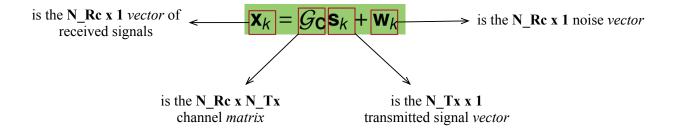
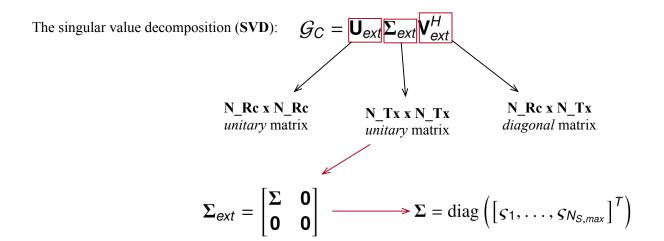
## MIMO Signal Procession - Digital Communications 23/24

We should consider the following expression:



$$N_{S,max} \stackrel{\Delta}{=} \operatorname{rank} \mathcal{G}_{\mathbf{C}} \circ ---- \circ N_{S,max} \leq \min(N_{Rc}, N_{Tx})$$
for the definition of the rank



The capacity for the MIMO NB AWGN channel is:

$$C_{[bit/s]} = \frac{1}{T} \sum_{n=1}^{N_{S,max}} \log_2 \left( 1 + \boxed{\Gamma_n} \right) \longrightarrow \Gamma_n = \underline{M}_n \Theta_n, \longrightarrow \Theta_n = \frac{|\varsigma_n|^2}{\frac{N_0}{2} 2B}$$
SNR on stream n

With N\_Tx inputs and N\_Rc outputs we can transmit up to N\_S,max independent data streams, thus exploiting the multiplexing capabilities of the MIMO channel. Since N\_S,max  $\leq \min(N_Rc, N_Tx)$ , we observe that a larger number of streams can be transmitted only when both N\_Tx and N\_Rc increase.

1

The **optimum** architecture:

- We introduce the extended generated data vector  $\mathbf{a}_{ext} = \begin{bmatrix} \mathbf{a}^T, \mathbf{0} \end{bmatrix}^T$ , were the dimension of  $\mathbf{a}$  is  $N_{S,max}$ .
- **②** We apply the precoder  $\mathbf{s} = \mathbf{V}_{ext} \mathbf{a}_{ext}$ .
- 3 At the receiver we apply the combiner  $\mathbf{U}_{ext}^{H}$  obtaining  $\mathbf{y}_{ext} = \mathbf{U}_{ext}^{H} \mathcal{G}_{\mathbf{C}} \mathbf{s} + \tilde{\mathbf{w}}_{ext} = \mathbf{U}_{ext}^{H} \mathbf{U}_{ext} \boldsymbol{\Sigma}_{ext} \mathbf{V}_{ext}^{H} \mathbf{V}_{ext} \mathbf{a}_{ext} + \tilde{\mathbf{w}}_{ext} = \boldsymbol{\Sigma}_{ext} \mathbf{a}_{ext} + \tilde{\mathbf{w}}_{ext}$

We have **N\_S,max** parellel AWGNs and we know how to deal with AWGN