

Hybrid analog/digital precoding offers a compromise between hardware complexity and system performance in millimeter wave (mmWave) systems. This type of precoding allows mmWave systems to leverage large antenna array gains that are necessary for sufficient link margin, while permitting low cost and power consumption hardware. Most prior work has focused on hybrid precoding for narrow-band mmWave systems, with perfect or estimated channel knowledge at the transmitter. MmWave systems, however, will likely operate on wideband channels with frequency selectivity. Therefore, this paper considers wideband mmWave systems with a limited feedback channel between the transmitter and receiver. First, the optimal hybrid precoding design for a given RF codebook is derived. This provides a benchmark for any other heuristic algorithm and gives useful insights into codebook designs. Second, efficient hybrid analog/digital codebooks are developed for spatial multiplexing in wideband mmWave systems. Finally, a low-complexity yet near-optimal greedy frequency selective hybrid precoding algorithm is proposed based on Gram-Schmidt orthogonalization. Simulation results show that the developed hybrid codebooks and precoder designs achieve very-good performance compared with the unconstrained solutions while requiring much less complexity.