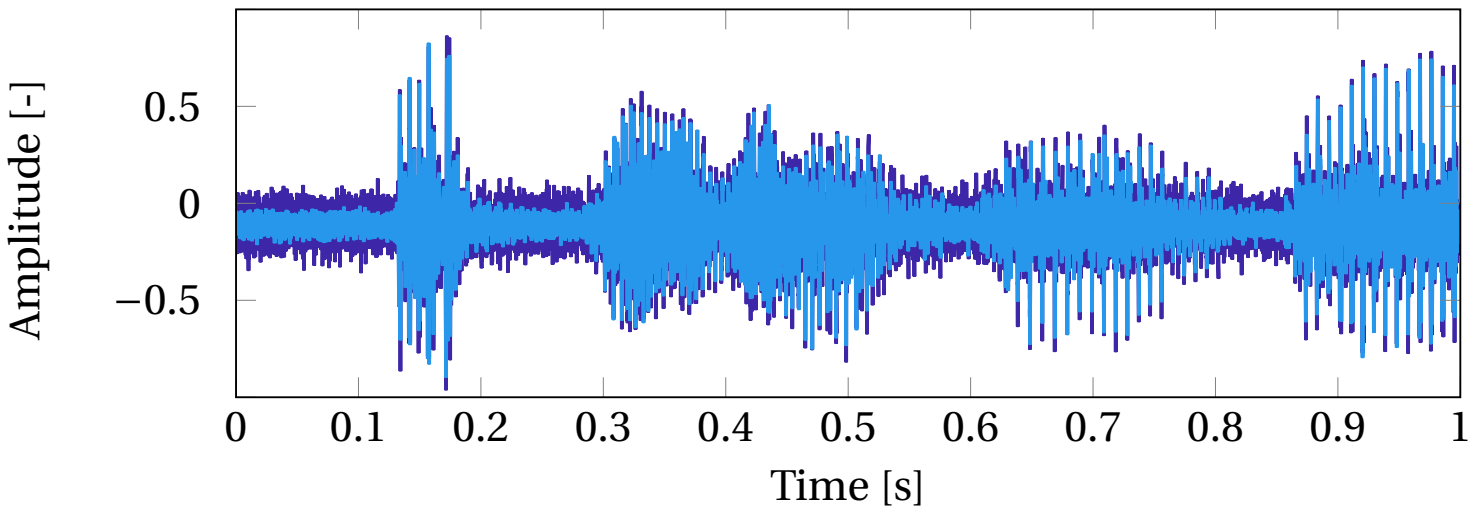

m_1
m_2
m_3
Amplitude [-]
0.5
0
−0.5
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Time [s]


Amplitude [-]
0.5
0
−0.5
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Time [s]

1 Delay and Sum Beamforming
2 Generalized Sidelobe Canceller (GSC)

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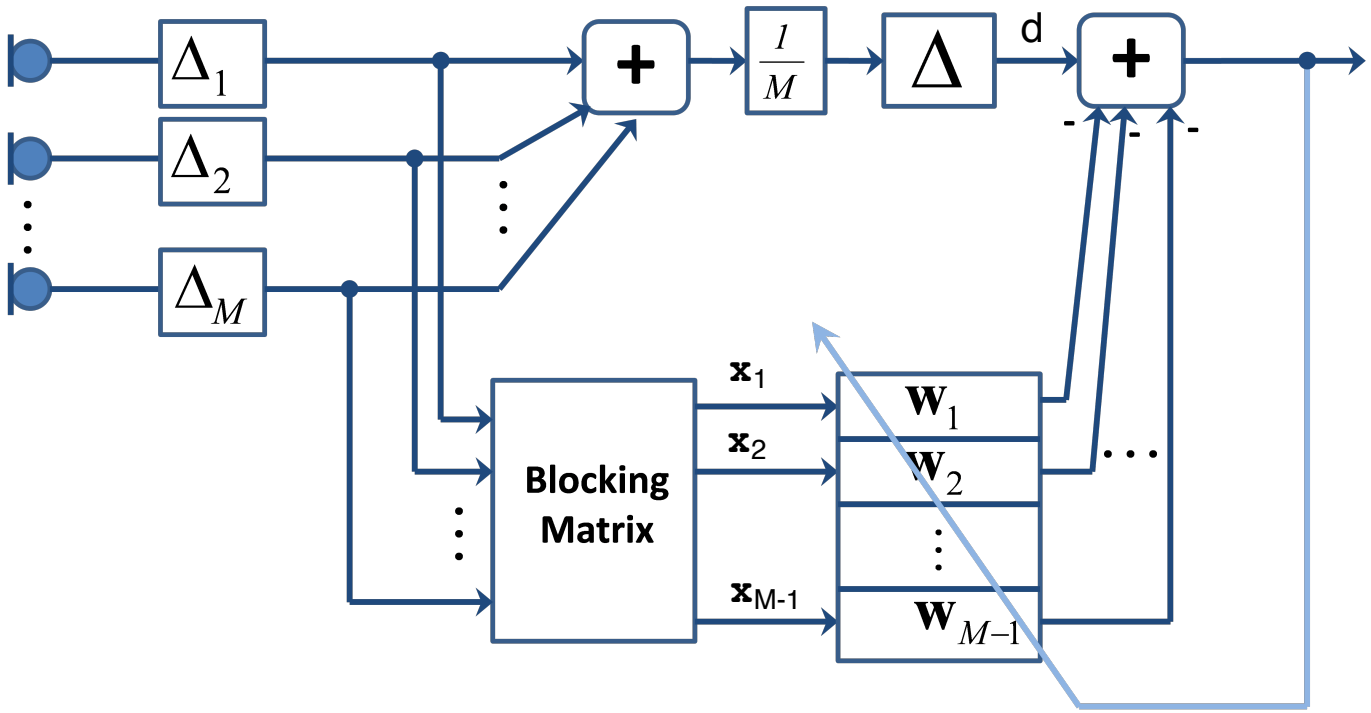
Δ_1
Δ_2
Δ_M
+
$\frac{1}{M}$
Δ
d
+
-
-
-
Blocking Matrix
$\mathbf{x}_1$
$\mathbf{x}_2$
$\mathbf{x}_{M-1}$
$\mathbf{w}_1$
$\mathbf{w}_2$
$\mathbf{w}_{M-1}$

