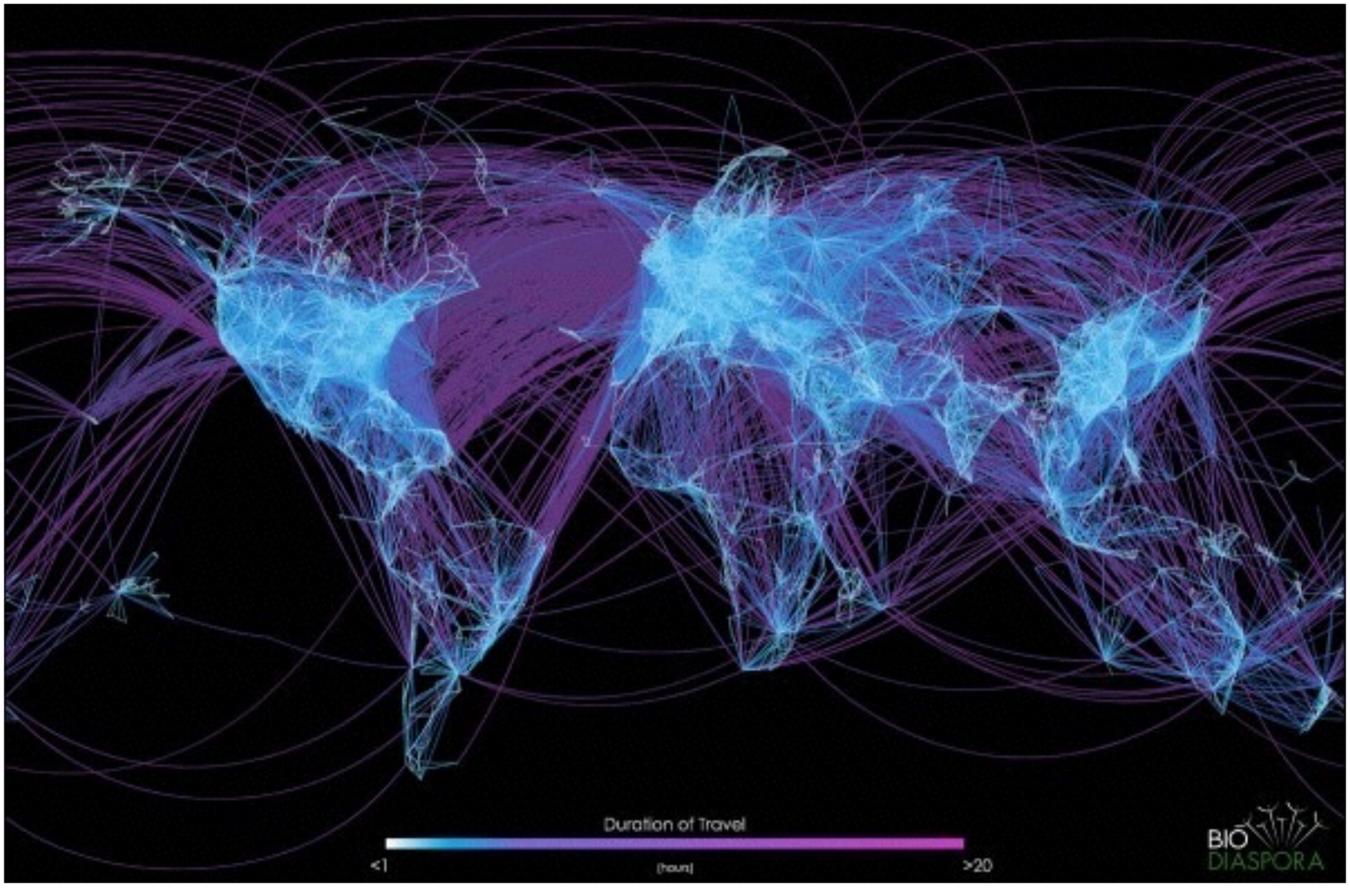
Network inference in the presence of latent confounders: The role of instantaneous causalities

