

solving for  $W \rightarrow$

$$X = \sum_k \sum_l |W(k, l) G(k, l) - F(k, l)|^2 + \lambda \sum_k \sum_l |L(k, l) W(k, l) - G(k, l)|^2$$

partial diff wrt  $W$

$$\frac{\partial}{\partial W} \{X\} = 0$$

$$\frac{\partial}{\partial W} \left\{ \sum_{k, l} |WHF + WN - F|^2 + \sum_{k, l} |LWHF + LWN|^2 \right\} = 0$$

$$2|F|^2 (WH - I)^* H + 2|N|^2 W^* + \lambda [ |L|^2 |H|^2 |F|^2 + |L|^2 |N|^2 ] W^* = 0$$

$$W^* [ |F|^2 |H|^2 + |N|^2 + \lambda |L|^2 |H|^2 |F|^2 + \lambda |L|^2 |N|^2 ] = |F|^2 H^*$$

$$W^* = \frac{|F|^2 H^*}{|H|^2 |F|^2 + |N|^2 + \lambda [ |L|^2 |H|^2 |F|^2 + |L|^2 |N|^2 ]}$$

dividing  $|F|^2$  in numerator and denominator

$$W^* = \frac{H^*}{|H|^2 + \frac{|N|^2}{|F|^2} + \lambda |L|^2 \left[ |H|^2 + \frac{|N|^2}{|F|^2} \right]}$$

$$\text{take } \frac{|N|^2}{|F|^2} = K$$

$$W^* = \frac{H^*}{|H|^2 + K + \lambda |L|^2 [ |H|^2 + K ]}$$

$$W^* = \frac{H^*}{(|H|^2 + K) (1 + \lambda |L|^2)}$$