$$W_{max\,SINR} = c\,R_{I+N}^{-1}\,\vec{s}_\theta$$

$$W_{MMSE} = \rho\,R^{-1}\vec{s}_\theta \quad ; \quad \rho = E\{|m(t)|^2\}$$

$$W_{MVDR} = \frac{1}{\vec{s}_\theta^{\,H} R^{-1}\vec{s}_\theta} \cdot R^{-1}\vec{s}_\theta$$

$$W_{ML} = \frac{R_{I+N}^{-1}\cdot\vec{s}_\theta}{\vec{s}_\theta^{\,H}\cdot R_{I+N}^{-1}\cdot\vec{s}_\theta}$$

$$R = E\{\vec{r}(t)\cdot\vec{r}(t)^H\}$$

$$\Big(\underbrace{\underbrace{m(t)\,e^{j2\pi f_c t}}_{d(t)}\cdot\vec{s}_\theta}_{x(t)} + \vec{i}(t) + \vec{n}(t)\Big)\cdot\Big(m(t)\,e^{j2\pi f_c t}\cdot\vec{s}_\theta + \vec{i}(t) + \vec{n}(t)\Big)^H$$

$$= E\{(\vec{d}(t)\cdot\vec{s}_\theta + \vec{i}(t) + \vec{n}(t))\cdot(d(t)\cdot\vec{s}_\theta + \vec{i}(t) + \vec{n}(t))^H\}$$

$$= E\{\vec{d}(t)\cdot\vec{s}_\theta\cdot\vec{d}(t)^H\vec{s}_\theta^{\,H} + \vec{i}(t)\cdot\vec{i}(t)^H + \vec{n}(t)\cdot n(t)^H\}$$

* $x(t)$ not correlated w/ $n(t)$ & $i(t)$, & $n(t)$ & $i(t)$ are not correlated

$$= E\{\vec{d}(t)\cdot\vec{s}_\theta\cdot\vec{d}(t)^H\,\vec{s}_\theta^{\,H}\} + E\{i(t)\cdot i(t)^H\} + E\{\vec{n}(t)\cdot\vec{n}(t)^H\}$$

$$R = \quad " \qquad " \quad + R_I + R_N$$

$$R = E\{d(t)\cdot s_\theta d(t)^H s_\theta^H\} + R_{I+N}$$

$$R^{-1} = [E\{" \qquad "\} + R_{I+N}]^{-1}$$

$$R^{-1} = [E\{"\,\, \quad "\,"\}]^{-1} + R_{I+N}^{-1}$$

$$R^{-1} = \underbrace{\Big[[\qquad]^{-1}\cdot R_{I+N} + 1\Big]}_{K}\cdot R_{I+N}^{-1}$$

$$R^{-1} = \left[[E\{d(t)\,d(t)^H\}\, \underbrace{S_\theta^* S_\theta^H}_{M^{-1}\,??}]^{-1} \cdot R_{I+N} + 1 \right] \cdot R_{I+N}^{-1}$$

$$\left[[\underbrace{E\{d(t) \cdot d(t)^H\}}_{\text{Autocorrelation of desired signal}}]^{-1} \cdot \underline{M} \cdot R_{I+N} + 1 \right] \cdot R_{I+N}^{-1}$$

$$(1) \quad R^{-1} = \underbrace{\left[R_d^{-1} \cdot M \cdot R_{I+N} + 1 \right]}_{\text{"}K\text{"}} \cdot R_{I+N}^{-1}$$

$$w_{max\,SINR} = \underline{c} \cdot R_{I+N}^{-1} S_\theta \quad \& \quad w_{ML} = \frac{1}{\vec{S}_\theta^H \cdot R_{I+N}^{-1} \cdot \vec{S}_\theta} \cdot R_{I+N}^{-1} \vec{S}_\theta$$

$$w_{max\,SINR} \stackrel{?}{=} w_{ML}$$

$$c \cdot R_{I+N}^{-1} \cdot \vec{S}_\theta = \frac{1}{\vec{S}_\theta^H \cdot R_{I+N}^{-1} \cdot \vec{S}_\theta} \cdot R_{I+N}^{-1} S_\theta$$

if $\boxed{c_1 = \frac{1}{\vec{S}_\theta^H \cdot R_{I+N}^{-1} \cdot \vec{S}_\theta}}$ then, $w_{max\,SINR} \equiv w_{ML}$

$$w_{max\,SINR} \stackrel{?}{=} w_{MVDR}$$

$$w_{MVDR} = \frac{1}{\vec{S}_\theta^H R^{-1} \vec{S}_\theta} \cdot R^{-1} \vec{S}_\theta \xrightarrow{\text{given "K" (1)}} \frac{1}{S_\theta^H K R_{I+N}^{-1} \cdot S_\theta} \cdot K \cdot R_{I+N}^{-1} \vec{S}_\theta$$

$$c \cdot [R_{I+N}^{-1} \cdot \vec{S}_\theta]^{-1} = \frac{1}{\vec{S}_\theta^H \cdot K \cdot R_{I+N}^{-1} \vec{S}_\theta} \cdot K \cdot [R_{I+N}^{-1} \vec{S}_\theta] \cdot [\;]^{-1}$$

if. $\boxed{c_2 = \frac{1}{\vec{S}_\theta^H \cdot K \cdot R_{I+N}^{-1} \vec{S}_\theta} \cdot K \cdot I_M}$ then, $w_{max\,SINR} \equiv w_{MVDR}$

$W_{maxSINR} \overset{?}{=} W_{MMSE}$

$$c \cdot R_{I+N}^{-1} \vec{S}_\theta = \rho R^{-1} \vec{S}_\theta$$

$$\frac{1}{K} \cdot R^{-1} \cdot \vec{S}_\theta = \rho R^{-1} s_\theta$$

if $\boxed{C_? = \frac{1}{K}}$ then $W_{maxSINR} = W_{MMSE}$

$$C_s = \left(\frac{1}{R_d^{-1} \cdot M \cdot R_{I+N}^{+} 1} \right)$$

Given C_1, C_2, C_3; $W_{maxSINR} = W_{ML}$ &

" " $= W_{MVDR}$

" " $= W_{MMSE}$

So

$$\boxed{C_1} \cdot W_{maxSINR} = W_{ML}$$

$$\boxed{C_2} \cdot W_{maxSINR} = W_{MVDR}$$

$$\boxed{C_3} \cdot W_{maxSINR} = W_{MMSE}$$

$$\boxed{\frac{C_2}{C_1}} \cdot W_{ML} = W_{MVDR}$$

$$\boxed{\frac{C_2}{C_3}} \cdot W_{MMSE} = W_{MVDR}$$

$$\boxed{\frac{C_3}{C_2}} W_{MVDR} = W_{MMSE}$$

$$\boxed{\frac{C_3}{C_1}} W_{MVDR} = W_{ML}$$

⋮

Derivation of eq:

$$W_{maxSINR} = \frac{W_{ML}}{C_1}$$

$$W_{maxSINR} = \frac{W_{MVDR}}{C_2}$$

$$\frac{W_{ML}}{C_1} = \frac{W_{MVDR}}{C_2}$$

$$\frac{C_2}{C_1} W_{ML} = W_{MVDR}$$

equivalent by scalar
$\left\{ \begin{array}{l} W_{ML} \\ W_{MVDR} \\ W_{MMSE} \\ W_{maxSINR} \end{array} \right\}$