Helen Shiells
ICSMB, University of Aberdeen
r01hcs14@abdn.ac.uk

Direct Measurement



http://www.visualisingdata.com/blog/wp-content/uploads/2012/02/World_FlightLines_BioDiaspora-600x393.jpg

Indirect Measurement

http://www.geneticsandsociety.org/article.php?id=8177

EEG

http://recherche.parisdescartes.fr/LaboratoireMemoireCognition_esl/Moyens-Techniques/EEG-Platform

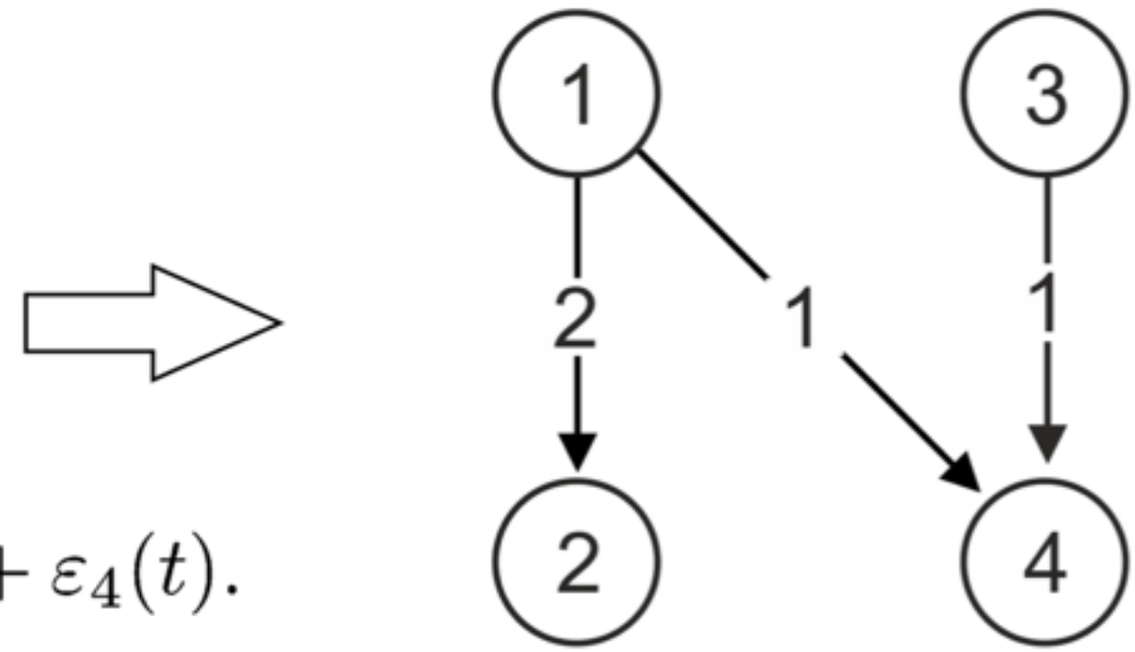
Vector Autoregressive (VAR) Model

$$X_1(t) = \varepsilon_1(t)$$

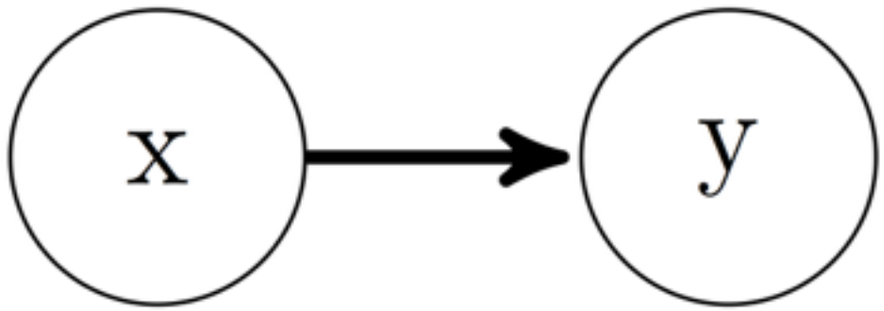
$$X_2(t) = \alpha\, X_1(t-2) + \varepsilon_2(t)$$

