

Analysis of Echo Chamber Formation by Friend Recommendation

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ACM Hypertext and Social Media

Background

- SNS have been criticized as the cause of social division.
- Mixed experimental results on whether friend recommendations promote echo chambers.



We need a further analysis

Goal of the Research

Experimental analysis on the influence by friend recommendation on echo chamber formation.

- A real SNS data
- Compare multiple recommendation algorithms
- Isolate influence by friend recommendation
- global bias / local bias
- link bias / content bias

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A subgraph extracted from X:

- Rejection controlled Metropolis-Hastings algorithm
[Li et al., ICDE 2015]
- 48k non-private accounts
 - with ≥ 20 posts
 - with a post not older than 6 months
- 709k edges
- 50 posts (at most) by each account $\rightarrow$ 1.6M posts
- Louvain method $\rightarrow$ 12 communities

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Compared Algorithms

Content-based Method (CM)

- recommend the most similar user
- cosine similarity of the content-based feature vectors

Most-Common-Neighbor (MCN)

- a user with the largest number of common neighbors

Adamic-Adar (ADA)

- Adamic-Adar index instead of the simple MCN

personalized SALSA (pSALSA)

- random walk starting from the target user with alternating direction (forward, backward, ...)

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Experiment Procedure

A simple simulation to isolate influence by friend recommendation:

Repeat:

1. Measure the bias
2. Add edges recommended by the algorithm

- No model of users' opinion changes.
- Users always obey the recommendation.

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Metrics for Global Biases

Global Bias: computed for the entire graph

Content Bias: **Pseudo F statistic**

1. Compute each user's vector:
TF-IDF of the posts by the followees
2. Cluster them and compute **Pseudo F statistic**
(how well the data points are clustered)

Link Bias: **Modularity** of the entire graph
(how well the graph can be partitioned
compared with random graphs)

Metric for Local Biases

Local Bias: computed for each target user

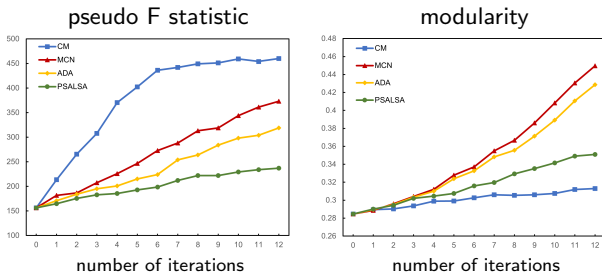
Content Bias:

- Average content similarity between the users recommended to the target user.
- Larger values mean more bias.

Link Bias:

- The ratio of communities from which at least one user was recommended.
- **Smaller** values mean more bias.

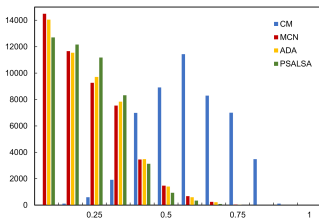
Result: Global Bias



- pseudo F: increased by all, but **no acceleration**
 - modularity: increased by all
 - **MCN**, **ADA**: acceleration
 - **pSalsa**, **CM**: no acceleration
- ↑ link-based method

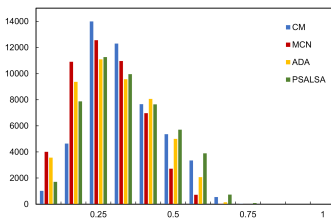
Result: Local Bias

Local Content Bias



Larger means more bias

Local Link Bias



Smaller means more bias

- Local content bias:
 - CM dominates
 - pSalsa produces modest bias than MCN, ADA
- Local link bias:
 - pSalsa produces less even than CM

Interesting findings:

- pseudo F
increased by all, but no acceleration
- modularity
no acceleration by a link-based pSalsa
- local content bias
pSalsa produces modest bias more often than MCN, ADA
- local link bias
a link-based pSalsa produces less than CM