Layered Attractor Selection for Clustering and Data Gathering in Wireless Sensor Networks

Ehssan Sakhae, Kenji Leibnitz, Naoki Wakamiya, Masayuki Murata
Graduate School of Information Science and Technology
Osaka University
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Overview
- Application Scenario
- Attractor Selection in a gene network.
- Protocol Architecture
- Two Layers for Clustering and Routing
- Network Assumptions
- Conclusion and Future Work

Application Scenario

Attractor Selection in a gene network

\[ \frac{dN}{dt} = f(n) + \eta \]

- \( \eta \) represents a property for selection.
- \( f(n) \) is a function defining the attractors.
- \( n \) is the activity, the "goodness" of the selection.
- \( \eta \) is a Gaussian noise term for inducing random selection.

Layered Clustering and Routing Architecture

Attractor Selection for Clustering

Local cluster activity affects local clusterhead election

\[ \frac{dN}{dt} = f(n) + \eta \]
Attractor Selection for Routing

Here we make a selection, and receive an activity based on that selection. The activity is not common among the candidate set. Each selection results in a unique activity for that particular selection. Low activity reflects a bad selection, and hence another candidate is selected. High activity reflects a good selection, and hence the same candidate is more likely to be selected.

Complete Protocol Mechanism

1. Hopcount-to-Sink Initialization Phase
   Clusterhead selection takes place. Feedback activity is generated.
2. Cluster Formation Phase
   Gateway selection takes place. Activity feedback is generated upon reception of data.
3. Data Gathering Phase
   Intermediate clusters await for data from higher clusters for further aggregation.
4. Routing Phase
   Sink
   Lower Neighboring Cluster (LNC)
   Higher Cluster (HC)

Complete Layered Attractor Flowchart

Layer 2 (Clustering)
- Information gathering
- Activity Calculation (pre-calculation)
- Selection
- Activity Calculation (feedback)
Layer 1 (Routing)
- Information gathering
- Activity Calculation (pre-calculation)
- Selection

Interaction between layers

Network Assumptions

- Each node has different energy levels, and some or all nodes have permanent or temporary power source, e.g. solar energy.
- Not all nodes are within transmission range of the sink, i.e. multihop routing of data is inevitable by nodes not within a one-hop range of the sink.
- GPS is not available.
- Environment influences the function of the network.

Conclusion and Future Work

- In this paper we outlined a bio-inspired approach to clustering and routing using a layered attractor selection model.
- The protocol is aimed at providing a self-organized, resilient and energy-efficient approach adaptable to changes in environmental conditions.
- Future work should aim at implementation analyzing the dynamics of the system and comparisons with previous studies.

Thank you!