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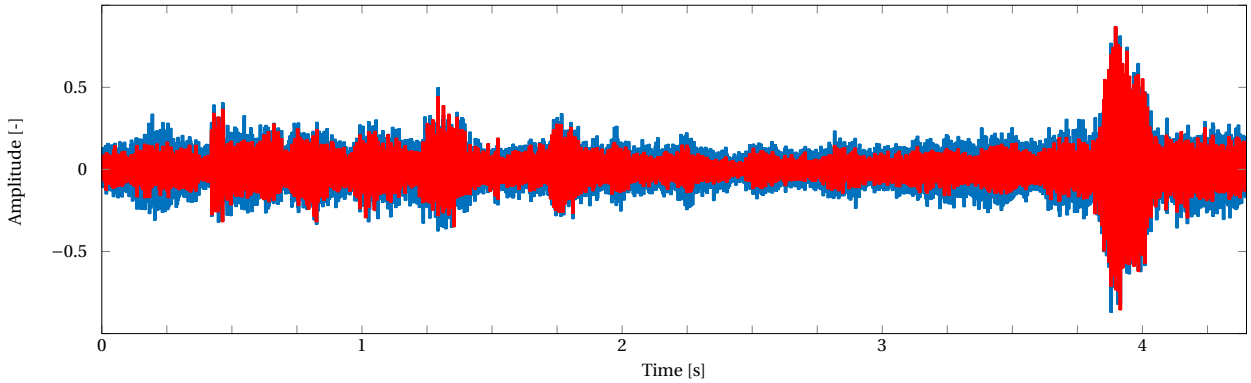
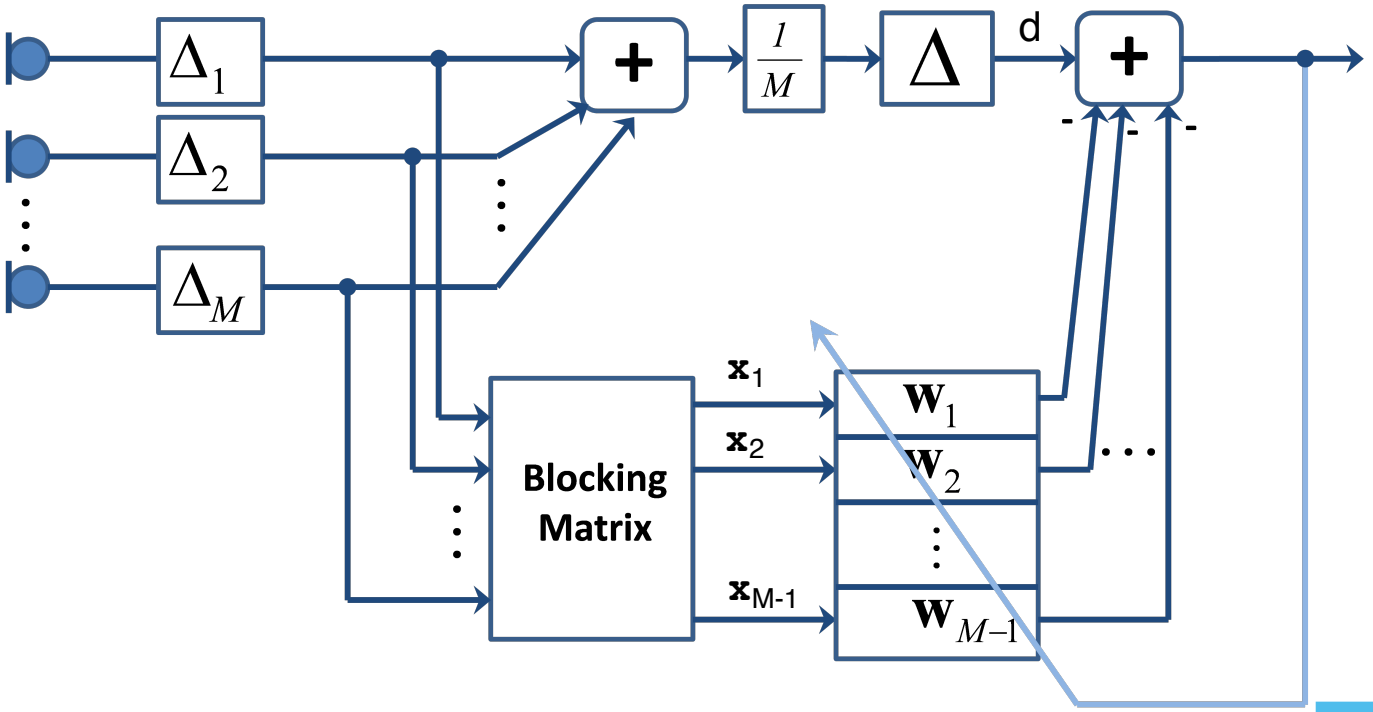