$$X_3(t) = \varepsilon_3(t)$$

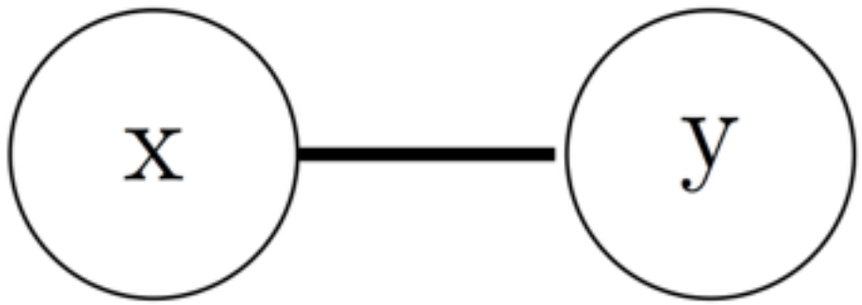
$$X_4(t) = \beta\, X_1(t-1) + \gamma\, X_3(t-1) + \varepsilon_4(t).$$



Inferring Influence Between Time Series



<u>Detected using:</u>
Renormalised partial directed coherence (rPDC)

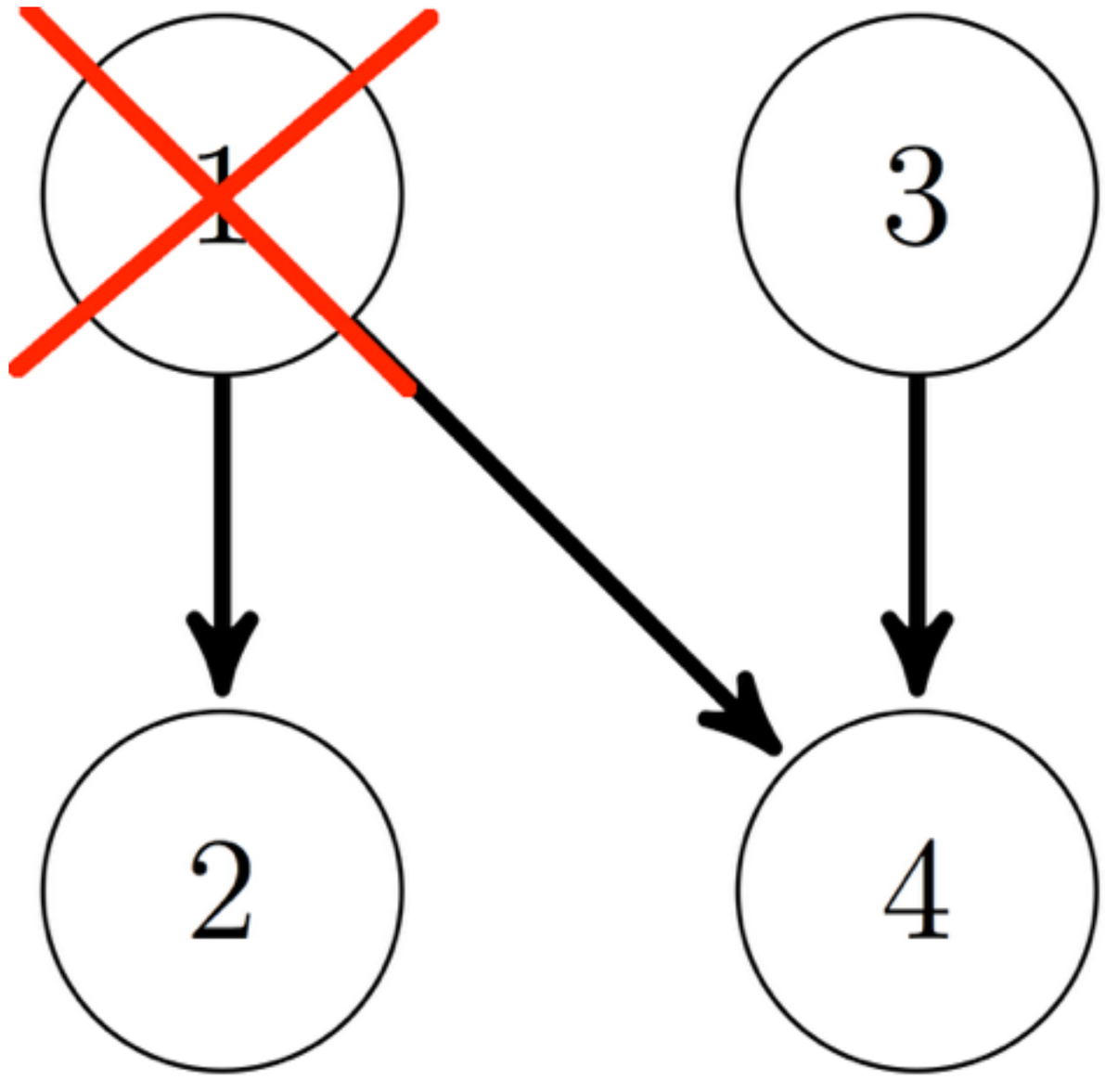


