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11/1/2023

# Hermes ICC: Communication Model Design

UAV  $u$  has  $A_u$  antennas  
 GN  $g$  has  $A_g$  antennas

$U$  UAVs total  
 $G$  GNs total

$u \in \{1, 2, \dots, U\}$  serving its assigned cluster  $G_u = \{g_1, g_2, \dots, g_n\}$

MU-MIMO ( $n$  GNs uploading to UAV  $u$ ) each with  $A_g$  streams.

Abstract this as  $n \cdot A_g$  GNs uploading 1 stream to the UAV  $u$ .

~~$x = \sqrt{P} s$~~   $\frac{x}{m \times 1} = \sqrt{P} \frac{s}{m \times 1}$ ,  $s$  is the concatenated stream of modulated symbols,  $\{s_1, s_2, \dots, s_m\}$  with  $\mathbb{E}[|s_i|^2] = 1$ ,  $i = 1, 2, \dots, m$ .

The signal received at UAV  $u$  is

~~$y$~~   $y_{A_u \times 1} = H_{A_u \times m} \cdot \frac{x}{m \times 1} + \frac{w}{m \times 1}$

$\hat{x} = \arg \min_x \|y - Hx\|_2^2 \Rightarrow \text{minimize } \sum_{j=1}^{A_u} y_j - Hx$

$\hat{x} = (H^* H)^{-1} H^* y$   
 $m \times A_u \cdot A_u \times m \cdot m \times A_u = m \times A_u \cdot A_u \times 1 = (m \times 1)$



$$\hat{\underline{x}} = (\underline{H}^* \underline{H})^{-1} \underline{H}^* (\underline{H} \underline{x} + \underline{w})$$

$$= \underline{x} + \underbrace{(\underline{H}^* \underline{H})^{-1} \underline{H}^* \underline{w}}_{\text{auxiliary}}$$

$m \times 1 \cdot 1 \times m$

$m \times m \cdot m \times 1$

$m \times 1 \cdot 1 \times 1$

$$\frac{P}{\|\hat{\underline{w}}\|^2} \rightarrow \frac{\cancel{\|\underline{x}\|^2} \cdot \cancel{\|\underline{x}\|^2} \cdot \frac{1}{m} \sum_{i=1}^m |x_i|^2}{\|\hat{\underline{w}}\|^2}$$

$$\frac{P}{\frac{1}{m} \sum_{i=1}^m |\hat{w}_i|^2}$$

$$\frac{1}{m} \sum_{i=1}^m \left| \sqrt{P} s_i \right|^2$$

$$\left( P \right) \left( \frac{1}{m} \sum_{i=1}^m |s_i|^2 \right)$$

$$E[|s_i|^2] = 1$$

$$h = \sqrt{\beta g}$$