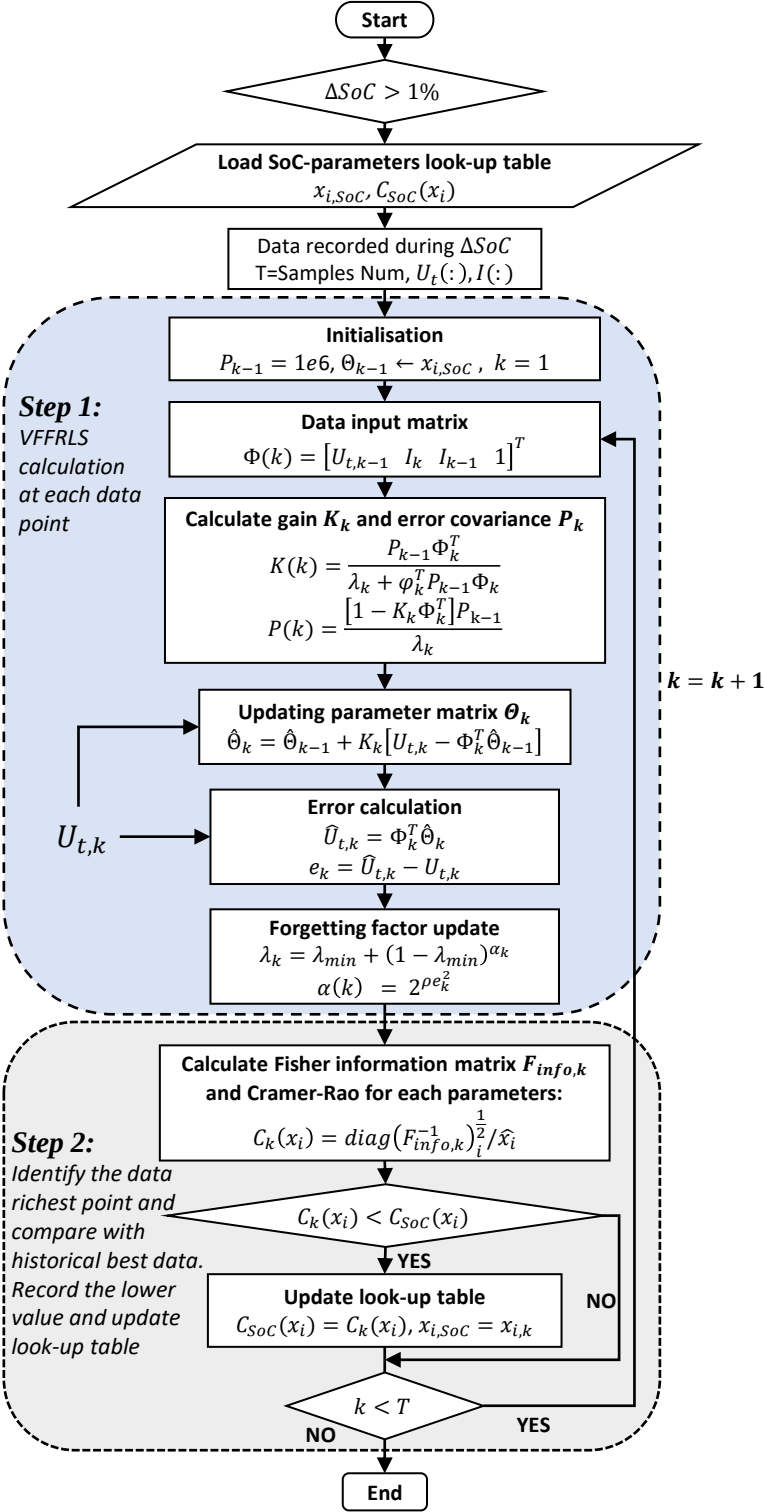
Start
$\Delta SoC > 1\%$
Load SoC-parameters look-up table
$x_{i,SoC}, C_{SoC}(x_i)$
Data recorded during ΔSoC
T=Samples Num, $U_t(:), I(:)$
Initialisation
$P_{k-1} = 1e6, \Theta_{k-1} \leftarrow x_{i,SoC}\ ,\ k = 1$
Step 1:
VFFRLS calculation at each data point
Data input matrix
$\Phi(k) = \begin{bmatrix} U_{t,k-1} & I_k & I_{k-1} & 1 \end{bmatrix}^T$
Calculate gain K_k and error covariance P_k
$K(k) = \frac{P_{k-1}\Phi_k^T}{\lambda_k + \varphi_k^T P_{k-1}\Phi_k}$
$P(k) = \frac{\left[1 - K_k\Phi_k^T\right]P_{k-1}}{\lambda_k}$
Updating parameter matrix Θ_k
$\hat{\Theta}_k = \hat{\Theta}_{k-1} + K_k\left[U_{t,k} - \Phi_k^T\hat{\Theta}_{k-1}\right]$
$U_{t,k}$
Error calculation
$\hat{U}_{t,k} = \Phi_k^T\hat{\Theta}_k$
$e_k = \hat{U}_{t,k} - U_{t,k}$
Forgetting factor update
$\lambda_k = \lambda_{min} + (1 - \lambda_{min})^{\alpha_k}$
$\alpha(k) = 2^{\rho e_k^2}$
$k = k + 1$
Step 2:
Identify the data richest point and compare with historical best data. Record the lower value and update look-up table
Calculate Fisher information matrix $F_{info,k}$ and Cramer-Rao for each parameters:
$C_k(x_i) = diag\left(F_{info,k}^{-1}\right)_i^{\frac{1}{2}} / \hat{x}_i$
$C_k(x_i) < C_{SoC}(x_i)$
YES
NO
Update look-up table
$C_{SoC}(x_i) = C_k(x_i),\ x_{i,SoC} = x_{i,k}$
$k < T$
NO
YES
End