# Vienna 5G Link Level Simulator v1.1 - List of Features

## General Functionality

The Vienna 5G Link Level Simulator evaluates the average PHY layer performance by means of Monte Carlo simulations.

- no network geometry, no path loss model
- average user SINR is an input parameter
- simulate almost any multicarrier system
- choose parameters individually for each node

## Channels and Links

Currently a FDD frame structure is implemented.

- Uplink data channel
- Downlink data channel

## Channel Coding

Different channel coding schemes may be chosen for different cells to investigate their co-existence.

- Turbo coding
- TB convolutional coding
- Polar coding
- LDPC coding

## Feedback

Quantized feedback to adapt the transmission parameters to the channel conditions.

- CQI, RI and PMI feedback selectable
- user defined or LTE-A compliant code-book
- variable feedback delay (in multiples of the frame duration)
## Channel Models

**Doubly-fading channel model**
- time selectivity via sum of sinusoids (Jakes)
- frequency selectivity via tap delay models (pedestrian, vehicular, etc.)
- spatial correlation via Kronecker model
- TDL models with adjustable RMS delay spread
- correlated time selectivity via sum of sinusoids
- TWDP and Rican fading for static channels

## Channel Estimation

**Pilot based channel estimation**
- LTE like, rectangular or diamond shaped pilot patterns
- LS channel estimation
- perfect channel knowledge

## Transmission Modes

**MIMO modes**
- transmit diversity
- receive diversity
- open loop spatial multiplexing
- closed loop spatial multiplexing

**Non-orthogonal multiple access**
- 3GPP MUST
Modulation
Different modulation schemes and waveforms may be chosen for different cells to investigate their coexistence.

- OFDM
- f-OFDM
- WOLA
- FBMC
- UFMC

Equalization and Detection
One-tap equalization with MIMO detection schemes

- Zero-Forcing
- MMSE
- Sphere Decoder
- Maximum likelihood

Power Amplifier Models
Non-linear power amplifier models for downlink transmissions

- Rapp model
- adjustable amplifier back-off

Performance Evaluation
Simulation results for up- and downlink:

- throughput per user
- coded and uncoded Bit Error Ratio
- Frame Error Ratio
- channel estimation MSE
- transmit signal peak-to-average power ratio