

Preliminary Discussion on Taped-Delay-Line Based MIMO Channel Model

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Purpose:

To discuss the probability assignment for RS above and below rooftop and the standard deviation of lognormal shadowing distribution

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Introduction and Background

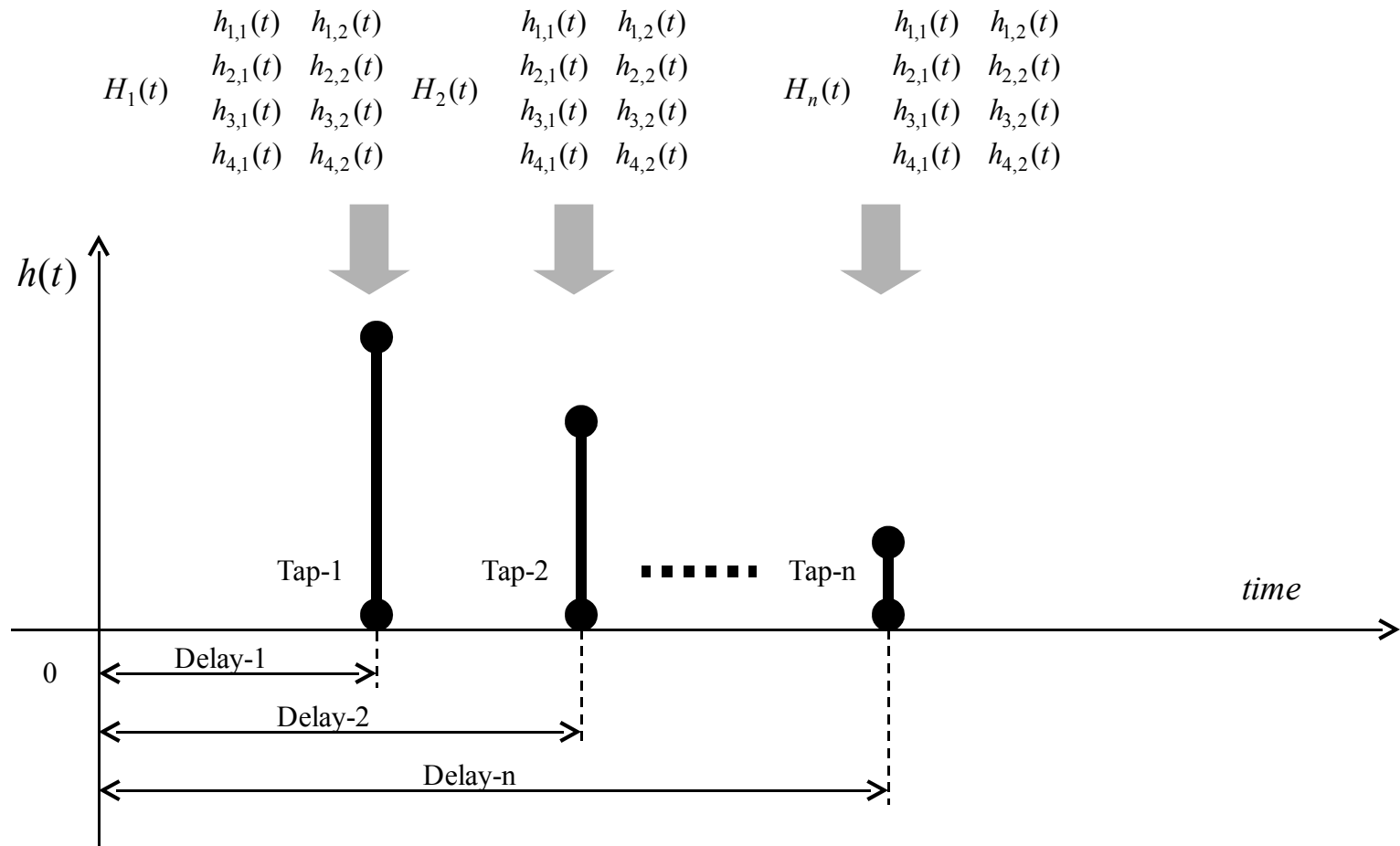
- Full Spatial Channel Models (SCM) is available for system level simulation
 - With narrow band limitation (max 5MHz)
 - Very complicated for generation and excessive run time is required
- Simplified Taped-Delay-Line MIMO channel model can be employed
 - For both link level and system simulations
- We discuss the MIMO channel generation method
 - Independent MIMO channel generation
 - Correlated MIMO channel generation

Methodology

- A tapped-delay-line based MIMO model is used for link level performance evaluation
 - It is a simplified MIMO propagation channel model
- The link level propagation aspects are captured by impulse response model
 - E.g. ITU channel model for narrow band (5MHz) channel
- The independent multiple Rayleigh faders are employed
 - Li-Hung model
- The MIMO-antenna /MIMO-channel correlation aspects are captured by correlation factor

