Random Tree Optimization for Energy-Efficient Broadcast in All-Wireless Networks

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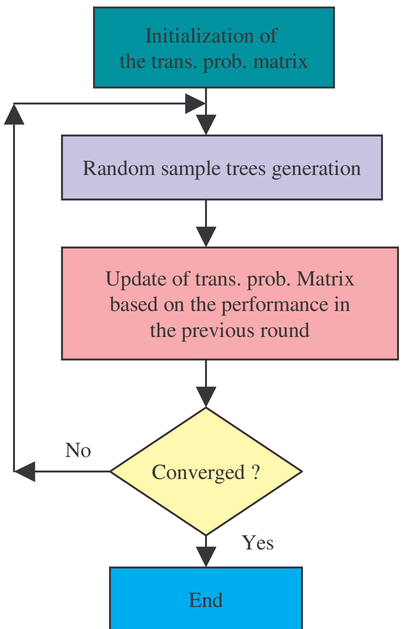
I. Background

- Event notification system (**ENS**), resource discovery, paging, etc. need broadcast services.
- Intelligently relaying information between nodes may lead to lower power attenuation than communication directly over large distances.
- Cross Entropy (**CE**) method is a powerful tool to tackle combinatorial optimization problems.

II. RTO Overview

The basic idea is to translate the *deterministic* optimization problem into a related *stochastic* optimization one and then use Rare Event Simulation (**RES**) techniques to find the solution.

III. RTO Process



Notes: define $Q=(q_{i,j})_{((N+1)\times(N+1))}$ as one-step trans. prob. matrix.

$q_{i,j}$ denotes the prob. that there is a transmission from node i to node j.

The rationale behind the update of the trans. prob. is that if it performs well in the precious round for a given trans., it will have bigger chance to transmit in the next round.

IV. Preliminary Results and Summary

We apply Cross-Entropy (CE) method for the construction of energy-efficient broadcast trees. Random Tree Optimization algorithm can save up to 20%~30% total required power on average compared with other existing state-of-the-art approaches. We plan to implement RTO algorithm in a distributed way so that nodes are divided into groups, on which sub-trees are generated separately, then merged to a single tree.

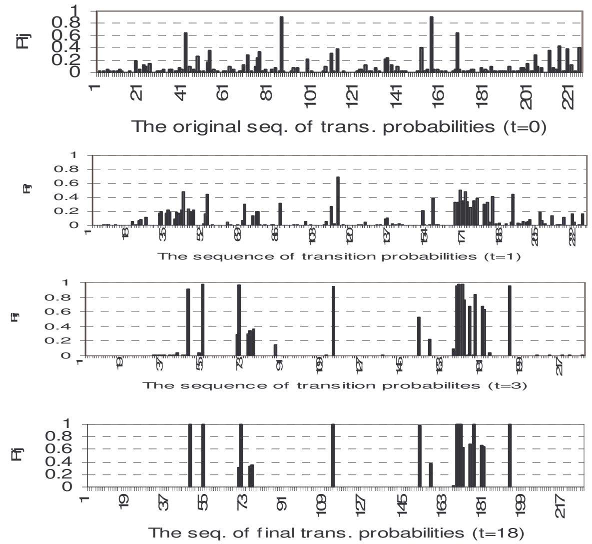


Fig. 1: An example run of the evolving of the trans. probability matrix during RTO

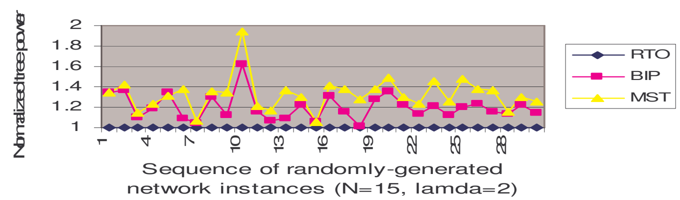


Fig. 2: Normalized tree power in a number of random networks (N=15).

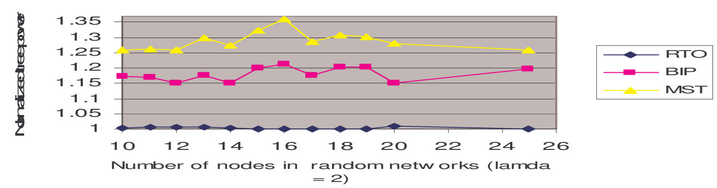


Fig. 3: Mean normalized tree power over 60 random network instances with different number of nodes in the network.

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