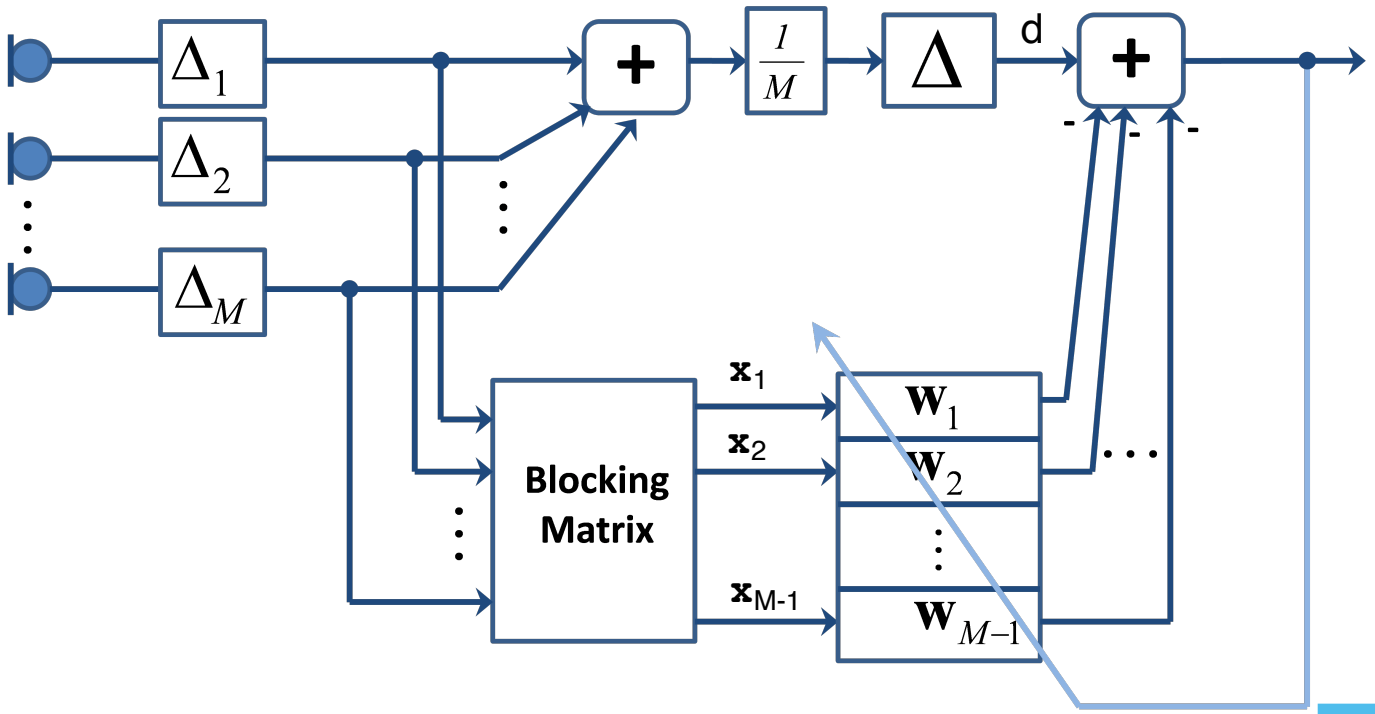
2 – GSC: Top Branch - Noisy Mic. Signals (blue) + DAS (red)





