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Organization

- Online Policies for Energy Harvesting Receivers With Time-Switching Architectures
- Resource Allocation for Wireless-Powered IoT Networks With Short Packet Communication
- An Analysis of Two-User Uplink Asynchronous Non-orthogonal Multiple Access Systems

Online Policies for Energy Harvesting Receivers With Time-Switching Architectures (Z.Ni and M.Motani)

- Formulate Markov decision process problems and perform online optimization to maximize the number of bits decoded for an EH receiver with a time-switching architecture
- Harvests energy from both a dedicated transmitter and other ambient RF sources
- Find online policies maximizing the total number of information bits decoded

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- Energy status, $e_1, \ldots, e_N$
- Fraction of channel uses for energy harvesting is denoted by α_i
- Normalized code rate, $v_i = \frac{R_i}{C}$
- Amount of energy consumed for decoding per channel use, $g(v_i)$
- Energy stored in the battery at the beginning of $i+1$th block, b_{i+1} can be obtained as

$$b_{i+1} = b_i + \alpha_i e_i - (1 - \alpha_i)g(v_i) \tag{1}$$

- Reward received is the total number of bits decoded,

$$r(s, a) = (1 - \alpha)v \tag{2}$$

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- expected total reward,

$$o_N^{\pi}(s_1) = E^{\pi}\left[\sum_{t=1}^{N-1} r_t(S_t, A_t) + r_N(S_N)\middle| S_1 = s_1\right] \qquad (3)$$

- An optimal policy π^* should satisfy that

$$o_N^{\pi^*}(s_1) = \sup_{\pi} o_N^{\pi}(s_1) \qquad (4)$$

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- Optimization problem

$$\underset{\alpha_i, v_i}{max}(1-\alpha_i)v_i \tag{5}$$

$$\text{st } \alpha_i \geq 0, v_i \leq 1, \tag{6}$$

$$b_{i+1} = b_i + \alpha_i e_i n - (1-\alpha_i)g(v_i)n \tag{7}$$

- Optimal values

$$v_i^* = \text{arg max}\frac{v_i}{e_i + g(v_i)} \tag{8}$$

$$\alpha_i^* = \frac{b_{i+1} - b_i + g(v_i^*)}{e_i + g(v_i^*)} \tag{9}$$

Resource Allocation for Wireless-Powered IoT Networks With Short Packet Communication (J.Chen, L.Zhang and Y.Liang)

- A hybrid access point (HAP) first transmits power to the IoT devices wirelessly, then the devices in turn transmit their short data packets
- Jointly optimize the transmission time and packet error rate of each user to maximize the total effective-throughput or minimize the total transmission time
- Develop efficient algorithms to find high-quality suboptimal solutions

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- Optimization problem

$$\max_{n,\epsilon} R(n,\epsilon) = \sum_{k=1}^{K} r_k \tag{10}$$

$$\text{s.t. } \sum_{k=0}^{K} n_k \leq N, \tag{11}$$

$$n_k \in \mathbb{N}, 0 \leq k \leq K, \tag{12}$$

$$0 \leq \epsilon_k \leq \epsilon_{max,k}, 1 \leq k \leq K, \tag{13}$$

where
r_k, effective throughput
n_k, packet length of signal s_k
ϵ_k, packet error rate

An Analysis of Two-User Uplink Asynchronous Non-orthogonal Multiple Access Systems (X.Zou, B.He and H.Jafarkhani)

- ANOMA with a sufficiently large frame length can outperform the NOMA in terms of the sum throughput
- The ANOMA makes use of the oversampling technique by intentionally introducing a timing mismatch between symbols of different users

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- System model-

$$y(t) = \sum_{i=0}^{N-1} a_1[i]p(t-iT) + \sum_{i=0}^{N-1} a_2[i]p(t-iT-\tau T) + n(t) \quad (14)$$

  where
  $a_1[i] = h_1\sqrt{P_1}s_1[i]$, $a_2[i] = h_2\sqrt{P_2}s_2[i]$

- ith element in the first sample vector is

$$y_1[i] = a_1[i] + \tau a_2[i-1] + (1-\tau)a_2[i] + n_1[i] \quad (15)$$

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- Outputs at the BS in a matrix form

$$\mathbf{Y{=}RHX{+}N} \tag{16}$$

where $\mathbf{R}= \begin{bmatrix} 1 & 1-\tau & 0 & \dots & \dots & 0 \\ 1-\tau & 1 & \tau & 0 & \dots & 0 \\ \ddots & \ddots & \ddots & \ddots & \ddots & \\ 0 & \dots & \dots & 0 & 1-\tau & 1 \end{bmatrix}$

- Sum throughput of the two-user uplink ANOMA system

$$R^{ANOMA} = \frac{1}{N+\tau} \log\det\left(\mathbf{I}_{2N} + \mathbf{HH}^{H} R\right) \tag{17}$$

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- Results - The two-user uplink ANOMA system as $N \to \infty$ achieves an equal or higher throughput compared with the NOMA system
- For the two-user uplink ANOMA system with any frame length, N, and the normalized timing mismatch, τ, the optimal transmit powers at Users 1 and 2, P_1^* and P_2^* are equal to the maximum available powers at which Users 1 and 2 can transmit, $P_{1,max}$ and $P_{2,max}$, i.e., $P_1^* = P_{1,max}$ and $P_2^* = P_{2,max}$
- For the two-user uplink ANOMA system with the frame length $N \to \infty$, the optimal normalized timing mismatch to maximize the sum throughput is given by $\tau^* = 0.5$