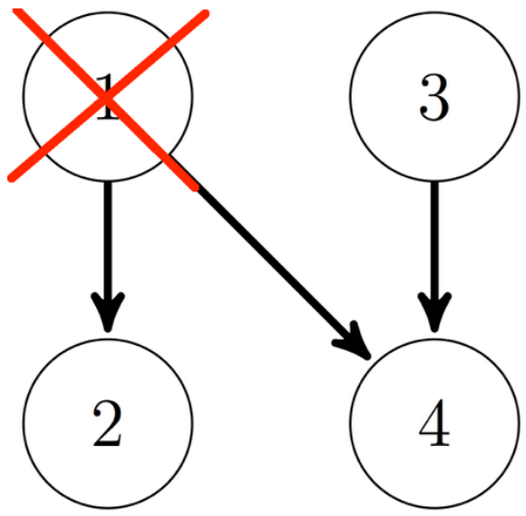
<u>Detected using:</u>
Inverse of the partial covariance matrix of the noise

Granger Causality

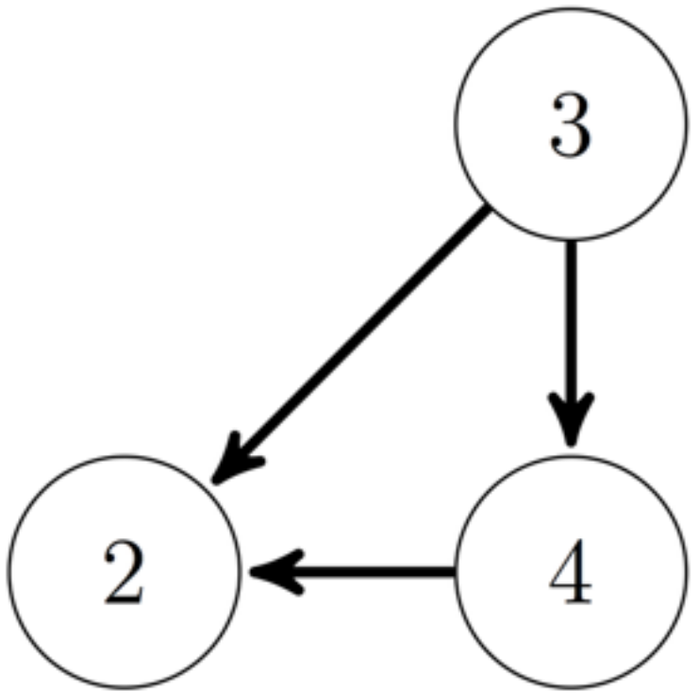
- In this instance causality = Granger causality.
- Causes will always precede their effects in time.
- Granger presented his idea independently of a model.