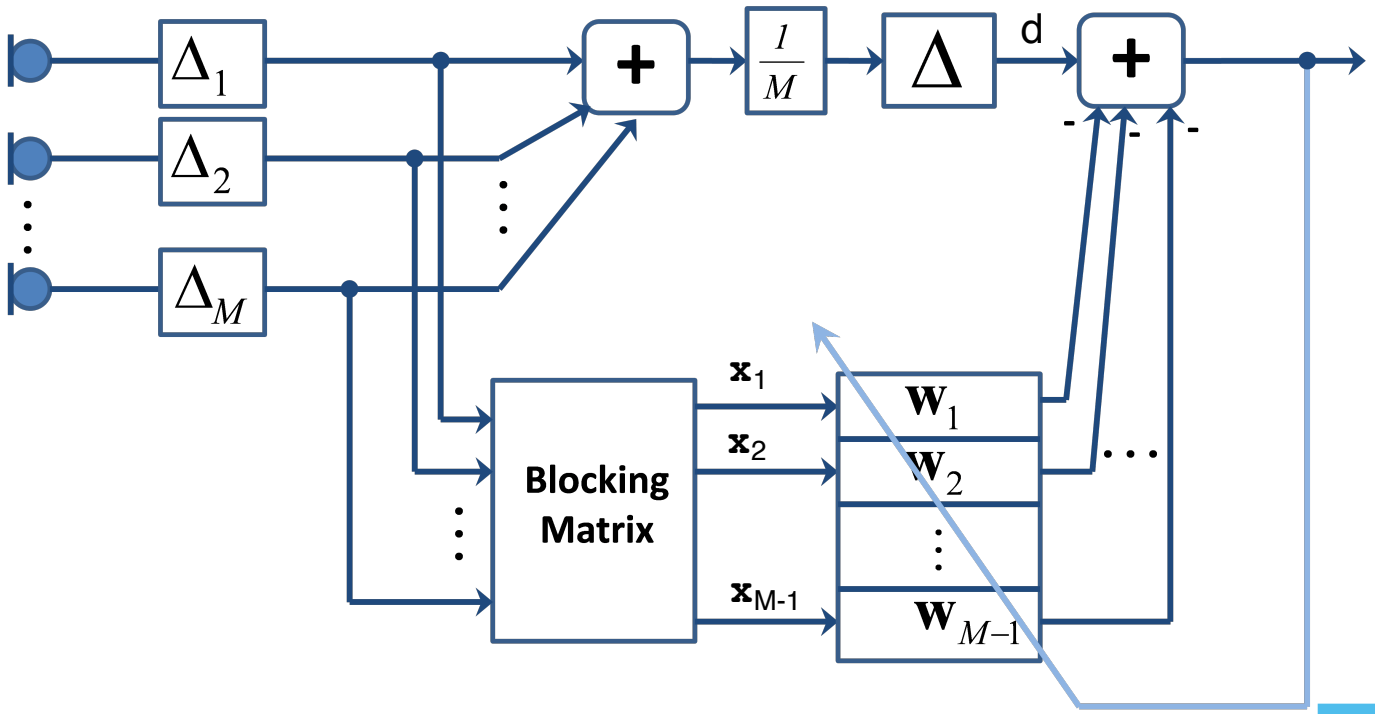
Signals and Filter

$$\mathbf{W}(i) = [\mathbf{w}_1(i), \ldots, \mathbf{w}_{M-1}(i)] \quad L \times (M-1)$$
$$\mathbf{X}(i) = [\mathbf{x}_1(i), \ldots, \mathbf{x}_{M-1}(i)] \quad L \times (M-1)$$

