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► **To cite this version:**

Ali Yassin, Hocine Cherifi, Hamida Seba, Olivier Togni. An Empirical Investigation of Statistical Backbone Filtering Techniques. Conference on Complex Systems, Oct 2022, Palma de Mallorca, Spain. hal-04321035

**HAL Id: hal-04321035**

**<https://hal.science/hal-04321035>**

Submitted on 4 Dec 2023

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# An Empirical Investigation of Statistical Backbone Filtering Techniques

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## What is a Network Backbone?

Filtering Noise?  
Preserving Topological Properties?

**No Universal Definition!**

## Types of Backbone Filtering Techniques

1. Structural Backbone Filtering Techniques.
2. Statistical Backbone Filtering Techniques.

## Statistical Backbone Filtering Techniques

- **Noise Corrected Filter**

edge weights are drawn from a *binomial distribution*. However, it estimates the probability of observing a weight connecting two nodes using a Bayesian framework.

- **Marginal Likelihood Filter**

each unit edge randomly chooses two nodes, which results in a *binomial distribution*.

- **ECM Filter**

Employs a null model based on the *canonical maximum-entropy ensemble* of weighted networks having the same degree and strength distribution as the original network.

- **LANS Filter**

Employs the *empirical cumulative density function* to judge statistical significance.

- **Disparity Filter**

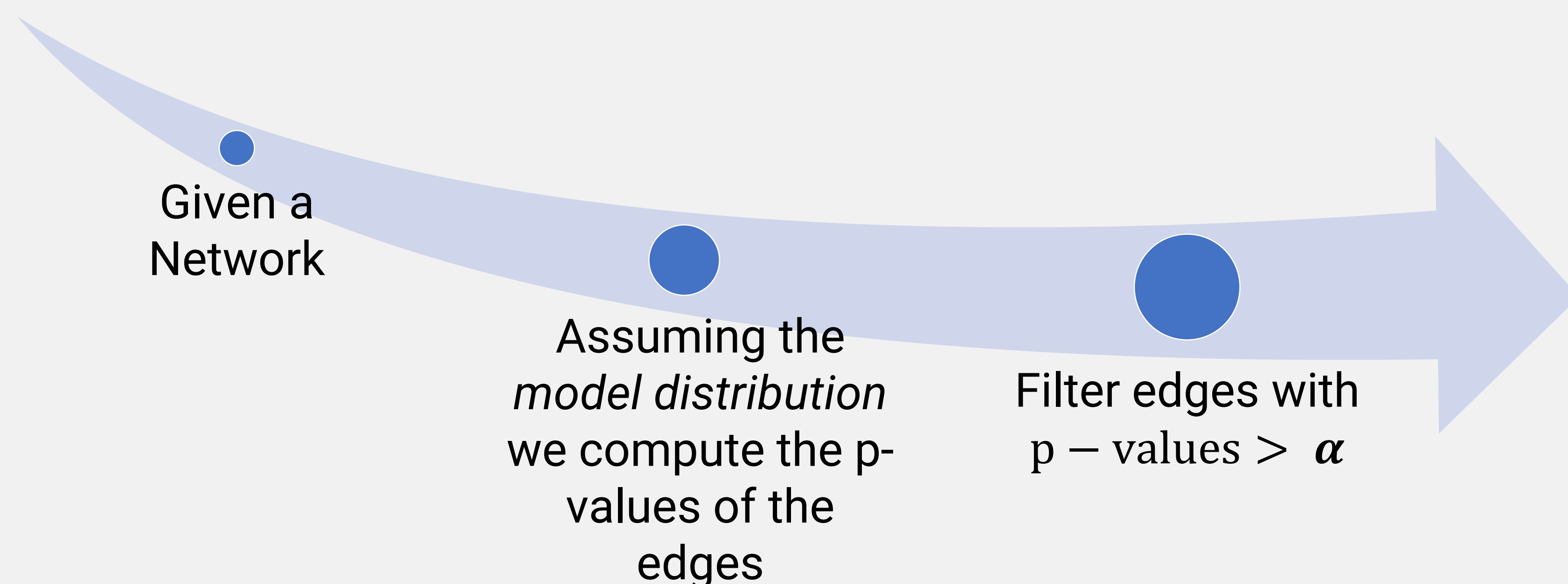
a node distributes its strength (summation of weights) *uniformly* on the edges.

- **Polya Urn Filter**

a node distributes its strength at random through a Polya process, which results in a *Beta-binomial distribution*.

- **GloSS Filter**

edge weights are randomly drawn from the *empirical weight distribution*.



