

Predicting Dynamic Wireless Channel with OTFS Modulated Signal

This exhibit addresses: FORM 442 QUESTION 7: EXPERIMENTATION DESCRIPTION

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1. Description of Experiment

This experiment is a part of our research project aiming at systematically exploring the potential of Orthogonal Time Frequency and Space (OTFS) modulation to predict the future wireless channel. The wireless channel in the delay-Doppler domain can be expressed as

$$h(\tau, \nu) = \sum_{i=1}^P a_i \delta(\tau - \tau_i) \delta(\nu - \nu_i), \quad (1)$$

where $h(\tau, \nu)$ is the channel parameterized by the delay τ and Doppler ν , P is the number of propagation paths, $\delta(\cdot)$ is the Dirac delta function, and a_i , τ_i and ν_i are the gain, delay, and Doppler shift associated with the i -th path, respectively [1].

We plan to send OTFS modulated signals described in [2] on different general LTE frequency bands (600-800MHz, 1710-1990MHz, 2000-2200MHz) with a maximum transmit power of 500mW. The maximum coverage of the transmitter (Tx) is a circle with radius of 500m. We plan to place the Tx on the roadside near 1501 S MoPac Expy, Austin, TX 78746, at a height of 1.5m, and mount the receiver (Rx) at the top of an experiment vehicle (a BMW 328i, 1.5m height). The experiment vehicle will carry the Rx around to collect the signals propagating through multipath in the environment.

Since our signal are mainly preambles and does not have ability to carry station identification number, we request a waiver of Section 5.115 of the rules, which requires us to transmit station identification.

2. Description of Equipment

Our testbed is built on common Universal Software Radio Peripherals (USRP). All the key parameters strictly comply with FCC regulations, which can be found in the table attached. Note that, the daughterboard we used for experiment do have the ability to transmit signals from 400MHz to 4400MHz. However, we will follow the rule and only transmit signals on the frequency band licensed to us. The antenna VERT 900 and VERT2450 are omni-directional vertical dipole antennas providing a 3 dBi gain on 824-960 MHz and 1710-1990 MHz, 2.4-2.5GHz and 4.9-5.9 GHz, respectively, which doesn't exceed the regulated power constraint.

Tx/Rx	#	Model	Manufacturer	Daughterboard	Maximum Bandwidth (MHz)	Maximum Transmit Power (mW)	Number of Antenna	Antenna Manufacturer	Model	Type of Antenna
Tx	1	Ettus N210	National Instrument	SBX-40	40	100	1	National Instrument	VERT900 or VERT2450	Dipole
Rx	1	Ettus N210	National Instrument	SBX-40	40	100	1	National Instrument	VERT900 or VERT2450	Dipole

References

- [1] P. Bello, "Characterization of randomly time-variant linear channels," *IEEE transactions on Communications Systems*, vol. 11, no. 4, pp. 360–393, 1963.
- [2] P. Raviteja, K. T. Phan, and Y. Hong, "Embedded pilot-aided channel estimation for otfs in delay-doppler channels," *IEEE Transactions on Vehicular Technology*, vol. 68, pp. 4906–4917, 2018.