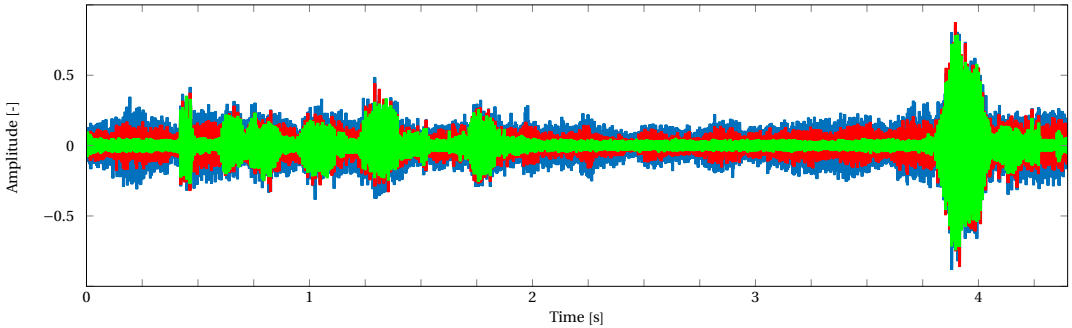


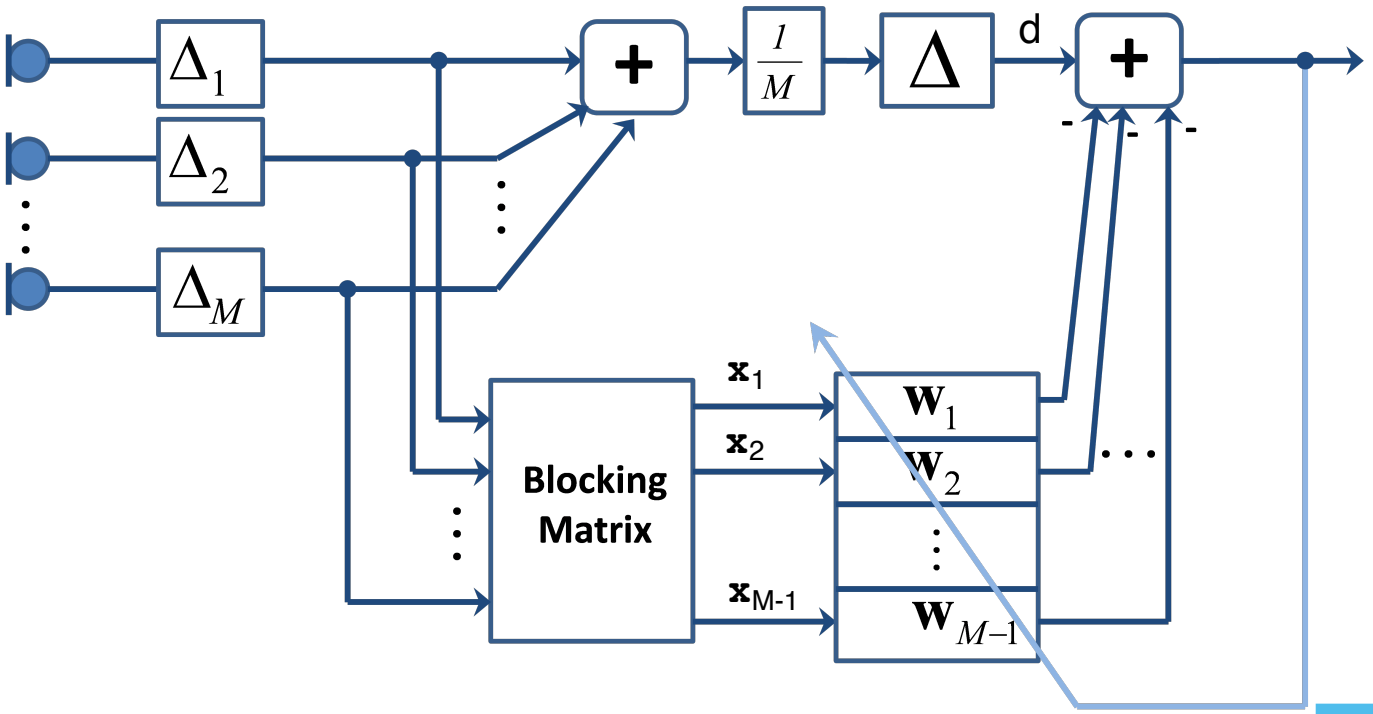
NLMS Filter Update

$$\mathbf{W}(i+1) = \mathbf{W}(i) + \frac{\mu}{\|\mathbf{X}(i)\|_{\mathrm{F}}^2}\mathbf{X}(i)\left[d(i) - \sum_{k=1}^{M-1}\mathbf{w}_k(i)^T\mathbf{x}_k(i)\right]$$



2 – GSC: Final Output (green)





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