Worldwide Air Transportation Network



Noise Corrected Filter



Marginal Likelihood Filter



ECM Filter



LANS Filter



Disparity Filter



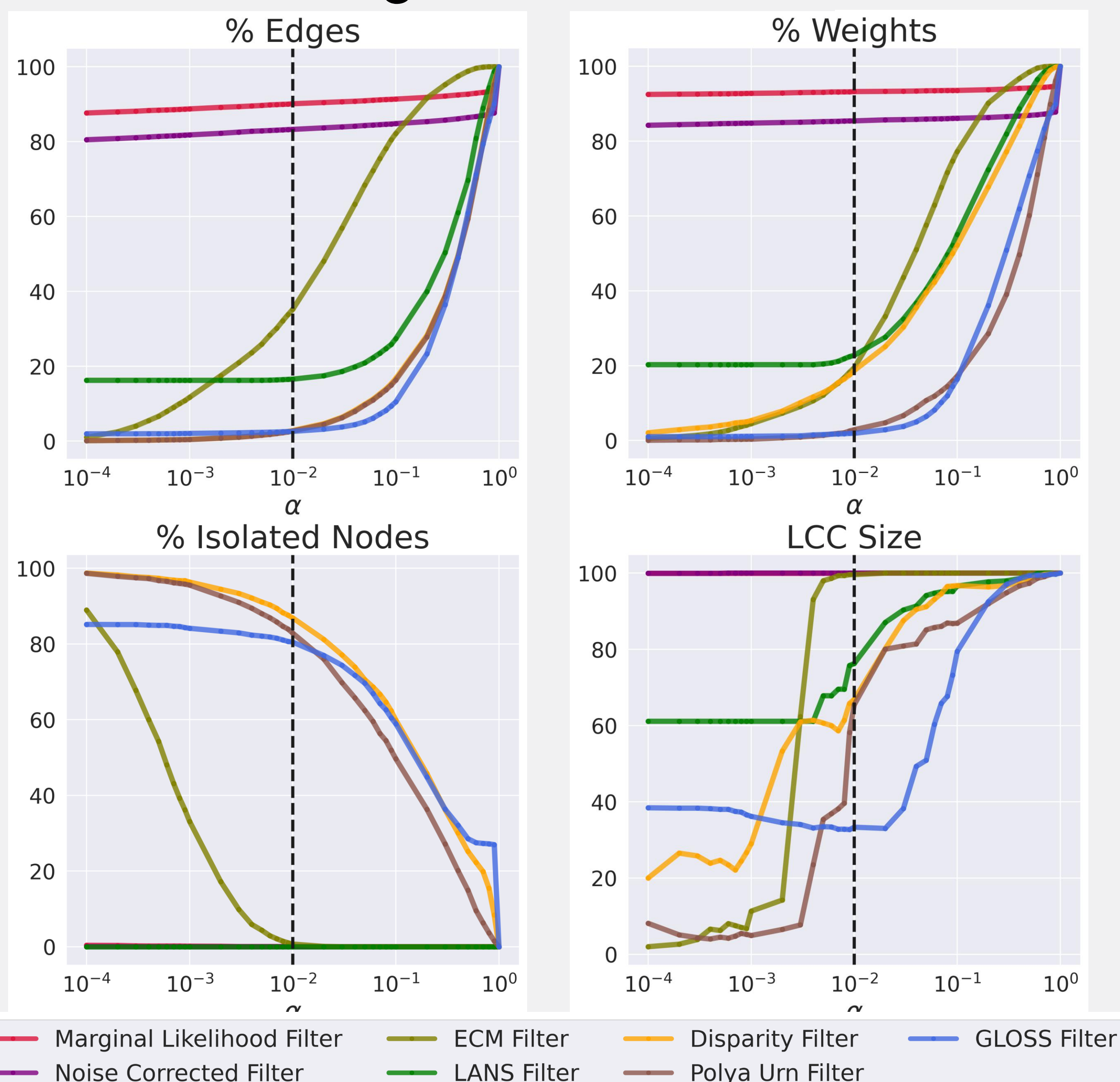
Polya Urn Filter



GloSS Filter



## Evaluation Using Four Indicators



## Conclusion

Filter	Technique Behavior	Giant Component	Isolated Nodes	Weights Retained
Marginal Likelihood	Conservative	Always	Low	High
Noise Corrected	Conservative	Always	Low	Small & High
ECM	Flexible	$\alpha > 10^{-2}$	$\alpha < 10^{-2}$	Small & High
LANS	Aggressive	Always	Low	High
Disparity	Aggressive	$\alpha > 10^{-2}$	High	High
Polya Urn	Aggressive	$\alpha > 10^{-2}$	High	Small & High
GloSS	Aggressive	$\alpha > 10^{-2}$	High	Small & High

**What about the distributions?**