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

Introduction and Background

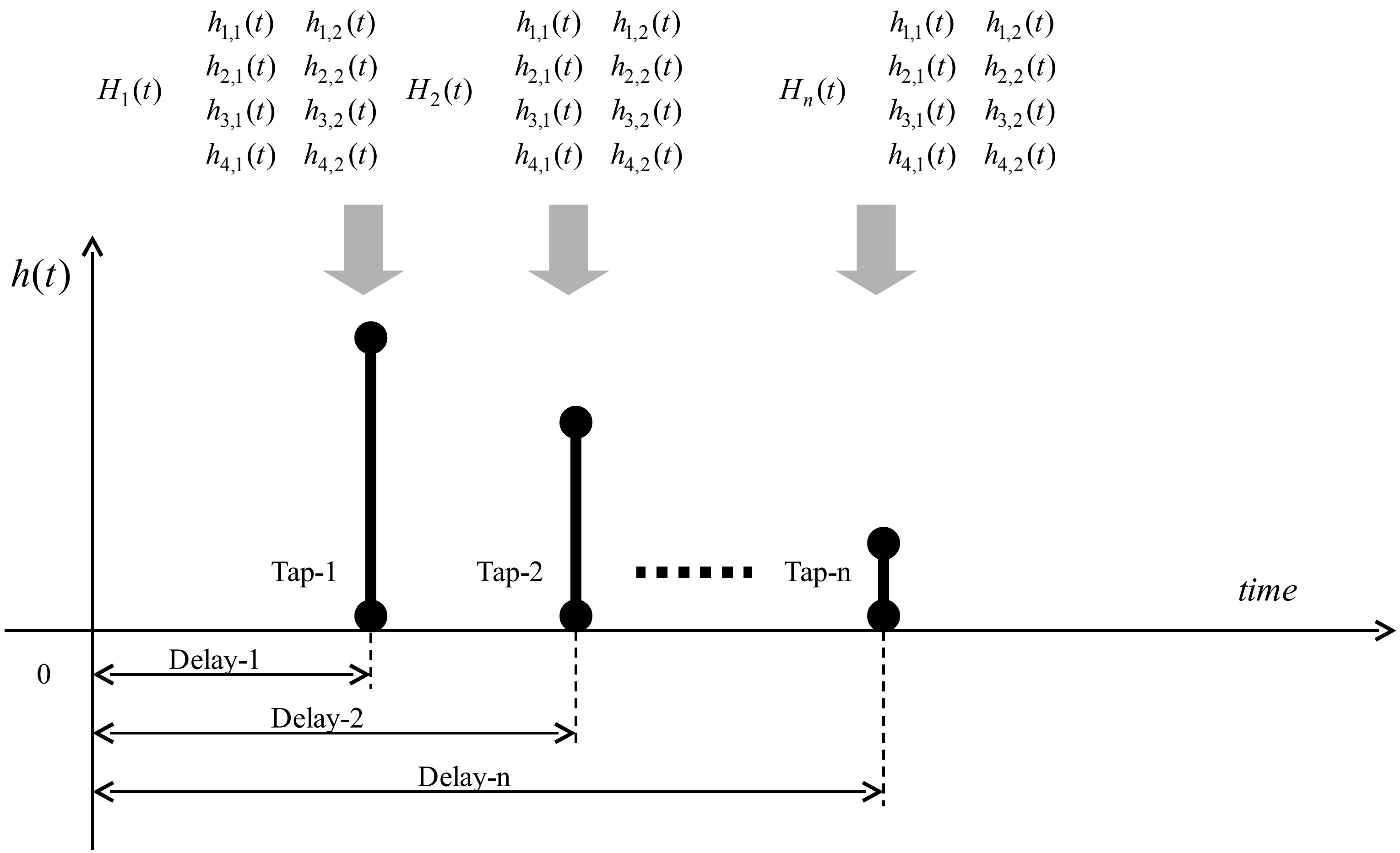
- Full Spatial Channel Models (SCM) is available for system level simulation
  - With narrow band limitation (max 5MHz)
  - Very complicated for generation and excessive run time is required
- Simplified Taped-Delay-Line MIMO channel model can be employed
  - For both link level and system simulations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



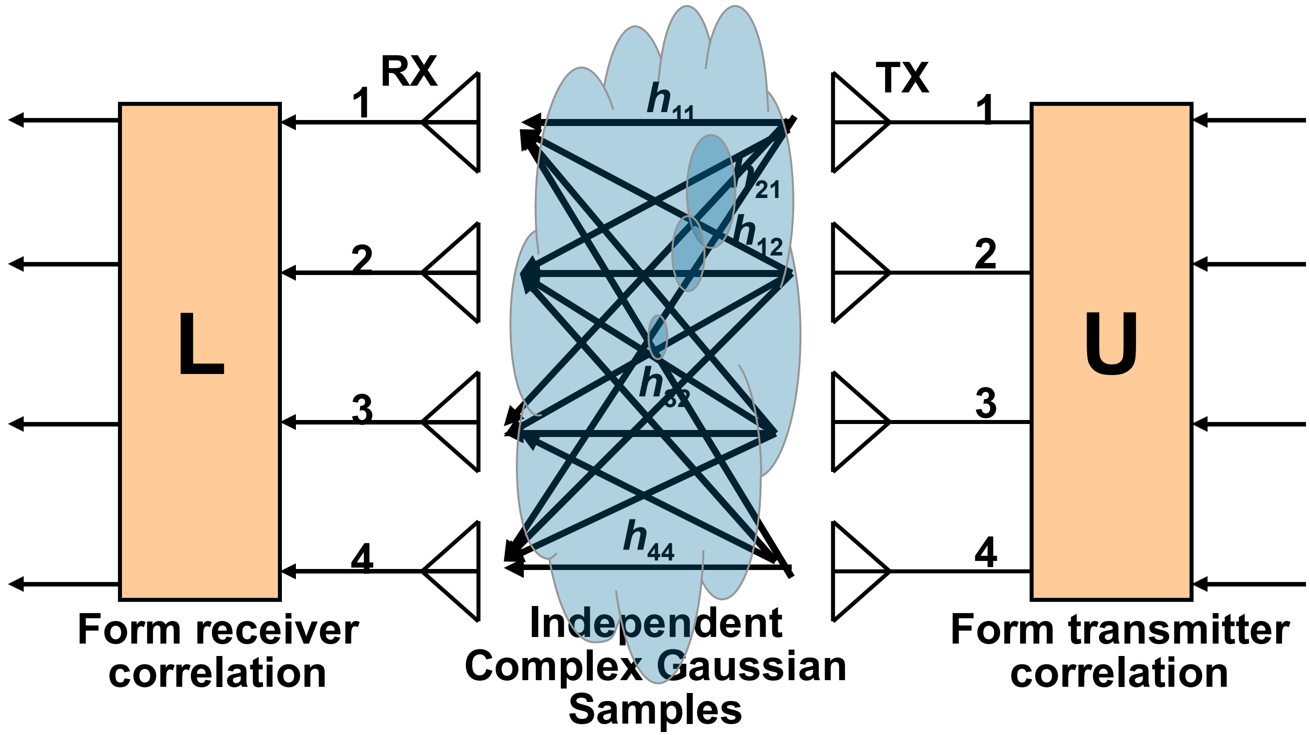
ITU Channel Model Parameters (Examples)

- 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)



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

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

* We assume the receive antennas are uncorrelated

Correlated MIMO Channel Model –(2)

1 2 3

1 2

R

2 1

3 2 1

	# 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 $N_T x N_R$ MIMO path.
- STEP-3: Apply an iindependent 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