The Kalman Filter

With Correlated Process and Observation Noise

System equation Observation equation	$egin{aligned} oldsymbol{x}_k &= F_{k-1} oldsymbol{x}_{k-1} + oldsymbol{\epsilon}_{k-1} \ oldsymbol{\epsilon}_k &\sim N(0, oldsymbol{\Sigma}_{\epsilon,k}) \ oldsymbol{b}_k &= A_k oldsymbol{x}_k + oldsymbol{e}_k \ e_k &\sim N(0, oldsymbol{\Sigma}_{e,k}) \end{aligned}$
Initial conditions Other conditions	$E\{x_0\} = \hat{x}_0$ $E\{(x_0 - \hat{x}_{0 0})(x_0 - \hat{x}_{0 0})^{T}\} = P_{0 0}$ $E\{\epsilon_k e_j^{T}\} = C_k, \text{for all } k, j$
Prediction of state vector Prediction of covariance matrix	$\hat{x}_{k k-1} = F_{k-1}\hat{x}_{k-1 k-1}$ $P_{k k-1} = F_{k-1}P_{k-1 k-1}F_{k-1}^{T} + \Sigma_{\epsilon,k}$
Kalman gain matrix Updating of state vector Covariance matrix for updating	$K_{k} = (P_{k k-1}A_{k}^{T} + C_{k})(A_{k}P_{k k-1}A_{k}^{T} + \Sigma_{e,k} + A_{k}C_{k} + C_{k}^{T}A_{k}^{T})^{-1}$ $\hat{x}_{k k} = \hat{x}_{k k-1} + K_{k}(b_{k} - A_{k}\hat{x}_{k k-1})$ $P_{k k} = (I - K_{k}A_{k})P_{k k-1} - K_{k}C_{k}^{T}$