Network Management Optimization for Self-Organizing Radio Networks

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ENROLLED IN JUNE 2011
13,03,2013
PhD Thesis Work

- Format: Collection of articles
- Supervisor: professor Tapani Ristaniemi (University of Jyväskylä)
- Expected completion date: 1/2015 – 9/2015
- Earned credits: 58 out of 60 ECTS.
Scope of the work

- The research work is focused on the SON concept
- ns-3 – advanced LTE/LTE-A system level simulator
- Data mining for problem/fault detection and diagnosis
- Sleeping cell detection
SON concept
Sleeping cell detection

This is a special case of cell outage which makes mobile service unavailable for subscribers even though the cell still appears to be operable from the network point of view.

The objective for this task is to define suitable models for sleeping cells and to research advanced mechanisms for the faulty cell identification.
Publications

- Accepted
  ICASP 2013 conference
  “N-GRAM ANALYSIS FOR SLEEPING CELL DETECTION IN LTE NETWORKS”
  Fedor Chernogorov, Tapani Ristaniemi, Kimmo Brigatti, Sergey Chernov

Currently our research group is about to start the writing of a journal article

Also, I’m involved in one more data mining research. Thus, I’m planning to write an article about it during this semester
Accepted paper

Simulation

Data mining:
- Dim. reduction: PCA
- Anom. detection: FindCBLOF
Ongoing research. Simulation

Whole set of events:

0 - PL_PROBLEM
1 - PL_PROBLEM_RECOVERY
2 - RLF
3 - RLF_REESTABLISHMENT
4 - RLF_RECONNECTION
5 - RESELECTION
6 - TXP_HR_ENTER
7 - TXP_HR_LEAVE
8 - A2_RSRP_ENTER
9 - A2_RSRP_LEAVE
10 - A2_RSRQ_ENTER
11 - A2_RSRQ_LEAVE
12 - A3_RSRP
13 - HO_COMMAND_RCVD
14 - HO_COMPLETE_RCVD
15 - PERIODIC
16 - OUT_OF_SERVICE
17 - HO_TO_VOID
18 - RESELECTION_TO_VOID
19 - HO_FAILURE
20 - ESTABLISHMENT_FAILURE
Ongoing research. Raw data

- **Datasets:**
  - Training: Normal scenario 1 (without sleeping cell)
  - Testing:
    - Problem scenario (with sleeping cell)
    - Normal scenario 2 (without sleeping cell)

- **Mobility log**
  - 1: Time stamp
  - 2: Mobile terminal ID
  - 3: Serving Base station ID
  - 5: x-coordinate of terminal
  - 6: y-coordinate of terminal
  - 7: Events:
    - 23: Target BS id

- **Data mining**
  - 2-gram analysis
  - Dimensionality reduction method: diffusion maps
  - Anomaly detection algorithm: FindCBLOF
Ongoing research. Data mining

Datasets:
- Training: Normal scenario
- Testing: Problem scenario

Diffusion maps + FindCBLOF

Embedded Space.
Testing dataset

Clusters of training dataset

ROC Curve

AUC = 0.99383
Ongoing research. Results

If $[\text{mean}(\text{CBLOF}) + \text{std}(\text{CBLOF})]$ is a splitting point between outliers and normal points, then

- **Testing: Problem scenario**
- **Testing: Normal scenario 2**
Ongoing research. Future plans

- Use nystöm extension for dimensionality reduction
- Online sleeping cell detection
- There are some other steps to do, but it is too much in details for this presentation
Thank you for attention :)