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1. Multipath Multiplexing for Capacity Enhancement in SIMO Wireless Systems

Authors: Tadilo Endeshaw Bogale, Long Bao Le, Xianbin Wang, Fellow, and Luc Vandendorpe

Goal: Higher Transmission Rate than existing OFDM.

- Proposed a novel and simple orthogonal faster than nyquist(OFTN) data transmission & detention approach for a SIMO.
- This paper provides a novel & simple OFTN transmission and symbol by symbol detention approach that exploits the multiplexing gain.
- The achievable rate gap between the proposed approach and OFDM as the number of receiver antenna increses for the fixed number of multipath components.
- So, this performance gain can be very significant for large scale multi antenna wireless systems.

1. Signal & Channel Model

We first consider a SISO channel and the result is then extended to a SIMO channel.

$$y(t) = h(t) * x(t) + w(t)$$

$$h(\tau) = \sum_{i=0}^{P-1} \alpha_i e^{j\phi_i(\tau)} \delta(\tau - \tau_i)$$

where,
P is the total number of multi path components.
α_i, ϕ_i & τ_i are the attenuation, phase and propagation delay of the channel from the transmitter to the receiver in path i.
When the channel has M multipath taps and the receiver has $N \geq M$ multiple antennas, one can achieve the following upper-bound rate.

$$R = \frac{M^2}{3M-2} log_2 \left(1 + \frac{3M-2}{M^2}\left(\frac{N-M-1}{\sigma^2}\right)\right)$$

1. Proposed OFTN Transmission Approach

- Our objective is to transmit multiple symbol in T_s seconds.
- We split the bandwidth B into L equivalent sub-bands.
- With bandwidth B_L, the OFDM transmission approach is able to transmit $N_L \triangleq \frac{N_s}{L}$ data symbols in $T_b = N_s T_s$ seconds.
- So, our objective will be to transmit more than N_L symbols in T_b seconds in the same bandwidth.

The transmitted data signal at time $t = l\tilde{T}_s$

$$x_l \triangleq x(l\tilde{T}_s) = \sum_{k=-\frac{\tilde{Q}}{2}}^{\frac{\tilde{Q}}{2}} \tilde{g}(l\tilde{T}_s - k\tilde{T}_s) d_{l+k}$$

$$x_l = \sum_{k=l-P+1}^{l} d_k$$

the only difference is that in the existing approach $d_k = 0$ for $k \neq l$.

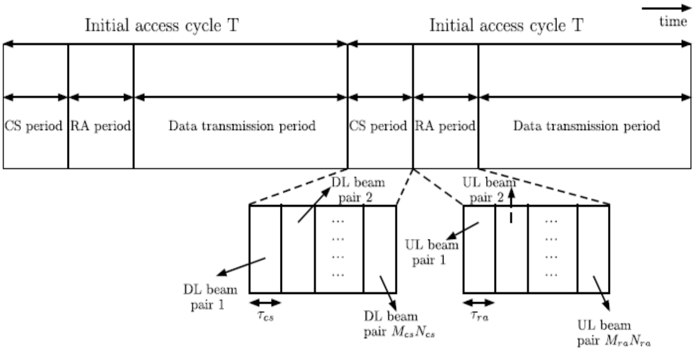
2. Design and Analysis of Initial Access in Millimeter Wave Cellular Networks

Authors: Yingzhe Li, Jeffrey G. Andrews, Franois Baccelli, Thomas D. Novlan, and Charlie Jianzhong Zhang,

Goal: Design of initial access protocols and its analysis.

- Initial access is the process which allows a mobile user to first connect to a cellular network.
- It consists of two main steps: cell search (CS) on the downlink and random access (RA) on the uplink.
- Millimeter wave cellular systems typically must rely on directional beamforming (BF) in order to create a viable connection.
- This paper considers four simple initial access protocols that use various combinations of directional BF and omnidirectional transmission and reception at the mobile and the BS, during the CS and RA phases.

2. System Model



The two main design objectives for initial access in mmWave cellular networks include:
(1) connect the users to the network, and
(2) enable both BS and its associated user to learn their aligned beamforming directions.

2. Protocols for BS and User to Determine Beamforming Directions

The Protocols that are investigated in this paper are as follows:

- Baseline
- Fast RA
- Fast CS
- Omni RX

Contributions:

- Accurate analytical framework for mmWave system level performance under various initial access protocols.
- Beam sweeping is shown to be essential for cell search.
- A detailed performance evaluation for the baseline exhaustive search protocol.
- Comparison of expected initial access delay and average user-perceived downlink throughput.

