

Ambient Intelligence with RIS and backscatter-type devices

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Gesture recognition from 4D Point-clouds



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Ambient Intelligence

Sensing with a FMCW mmWave radar

Sensing with a RIS































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Assessing Wireless Sensing Potential With Large Intelligent Surfaces, Vaca-Rubio, IEEE Open Journal of the Communication Society, 2021







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Phase profile at each tag group at time t $\boldsymbol{\alpha}_{n,t} = \begin{bmatrix} \alpha_{nt0} & \alpha_{nt1} \end{bmatrix}^{\top} \quad n = 1,2 \quad t = 0,1$





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Phase profile at each tag group at time t $\alpha_{n,t} = \begin{bmatrix} \alpha_{nt0} & \alpha_{nt1} \end{bmatrix}^{\top} \quad n = 1,2 \quad t = 0,1$

Received signal at time t $y_t = \sum_{n=1}^{2} H_n(\alpha_{n,t}) \sqrt{E} x_0 + z_t,$





$$\begin{aligned} & \text{signal components } v_t \text{ at time 0 and 1} \\ & v_0 = (H_1(\alpha_{1,0}) + H_2(\alpha_{2,0}))\sqrt{E} + z'_0 \\ & = (h_{1,0}^d h_{1,0}^s + h_{1,1}^d h_{1,1}^s - (h_{2,0}^d h_{2,0}^s + h_{2,1}^d h_{2,1}^s))\sqrt{E} + z'_0, \end{aligned} \quad \begin{aligned} & \text{Receive} \\ & v_1 = (H_1(\alpha_{1,1}) + H_2(\alpha_{2,1}))\sqrt{E} + z'_1 \\ & = (h_{1,0}^d h_{1,0}^s + h_{1,1}^d h_{1,1}^s + (h_{2,0}^d h_{2,0}^s + h_{2,1}^d h_{2,1}^s))\sqrt{E} + z'_1. \end{aligned}$$

Phase profile at each tag group at time t $\alpha_{n,t} = \begin{bmatrix} \alpha_{nt0} & \alpha_{nt1} \end{bmatrix}^{\top} \quad n = 1,2 \quad t = 0,1$

> vived signal at time t $y_t = \sum_{n=1}^{2} H_n(\alpha_{n,t}) \sqrt{E} x_0 + z_t,$

Remove pilot: multiply with x_0^* ($x_0x_0^* = 1$)

$$v_{t} = y_{t}x_{0}^{*} = \sum_{n=1}^{2} H_{n}(\alpha_{n,t})\sqrt{E} + z'_{t}$$
$$= (H_{1}(\alpha_{1,t}) + H_{2}(\alpha_{2,t}))\sqrt{E} + z'_{t}.$$



signal components
$$v_t$$
 at time 0 and 1
 $v_0 = (H_1(\alpha_{1,0}) + H_2(\alpha_{2,0}))\sqrt{E} + z'_0$
 $= (h_{1,0}^d h_{1,0}^s + h_{1,1}^d h_{1,1}^s - (h_{2,0}^d h_{2,0}^s + h_{2,1}^d h_{2,1}^s))\sqrt{E} + z'_0,$
 $v_1 = (H_1(\alpha_{1,1}) + H_2(\alpha_{2,1}))\sqrt{E} + z'_1$
 $= (h_{1,0}^d h_{1,0}^s + h_{1,1}^d h_{1,1}^s + (h_{2,0}^d h_{2,0}^s + h_{2,1}^d h_{2,1}^s))\sqrt{E} + z'_1.$







Thank you!

