

$$\begin{aligned}
P_k &= (I - K(k)H') \tilde{P}_k (I - K(k)H')^T - M(k)K^T(k) - K(k)M^T(k) \\
&\quad + K(k) \left( H'M(k) + M^T(k)H'^T + H \left( \sum_{j=1}^k C_j \tilde{P}_{k+1-j} C_j^T \right) H^T + R'(k) \right) K^T(k) \\
&= \tilde{P}_k - K(k)H' \tilde{P}_k - \tilde{P}_k H'^T K^T(k) - M(k)K^T(k) - K(k)M^T(k) \\
&\quad + K(k) \left( H' \tilde{P}_k H'^T + H'M(k) + M^T(k)H'^T + H \left( \sum_{j=1}^k C_j \tilde{P}_{k+1-j} C_j^T \right) H^T + R'(k) \right) K^T(k) \\
&= \tilde{P}_k - K(k) \left( H' \tilde{P}_k + M^T(k) \right) - \left( \tilde{P}_k H'^T + M(k) \right) K^T(k) \\
&\quad + \left( \tilde{P}_k H'^T + M(k) \right) \left( H' \tilde{P}_k H'^T + H'M(k) + M^T(k)H'^T + H \left( \sum_{j=1}^k C_j \tilde{P}_{k+1-j} C_j^T \right) H^T + R'(k) \right)^{-1} \\
&\quad \left( H' \tilde{P}_k + M^T(k) \right) \\
&= \tilde{P}_k - K(k) \left( H' \tilde{P}_k + M^T(k) \right) - \left( \tilde{P}_k H'^T + M(k) \right) K^T(k) + \left( \tilde{P}_k H'^T + M(k) \right) K^T(k) \\
&= \tilde{P}_k - K(k) \left( H' \tilde{P}_k + M^T(k) \right)
\end{aligned} \tag{1}$$