

APPENDIX D

RECEIVED MULTIUSER SIGNAL FOCUSED ON CHANNEL GAINS

• We want the vector of samples at antenna m as

$$\underline{r}_m = \underline{S} \underline{A}' \underline{B}' \underline{c}_m + \underline{n}_m$$

so that the channel gains are in a column vector.

• Start with the gains. We have, from p. 2.2.6

$$\underline{c}_{km}(n) = \begin{bmatrix} c_{k0m}(n) \\ c_{k1m}(n) \\ \vdots \\ c_{k,L-1,m}(n) \end{bmatrix} \quad \downarrow \text{path}$$

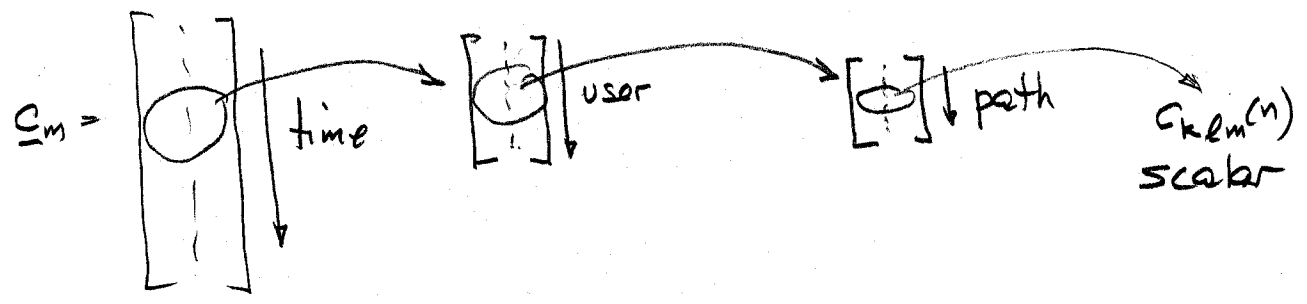
Stack them by user:

$$\underline{c}_m(n) = (\underline{c}_{1m}^T(n), \underline{c}_{2m}^T(n), \dots, \underline{c}_{K_m}^T(n))^T$$

Then by time:

$$\underline{c}_m = (\underline{c}_m^T(0), \underline{c}_m^T(1), \dots, \underline{c}_m^T(N-1))^T$$

So



• Now we need to weight each component of Σ_m with the right $A_k b_k(n)$.

- Define $A = \text{diag}(A_1, A_2, \dots, A_k)$ as before $K \times K$

$A = \text{diag}(\underbrace{A, A, \dots, A}_{N \text{ times}})$ as before $NK \times NK$

- Define $B(n) = \text{diag}(\underline{b}(n)) = \text{diag}(b_1(n), b_2(n), \dots, b_k(n))$

$B = \text{diag}(B(0), B(1), \dots, B(N-1))$ $NK \times NK$

- Check:

$$AB = \text{diag}(A_1 b_1(0), A_2 b_2(0), \dots, A_k b_k(0), A_1 b_1(1), \dots, A_k b_k(1), \dots, A_k b_k(N-1)) \quad NK \times NK$$

- Expand each component of AB by L -fold replication to accommodate the L paths.

$$A' = A \otimes I_L$$

$$= \text{diag}(\underbrace{A_1, A_1, \dots, A_1}_{L \text{ times}}, A_2, \dots, A_2, \dots, A_k, \dots, A_k, \underbrace{A_1, A_1, \dots, A_1}_{L \text{ times}}, A_2, \dots, A_2, \dots, A_k, \dots, A_k, \dots, A_1, A_1, \dots, A_1, A_2, \dots, A_2, \dots, A_k, \dots, A_k) \quad \left. \vphantom{\text{diag}} \right\} N \text{ times}$$

$NKL \times NKL$

- Similarly $B' = B \otimes I_L$

• Then $A'B' \underline{\epsilon}_m$ is a vector of weights applied to each received signal component.

$$\underline{x}_m = S A' B' \underline{\epsilon}_m$$

In fact our rearrangement has produced

$$A' B' \underline{\epsilon}_m = A C \underline{b}$$

notation of this Appendix

main notation of Section 2.2

