PDSCH

This module contains classes related to the Physical Downlink Shared Channel, PDSCH.

class aerial.phy5g.pdsch.pdsch_tx.PdschTx

PDSCH transmitter.

This class implements the whole PDSCH transmission pipeline from the transmitted transport block to the transmitted frequency-domain symbols.

__init__(*cell_id*, *num_rx_ant*, *num_tx_ant*, *num_ul_bwp=273*, *num_dl_bwp=273*, *mu=1*)

Initialize PdschTx.

Parameters

- **cell_id** (*int*) – Physical cell ID.
- **num_rx_ant** (*int*) – Number of receive antennas.
- **num_tx_ant** (*int*) – Number of transmit antennas.
- **num_ul_bwp** (*int*) – Number of PRBs in a uplink bandwidth part. Default: 273.
- **num_dl_bwp** (*int*) – Number of PRBs in a downlink bandwidth part. Default: 273.
- **mu** (*int*) – Numerology. Values in [0, 3]. Default: 1.

Return type

None

run(*tb_inputs*, *num_ues*, *slot*, *num_dmrs_cdm_grps_no_data=2*, *dmrs_scrm_id=41*, *resource_alloc=1*, *prb_bitmap=None*, *start_prb=0*, *num_prbs=273*, *dmrs_syms=None*, *start_sym=2*, *num_symbols=12*, *scids=None*, *layers=None*, *dmrs_ports=None*, *bwp_starts=None*, *ref_points=None*, *rntis=None*, *data_scids=None*, *precoding_matrices=None*, *mcs_tables=None*, *mcs_indices=None*, *code_rates=None*, *mod_orders=None*, *rvs=None*, *num_prb_lbrms=None*, *max_layers=None*, *max_qms=None*)

Run PDSCH transmission.

Set dynamic PDSCH parameters and call cuPHY to run the PDSCH transmission.

Parameters

- **tb_inputs** (*List[np.ndarray]*) – Transport blocks in bytes for each UE.
- **num_ues** (*int*) – Number of UEs.
- **slot** (*int*) – Slot number.
- **num_dmrs_cdm_grps_no_data** (*int*) – Number of DMRS CDM groups without data [3GPP TS 38.212, sec 7.3.1.1]. Value: 1->3.
- **dmrs_scrm_id** (*int*) – Downlink DMRS scrambling ID.
- **resource_alloc** (*int*) – Resource allocation type.
- **prb_bitmap** (*List[int]*) – Array of bytes indicating bitmask for allocated RBs.
- **start_prb** (*int*) – Start PRB index for the UE group.
- **num_prbs** (*int*) – Number of allocated PRBs for the UE group.
- **dmrs_syms** (*List[int]*) – For the UE group, a list of binary numbers each indicating whether the corresponding symbol is a DMRS symbol.
- **start_sym** (*int*) – Start OFDM symbol index of the UE group allocation.
- **num_symbols** (*int*) – Number of symbols in the allocation, starting from *start_sym*.
- **scids** (*List[int]*) – DMRS sequence initialization for each UE [TS38.211, sec 7.4.1.1.2].
- **layers** (*List[int]*) – Number of layers for each UE.
- **dmrs_ports** (*List[int]*) – DMRS ports for each UE. The format of each entry is in the SCF FAPI format as follows: A bitmap (mask) starting from the

LSB where each bit indicates whether the corresponding DMRS port index is used.

- **bwp_starts** (*List[int]*) – Bandwidth part start (PRB number starting from 0). Used only if reference point is 1.
- **ref_points** (*List[int]*) – DMRS reference point per UE. Value 0 or 1.
- **rntis** (*List[int]*) –
- **data_scids** (*List[int]*) – Data scrambling IDs for each UE, more precisely *dataScramblingIdentityPdsch* [TS38.211, sec 7.3.1.1].
- **precoding_matrices** (*List[np.ndarray]*) – Precoding matrices, one per UE. The shape of each precoding matrix is number of layers x number of Tx antennas. If set to None, precoding is disabled.
- **mcs_tables** (*List[int]*) – MCS table per UE.
- **mcs_indices** (*List[int]*) – MCS index per UE.
- **code_rates** (*List[int]*) – Code rate for each UE in 3GPP format, i.e. code rate x 1024.
- **mod_orders** (*List[int]*) – Modulation order for each UE.
- **rvs** (*List[int]*) – Redundancy version per UE (default: 0 for each UE).
- **num_prb_lbrms** (*List[int]*) – Number of PRBs used for LBRM TB size computation. Possible values: {32, 66, 107, 135, 162, 217, 273}.
- **max_layers** (*List[int]*) – Number of layers used for LBRM TB size computation (at most 4).
- **max_qms** (*List[int]*) – Modulation order used for LBRM TB size computation. Value: 6 or 8.

Returns

A tuple containing:

- *np.ndarray*: Transmitted OFDM symbols in a frequency x time x antenna tensor.

- *np.ndarray*: Coded bits in a num_codewords x num_bits_per_codeword tensor.

Return type

np.ndarray, np.ndarray

classmethod cuphy_to_tx(*tx_slot*, *num_ues*, *dmrs_ports*, *scids*, *precoding_matrices=None*)

Map cuPHY outputs to Tx antenna ports.

Parameters

- **tx_slot** (*numpy.ndarray*) – Transmit buffer from cuPHY.
- **num_ues** (*int*) – Number of UEs.
- **dmrs_ports** (*List[int]*) – DMRS ports for each UE. The format of each entry is in the SCF FAPI format as follows: A bitmap (mask) starting from the LSB where each bit indicates whether the corresponding DMRS port index is used.
- **scids** (*List[int]*) – DMRS sequence initialization for each UE [TS38.211, sec 7.4.1.1.2].
- **precoding_matrices** (*List[np.ndarray]*) – Precoding matrices, one per UE. The shape of each precoding matrix is number of layers x number of Tx antennas. If set to None, precoding is disabled.

Returns

Transmitted OFDM symbols in a frequency x time x antenna tensor.

Return type

np.ndarray