

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

Ehssan Sakhaee, Kenji Leibnitz, Naoki Wakamiya, Masayuki Murata
 Graduate School of Information Science and Technology
 Osaka University
 IEICE Society Taikai, 17th September 2009

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

センサーネットワークの農場での応用例

Attractor Selection in a gene network

Adaptive-Response by Attractor Selection (ARAS)

$$\frac{dn}{dt} = f(n)\alpha + \eta$$

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

Layered Clustering and Routing Architecture

● Clusterhead

○ Clustermember

Layer 1 – Routing

Several gateways or clusterheads, select one for routing towards the sink.

Layer 2 – Clustering

Many candidate nodes, select one as clusterhead.

Attractor Selection for Clustering

Local cluster activity affects local clusterhead election

● Previous Clusterhead

● Current Clusterhead

○ Clustermembers

● Sink

$$\frac{dx_i}{dt} = f(\tilde{e}_i, x_i) \alpha_i + \eta_i$$

Attractor Selection for Routing

$\frac{dy_j}{dt} = g(\hat{e}_j, \hat{y}_j) \alpha_j^* + \xi_j$

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.

Society Taikai 2009 17th September 2009 7

Complete Protocol Mechanism

1. Hopcount-to-Sink Initialization Phase
Clusterhead selection takes place. Feedback activity is generated.
2. Cluster Formation Phase
Intermediate clusters higher clusters for further aggregation.
3. Data Gathering Phase
Generated upon reception of data.
4. Routing Phase
Gateway selection takes place. Activity feedback is generated upon reception of data.

Society Taikai 2009 17th September 2009 8

Complete Layered Attractor Flowchart

Interaction between layers

Society Taikai 2009 17th September 2009 9

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.

Society Taikai 2009 17th September 2009 10

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.

Society Taikai 2009 17th September 2009 11

Thank you!

Society Taikai 2009 17th September 2009 12