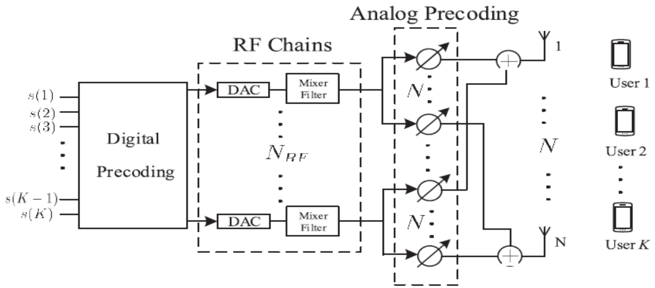
3. Angle Domain Hybrid Precoding and Channel Tracking for Millimeter Wave Massive MIMO Systems

Authors: Jianwei Zhao, Feifei Gao, Weimin Jia, Shun Zhang, Shi Jin, and Hai Lin

Goal: Proposed an angle domain hybrid precoding and channel tracking method by exploring the spatial features of the mm-wave massive MIMO channel.

- The number of the RF chains, is enormously decreased via the operation of spatial rotation.
- The users are then scheduled by the angle division multiple access scheme, which groups users according to their direction of arrivals (DOAs).
- A channel tracking method is designed for the subsequent data transmission through a small number of pilot symbols.
- The channel information is divided into the DOA information and the gain information, where the DOA information is tracked by a modified unscented Kalman filter (MUKF) and the gain information is estimated from beam training.

3. System Model

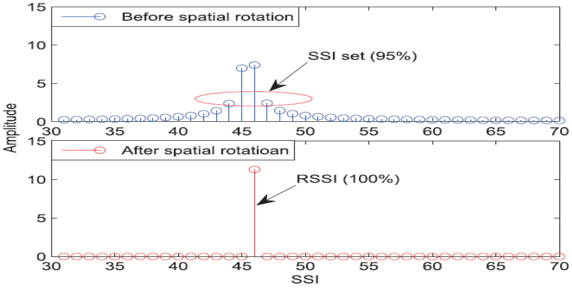


$$\mathbf{h}_k = \beta_k^{(0)} \mathbf{a}(\Psi_k^{(0)}) + \sum_{l=1}^{L} \beta_k^{(l)} \mathbf{a}(\Psi_k^{(l)})$$

$$[\mathbf{a}(\Psi_k^{(l)})]_n = e^{j2\pi n \Psi_k^{(l)}}, n \in \mathbb{J}(N)$$

where, $\Psi_k^{(l)} = \frac{d}{\lambda} sin(\theta_k^{(l)})$, $\mathbb{J}(N) = \{n - \frac{N-1}{2}, n = 0, 1, ..., N-1\}$

3. Spatial Rotation



The number of users is often larger than that of the finite RF chains. Hence, users should be divided into several groups for data transmission over different time interval.

Users are scheduled according to DOA information. The corresponding scheme is called angle division multiple access (ADMA).

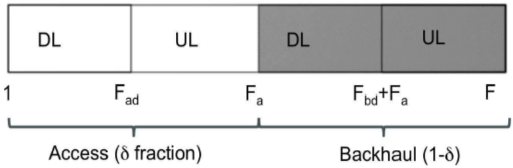
4.Performance of Dynamic and Static TDD in Self-Backhauled Millimeter Wave Cellular Networks

Authors: Mandar N. Kulkarni, Jeffrey G. Andrews, and Amitava Ghosh

Goal: Propose a random spatial model to analyze uplink (UL) and downlink (DL) signal to interference plus noise ratio distribution and mean rates corresponding to different access-backhaul and UL-DL resource allocation schemes in a self-backhauled mm-wave cellular network.

- A self-backhauled network has two types of base stations (BSs) master BSs (MBSs) and slave BSs (SBSs).
- A fundamental problem for designing a self-backhauled network is to split the available time frequency resources between uplink (UL) and downlink (DL) and for the access and backhaul links.
- We focus on implementations of static and dynamic time division duplexing (TDD) for access links with synchronized or unsynchronized access-backhaul (SAB or UAB) time splits.

4. TDD frame



The TDD frame is divided into 4 subframes each of duration T. These are $F_{ad}, F_{au}, F_{bd}, F_{bu}$.
All BSs allocate δ fraction of F for access and rest for backhaul.

4.Contributions

- A key analytical takeaway is how to explicitly incorporate TDD frame structures for resource allocation studies in self-backhauled cellular networks using stochastic geometry.
- From a system insights viewpoint, the key takeaways lie in the comparison of different TDD schemes as a function of different access-backhaul splits, UL/DL traffic asymmetry and the density of BSs.

Other Papers

- Efficient Coded Cooperative Networks With Energy Harvesting and Transferring ... *Nan Qi, Ming Xiao, Theodoros A. Tsiftsis, Lin Zhang, Mikael Skoglund, and Huisheng Zhang*
- Robust Resource Allocation in Full-Duplex-Enabled OFDMA Femtocell Networks ... *Sa Xiao, Xiangwei Zhou, Yi Yuan-Wu, Geoffrey Ye Li, and Wei Guo*
- Transmission Rate Optimization of Full-Duplex Relay Systems Powered by Wireless Energy Transfer ... *Long Zhao, Xiaodong Wang, and Taneli Riihonen*
- Energy-Efficient Resource Allocation in Buffer-Aided Wireless Relay Networks ... *Javad Hajipour, Javad Musevi Niya, and Derrick Wing Kwan Ng*