Creating a Latent Confounder

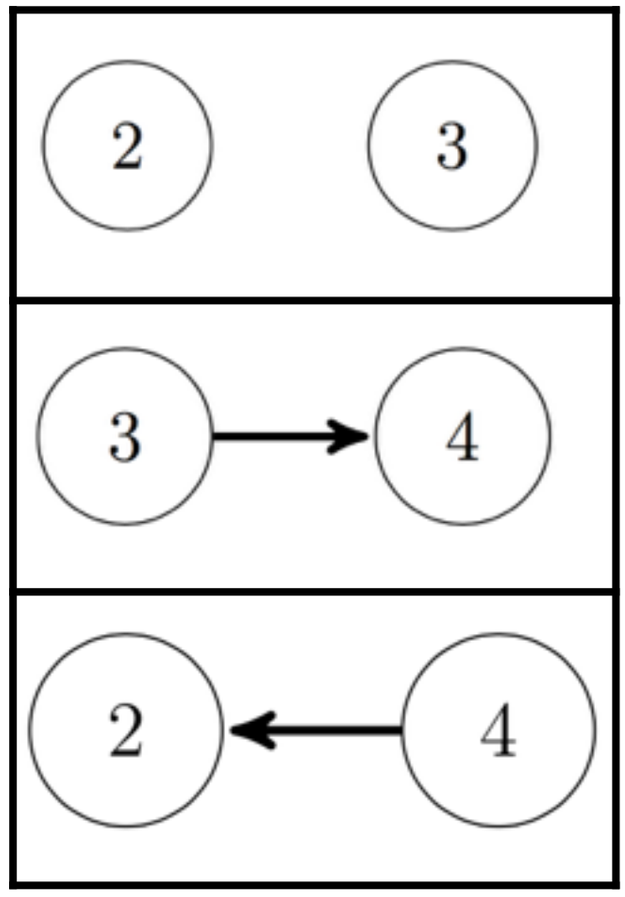




Measured Sub-Systems

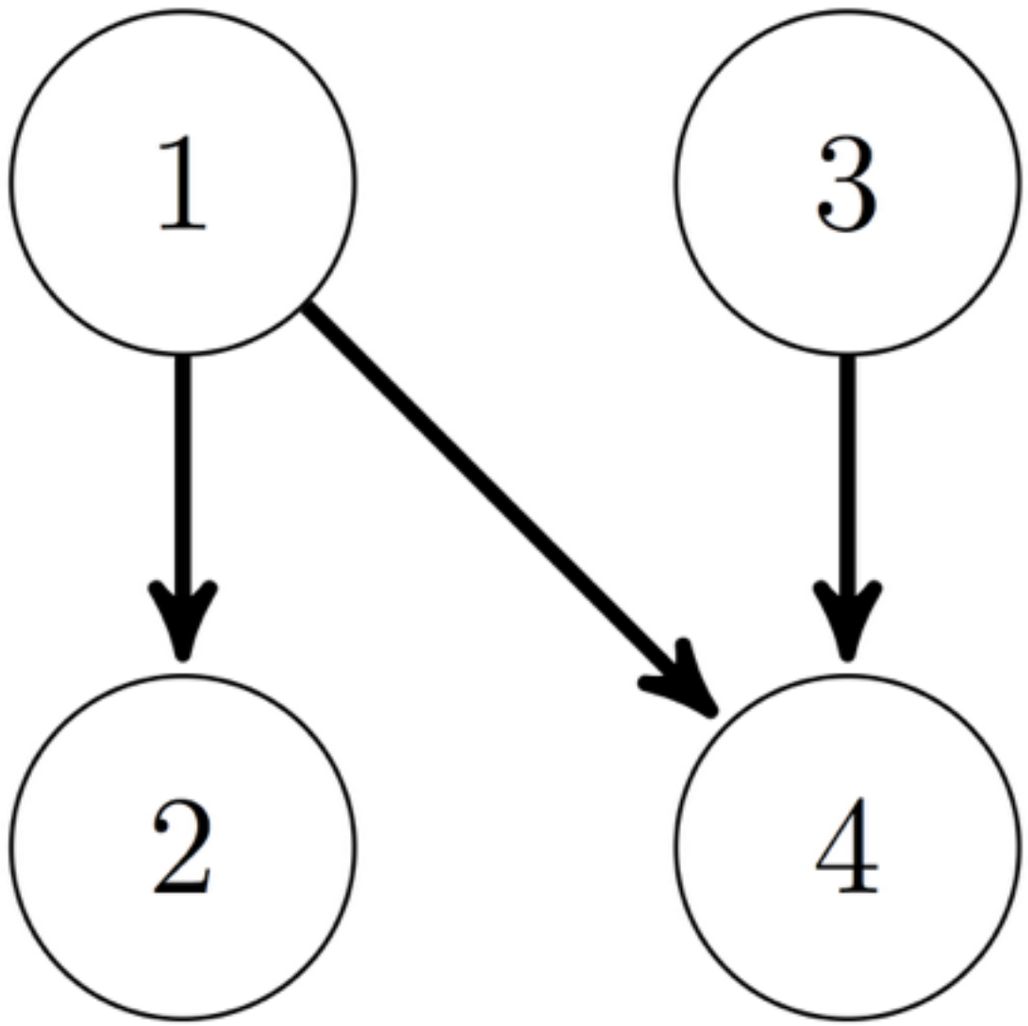


3-D observed network

