5G System Level Simulator

Vienna 5G System Level Simulator v1.4 - List of Features

General Functionality

The Vienna 5G System Level Simulator evaluates the average performance of large scale networks by means of Monte Carlo simulations with:

- Multiple base station and user types in one simulation
- Flexible and modular implementation using OOP in MATLAB
- Several performance metrics are evaluated (SINR, user throughput, etc.)
- Environment dependent choice of propagation models
- Downlink transmission and uplink *lite* SINR

Simulation Scenario

Base station, user and blockage types can be defined freely (number of antennas, transmit power, position) and used simultaneously in one simulation

- Macro, pico, femto cells
- Vehicular, pedestrian, indoor users with various movement and traffic models
- Buildings/blockages (Manhattan, predefined, OpenStreetMaps)

Propagation Models

Evaluation of large scale and instantaneous SINR considering

- Large scale path loss
- Shadow fading
- Antenna pattern
- Small scale fading
- Influence of blockage objects

Border Effect Mitigation

- wraparound
- interference region

Performance Evaluation

Simulation results:

- S(I)NR (*lite*, wideband, ...)
- user throughput, BLER
- transmission latency
- link properties: LOS/NLOS, path loss, scheduling, cell association ...

Transmission Parameters

- Zero Forcing Equalizer
- NOMA transmission
- HARQ (up to 64-QAM)
- Multi-user transmission with perfect CSI under several user grouping algorithms
- CLSM and OLSM feedback scheme with quantized and perfect feedback:
  - Rate adaptation (CQI)
  - MIMO (RI/PMI)

Flexible parameterization of transmission frame structure:

- Symbol intervals
- Mixed subcarrier spacings with inter numerology interference

Scheduler

Scheduler decision done per base station.

Supported schedulers are:

- Round Robin
- Best CQI
- Weighted Round Robin
- QoS Aware
- ZF MU-MIMO

Traffic Models

- Full buffer
- Constant rate
- Streaming
- VoIP
- Gaming
- HTTP
- FTP

Base Station Placement

Placement of network elements is 3D in general.

- Hexagonal grid
- Hexagonal ring
- Manhattan
- Predefined
- Uniform PPP

User Placement

- Uniform Poisson point process
- Poisson on streets
- Clustered
- Predefined

Movement:

- Random walk
- Random direction
- Constant
- Predefined

Channel Models

Supported channel models are:

- PDP
- 3GPP TR 38.901 3D clustered delay line
- AWGN (SISO)
- Rayleigh
- QuaDRiGa (interface, additional licensing terms apply)

Supported PDP channel models:

- Hilly Terrain
- PedA
- PedB
- Rural Area
- Typical Urban
- VehA
- VehB
- extended PedB

Path Loss Models

Path loss model is chosen dependent on the link state, i.e., LOS/NLOS, BS type, indoor/outdoor.

Supported large scale path loss models for direct links are:

- Fixed
- Free Space
- Indoor
- Rural (4G, 5G)
- Suburban
- Urban macro (3D, 4G, 5G, COST)
- Urban micro (3D, Street Canyon, COST)
- Ray Tracing (Matlab ray tracer interface)