On the Structure of Changes in Dynamic Contact Networks

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Outline

Context and problem

Our approach

Results
Outline

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Our approach

Results
Dynamic Contact Networks

Participants carry sensor devices
- send periodically
- listen at any time
- log received signals
Dynamic Contact Networks

Participants carry sensor devices
- send periodically
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Aggregation of contacts: series of contacts $\rightarrow$ series of graphs
Our goal

Correlation between consecutive graphs

Structure of changes: concentrated or spread?

Suitable object: difference graph
Difference graphs
Generality of our approach

Approach purely graph-based

- proximity contacts
- communications
- online social networks

No use of mobility data

- not always available
- not always relevant
- we study contacts
Outline

Context and problem

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Results
Structure of changes

→ Concentration of edges in the difference graphs

Two parameters:

- non-isolated nodes
  ⇒ nodes involved in changes
- minimum vertex cover
  ⇒ nodes that concentrate changes
Our approach

Minimum Vertex Cover

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Minimum Vertex Cover
Minimum Vertex Cover
Minimum Vertex Cover

Our approach
Our approach

Structure of changes (continued)

→ Concentration of edges in the difference graphs

Two parameters:

• non-isolated nodes
  ⇒ nodes involved in changes

• minimum vertex cover
  ⇒ nodes that concentrate changes

Comparison: actual values / expected values

Random graph of given density: Erdös-Rényi model.
Outline

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Results

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Example dataset: Infocom’06

Proximity contacts

**Sampling period:** 120 seconds  
**Chosen aggregation period:** 900 seconds

Other datasets: Infocom’05, RollerNet, Cambridge, MOSAR
Results

Parameters
Non-isolated nodes

![Graph showing changes in the number of nodes over time. The x-axis represents time in units of 900 seconds, and the y-axis represents the number of nodes. The graph compares the changes in non-isolated nodes in the Infocom'06 dataset with real-world data, showing fluctuations and the number of nodes varying between 0 and 80. The value at the end of the graph is 54.8 nodes.]
Non-isolated nodes

Conclusion: few nodes involved in changes
Results

Minimum Vertex Cover

Conclusion: few nodes concentrate change
Conclusion: MVC actually smaller than expected
Results

Parameters

Aggregation
Influence of the aggregation period

Conclusion: wide range of aggregation periods
Non-isolated nodes (several datasets)

Three groups of experiments
Same conclusion: MVC smaller than expected
Minimum Vertex Cover (MOSAR)

Same conclusion: MVC smaller than expected
Results

Parameters

Aggregation

Datasets

Conclusion
Conclusion

Results

- few nodes involved in changes
- few nodes concentrate the changes

Generality

- limited influence of the aggregation
- “independent” of the contact network

⇒ special structure of changes
Results

Models

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Minimum Vertex Cover

Not concerned about complexity issues:
- NP-complete problem
- preprocessing called leaf removal very efficient on sparse graphs
- practical observation: it performs even better on our graphs