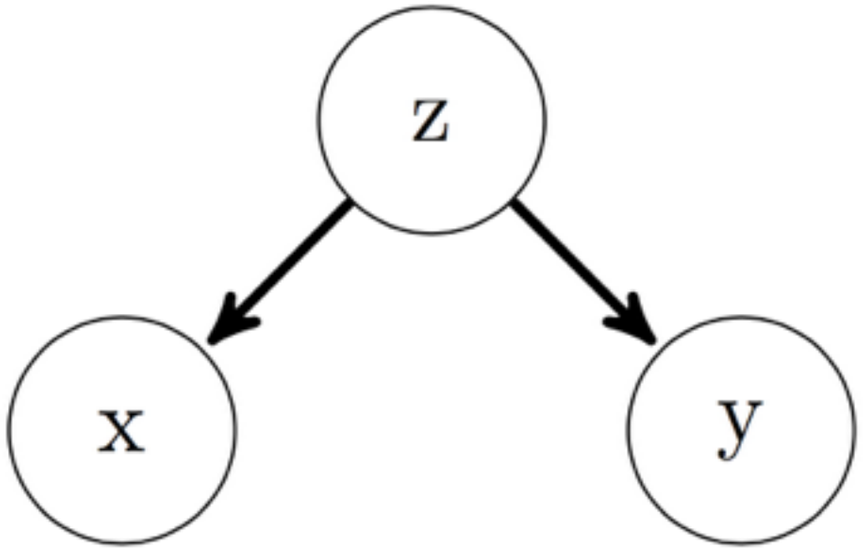


2-D sub-networks

Reconstructed Network

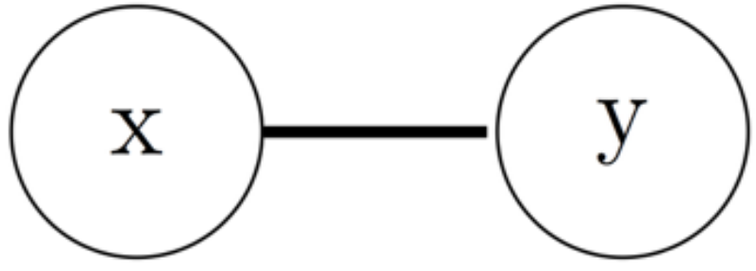


Latent Confounder or Volume Conduction?



