Multi-Antenna Systems

Exercise 1: Would a WiFi system be more likely to use multiple antennas for MIMO or SDMA? How about an cellular system?

WiFi → want to increase data rate to one user
→ use "MIMO"

cellular → want to support more users
→ use SDMA

Exercise 2: Consider a 2×2 channel where H is $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ and x is $[1, -1]$. Find y.

$y = Hx$

$y = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} \begin{bmatrix} 1 \\ -1 \end{bmatrix} = \begin{bmatrix} -1 \\ -1 \end{bmatrix}$

Exercise 3: By (up to) what factor could a MIMO system with 3 transmit and 4 receive antennas increase throughput?

$\min(3, 4) = 3$

Exercise 4: Which channel matrix is more likely to be full-rank (rank N), one for a LOS channel or one for a NLOS channel?

NLOS channel more likely to be full rank.

LOS example: antennas at vertices of regular tetrahedron: 

$H: \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$ $\det(H) = 1 \cdot 1 - 1 \cdot 1 = 0$ (singular)