Channel Model-Time Structure

- Tapped delay line model



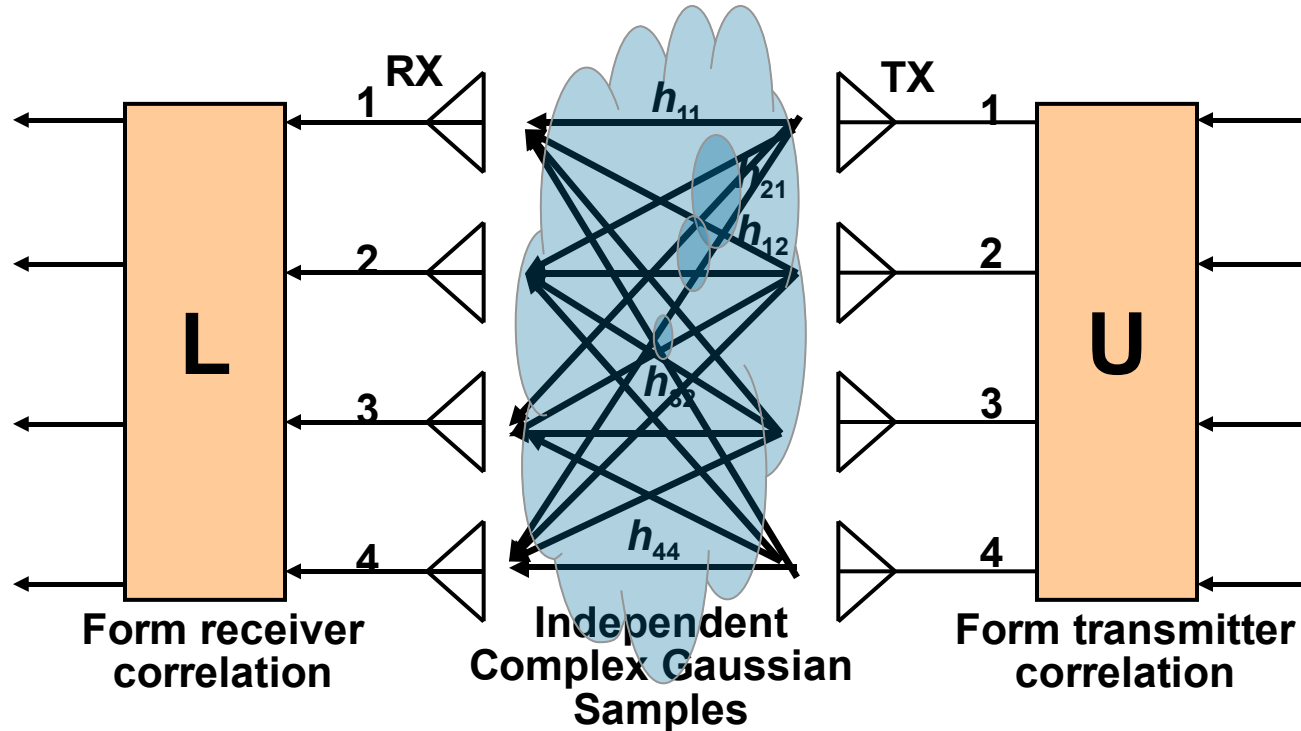
ITU Channel Model Parameters (Examples)

- 3 ITU channel models

Tap	OIP-A		OIP-B		V-A		Doppler spectrum
	Relative Delay (ns)	Average Power (dB)	Relative Delay (ns)	Average Power (dB)	Relative Delay (ns)	Average Power (dB)	
1	0	0	0	0	0	0	Classic
2	110	-9.7	200	-0.9	310	-1.0	Classic
3	190	-19.2	800	-4.9	710	-9.0	Classic
4	410	-22.8	1200	-8.0	1090	-10.0	Classic
5	-	-	2300	-7.8	1730	-15.0	Classic
6	-	-	3700	-23.9	2510	-20.0	Classic

- Need to improve ITU model to wider bandwidth channel (more than 6 taps)

Correlated MIMO Channel Model –(1)



$R_R = LL^H$ (L is lower triangular Cholesky RX correlation)

$R_T = UU^H$ (U is upper triangular Cholesky TX correlation)

* We assume the receive antennas are uncorrelated

Correlated MIMO Channel Model –(2)

$$R = \begin{bmatrix} 1 & & & & \\ & 1 & & & \\ & & 1 & & \\ & & & 1 & \\ & & & & 1 \end{bmatrix}$$

	# of transmit antennas				
	2	3	4	6	8
Low	0.2	0.2	0.2	0.5	0.5
High	0.7	0.7	0.7	0.85	0.85

Generation of Correlated MIMO Channel Model

- **STEP-1:** Specify the number of transmit antennas N_T and the number of receive antennas N_R .
- **STEP-2:** Select a tapped delay line model for the channel dispersion, where this is applied to all of the $N_T \times N_R$ MIMO path.
- **STEP-3:** Apply an independent complex Gaussian sample to each tap on each MIMO path to form H . The H is constructed in such a way that the correlation between any pair of fading taps will be zero. Consequently, the correlation matrix for every tap position will simply be an identity matrix
- **STEP-4:** Specify a correlation matrix for each tap position.
- **STEP-5:** Perform a Cholesky factorization of the correlation matrix R , such that R can be represented as $R = UU^H$.
- **STEP-6:** The uncorrelated taps at a given delay position can then be correlated by multiplying the uncorrelated H by the transform matrix $H_C = HU$.

Summary and Discussion

- Simplified MIMO channel model is discussed
 - Based on Taped-delay-line model
- Channel model extension to for wideband is required
- Channel model and associated correlation factors are required for the MMR links
 - BS-RS, RS-RS, BS-MS, RS-MS