IV. Numerical Results

We present several numerical results to demonstrate the performance of OFDMA systems using the proposed algorithms. We assume an OFDMA system with the average channel power gain $E[\alpha_{k,n}] = 1$. Furthermore, the feedback capacities of all users are assumed to be identical. That is, $C_k = C_{k'}$ for all $k \neq k'$. By Theorem 1, it implies that the mean quantization errors of all users on each subcarrier are identical, $\nu_{k,n} = \nu_{k',n}$.

First, for the problem (10), we compare the proposed suboptimal algorithm with a full-searching algorithm. This full-searching algorithm considers all possible subcarrier allocations, and for each subcarrier allocation, it assigns transmit power based on the dual optimization approach as proposed in Subsection III-C without projecting the final power allocation back to the feasible region. Thus, this algorithm gives an upper bound on the optimal solution to the problem in (10) [20].

Fig. 2 plots both the suboptimal results and the upper bound of the optimal results for an OFDMA system with $N = 8$ subcarriers and $K = 2$ users. In Fig. 2, as the capacity of the feedback channel increases from $C_k = 1.6$ bps/Hz to $C_k = 64$ bps/Hz, the performance gap between

$$\nu_{k,n} = q \leq q + 1$$

Then, the BS assigns subcarriers and transmit power with the knowledge of the power gain $\hat{\alpha}_{k,n}$, the user with the highest power gain $\hat{\alpha}_{k,n}$ is chosen on each subcarrier and the transmit power on each subcarrier is determined using the water-filling method [23]. This method gives the maximum throughput when $\alpha_{k,n} = \hat{\alpha}_{k,n}$ [23].

Fig. 3 shows the rate-distortion curves for the two schemes. In this figure, for a wide range of the average distortion, the required capacity of the feedback channel in the rate-distortion limit is about 50%-80% of the threshold-based quantization scheme. However, when the capacity of the feedback channel is zero (no CSI is fed back to the BS), both schemes result in the average distortion of $NE[\alpha_{k,n}] = 1024$.

Fig. 4 depicts the outage throughput in terms of the capacity of the feedback channel. When no CSI is available at the