$$(x_0 - x_{prior})^T M (x_0 - x_{prior}) = x_0^T M x_0 \underbrace{- x_0^T M x_{prior} - x_{prior}^T M x_0}_{= -2x_0^T M x_{prior}} + \overbrace{x_{prior}^T M x_{prior}}^{\text{constant irrelevant in cost}}$$

$$\frac{2\pi}{\mu_0 m} \cdot M \ddot{z}$$

$$z = [x_0 \dots x_N, w_0, \dots w_{N-1}, v_0, \dots v_N]$$

$$J = (x_0 - x_{prior})^T M (x_0 - x_{prior}) + \sum_{k=0}^{N-1} w^T Q w + \sum_{k=0}^{N} v^T R v$$

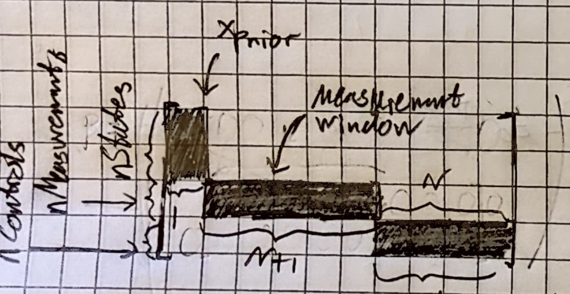
s.t. $x_{k+1} - A x_k - w_k = B u_k + z_{0block}$

$v_k + C x_k = y_{meas,k}$

$$\Rightarrow G = \begin{bmatrix} \underbrace{M\,0\,0\,0}_{N+1} & & \\ & \underbrace{Q\,Q\,Q\,Q}_{N} & \\ & & \underbrace{R\,R\,R\,R}_{N+1} \end{bmatrix}, \quad g = \begin{bmatrix} -2Mx_{prior} \\ 0 \\ \vdots \\ 0 \end{bmatrix} \Rightarrow J = z^T G z + z^T g$$

$$\begin{array}{l} N \left\{ \right. \\ N+1 \left\{ \right. \end{array} \begin{bmatrix} -A_0 & I & 0 & \cdots & 0 & -I & 0 & \cdots & 0 & 0 & \cdots & 0 \\ 0 & -A_1 & I & & \vdots & 0 & \ddots & & \vdots & \vdots & & \vdots \\ \vdots & & \ddots & \ddots & 0 & \vdots & & \ddots & 0 & \vdots & & \vdots \\ 0 & \cdots & 0 & -A_{N-1} & I & 0 & \cdots & 0 & -I & 0 & \cdots & 0 \\ C & 0 & \cdots & & 0 & 0 & \cdots & & 0 & I & 0 & \cdots \\ 0 & \ddots & & & \vdots & \vdots & & & \vdots & 0 & \ddots & \vdots \\ \vdots & & & \ddots & 0 & \vdots & & & \vdots & \vdots & \ddots & 0 \\ 0 & \cdots & & 0 & C & 0 & \cdots & & 0 & 0 & \cdots\ 0 & I \end{bmatrix} \begin{bmatrix} x_0 \\ \vdots \\ x_N \\ w_0 \\ \vdots \\ w_{N-1} \\ v_0 \\ \vdots \\ v_N \end{bmatrix} = \begin{bmatrix} B_0 \cdot u_{0,meas} + z_{0block} \\ \vdots \\ B_{N-1} \cdot u_{N-1,meas} + z_{0block} \\ y_{0,meas} \\ \vdots \\ y_{N,meas} \end{bmatrix}$$

$\underbrace{\quad}_{x,\ N+1}$ $\underbrace{\quad}_{w,\ N}$ $\underbrace{\quad}_{v,\ N+1}$




sparsity pattern of P

$$\begin{bmatrix} 0 & -1 & 1 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ -1 & -1 & 0 & 1 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} x_0 \\ x_1 \\ x_2 \\ x_3 \\ x_4 \\ \cancel{x_5} \\ w_0 \\ w_1 \\ w_2 \\ w_3 \\ v_0 \\ v_1 \\ v_2 \\ v_3 \\ v_4 \\ v_5 \end{bmatrix}$$

$\cdot\ -x_1 + x_2 - w_0$

$\cdot\ x_0 + x_1 + x_3 - w_1$

$$\begin{bmatrix} 0 & -1 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} x_0 \\ x_1 \end{bmatrix} + \begin{bmatrix} x_2 \\ x_3 \end{bmatrix} - \begin{bmatrix} w_0 \\ w_1 \end{bmatrix}$$

$$\begin{bmatrix} -x_1 + x_2 - w_0 \\ x_0 + x_1 + x_3 - w_1 \end{bmatrix}$$

check to see if $A_{eq} \cdot z$ gives the same as $-A \cdot x_k + x_{k+1} - w_k$