Start

Initialize
$\hat{\mathbf{F}}(0) = \mathbf{d}^T(0) = \mathbf{0}_{M\times 1}$

Initialize $\mathbf{W}_2(0)$

Select block from loudspeaker signal and take FFT
$\mathbf{U}(k) = diag\left\{\mathbf{F}_M\,[u(kR-M+1),\ldots,u(kR)]^H\right\}$

Calculate feedback signal estimate
$\hat{\mathbf{y}}(k) = \mathbf{Q}^H\mathbf{F}_M^{-1}\mathbf{U}(k)\hat{\mathbf{F}}(k)$

Calculate error signal
$\mathbf{d}(k) = \mathbf{y}(k) - \hat{\mathbf{y}}(k)$

Estimate model of the error signal
$[\hat{\mathbf{h}}(k), \hat{\sigma}^2_{d_h}(k)] = \texttt{Levinson-Durbin}([\mathbf{d}(k);\mathbf{d}(k-1)])$

Filter microphone and loudspeaker signal
$\mathbf{u}_h(k) = \texttt{filter}\left(\hat{\mathbf{h}}(k), 1, \mathbf{u}(k)\right)$
$\mathbf{y}_h(k) = \texttt{filter}\left(\hat{\mathbf{h}}(k), 1, \mathbf{y}(k)\right)$

Take FFT of prewhitened LS signal
$\mathbf{U}_h(k) = diag\{\mathbf{F}_M\mathbf{u}_h\}$

Calculate prewhitened feedback signal estimate
$\hat{\mathbf{y}}_h(k) = \mathbf{Q}^H\mathbf{F}_M^{-1}\mathbf{U}_h(k)\hat{\mathbf{F}}(k)$

Calculate prewhitened error signal
$\mathbf{d}_h(k) = \mathbf{y}_h(k) - \hat{\mathbf{y}}_h(k)$

Take FFT of prewhitened error signal
$\mathbf{D}_h(k) = \mathbf{F}_M\mathbf{Q}\mathbf{d}_h(k)$

Evaluate $\hat{\mathbf{\Psi}}_{ee}(k)$
$\hat{\mathbf{\Psi}}_{ee}(k) = \mathbf{\Psi}_{d_ad_a}(k) - \mathbf{U}_h(k)\mathbf{P}(k)\mathbf{U}_h^H(k)$

Threshold $\hat{\mathbf{\Psi}}_{ee}(k)$ with $\hat{\sigma}^2_{d_a}(k)$

Update P
$\mathbf{P}^+(k) = \left[\mathbf{I}_M - \frac{R}{M}diag\{\boldsymbol{\mu}(k)\}\mathbf{U}_h^H(k)\mathbf{U}_h(k)\right]\mathbf{P}(k)$
$\mathbf{P}(k+1) = A^2\cdot\mathbf{P}^+(k) + M\cdot diag\{\hat{\mathbf{\Phi}}_{\Delta\Delta}\}$

$\lambda = A$
$\mathbf{W}_1(k) = \hat{\mathbf{\Psi}}_{ee}(k)$
$\mathbf{W}_2(k+1) = \mathbf{P}(k+1)$

Calculate **optimal** stepsize
$diag\{\boldsymbol{\mu}(k)\} = \mathbf{W}_2(k)\left[\mathbf{U}_h(k)\mathbf{W}_2(k)\mathbf{U}_h^H(k) + \mathbf{W}_1(k)\right]^{-1}$

Update equation
$\hat{\mathbf{F}}(k+1) = \lambda\left[\hat{\mathbf{F}}(k) + \mathbf{F}_M\left[\mathbf{I}_M - \mathbf{Q}\mathbf{Q}^H\right]\mathbf{F}_M^{-1}\cdot diag\{\boldsymbol{\mu}(k)\}\mathbf{U}_h^H(k)\mathbf{D}_h(k)\right]$

$\texttt{mod}(k, N_{avg}) == 0$

YES

Update $\hat{\Phi}_{\Delta\Delta}(l)$
$\hat{\Phi}_{ff}(l) = \mathbb{E}_k\left\{|\hat{F}(l,k+1)|^2\right\}$
$\hat{\Phi}_{\Delta\Delta}(l) = (1-A^2)\hat{\Phi}_{ff}(l)$

NO

Is signal over

NO

YES

Stop

FDAF operations

PEM operations

Kalman operations