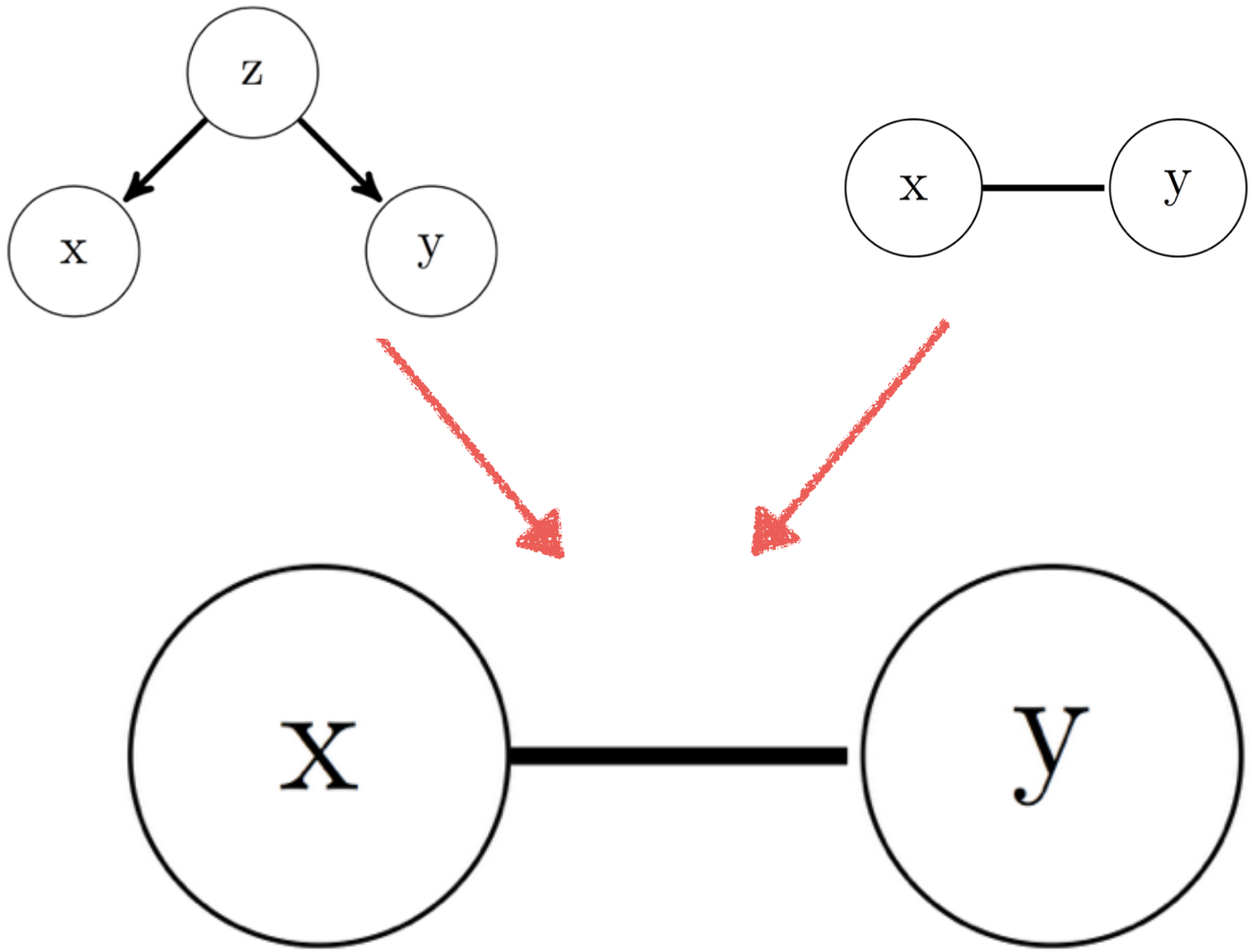
Latent Confounder

OR

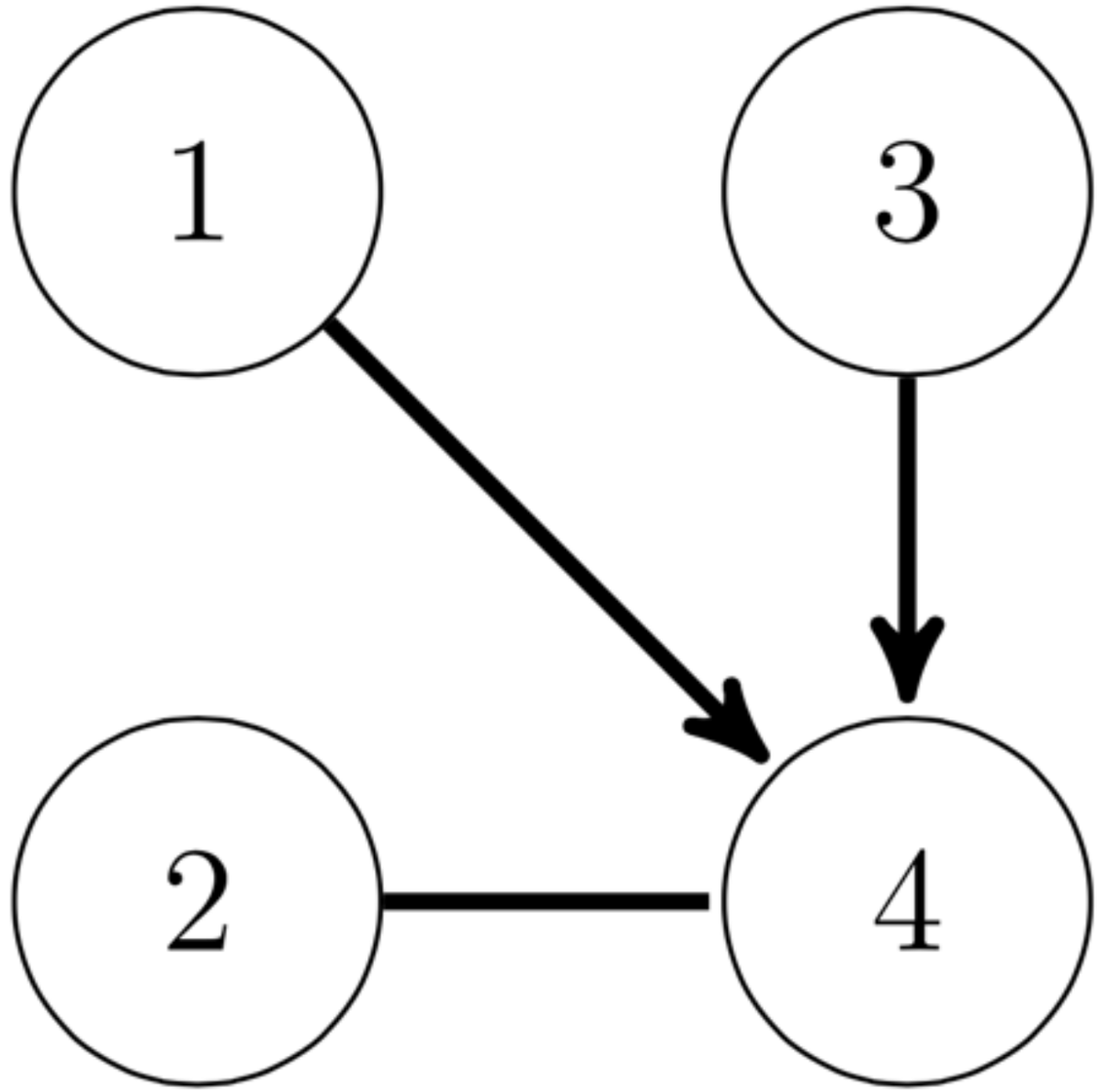


Volume Conduction

Latent Confounder or Volume Conduction?



Crucial Links for Reconstruction



Conclusion

- The inverse of the partial covariance of the noise contains information about instantaneous interactions.

- In some case complete network reconstruction is possible.

- Our novel approach allows us, for the first time, to identify between volume conduction and latent confounders.