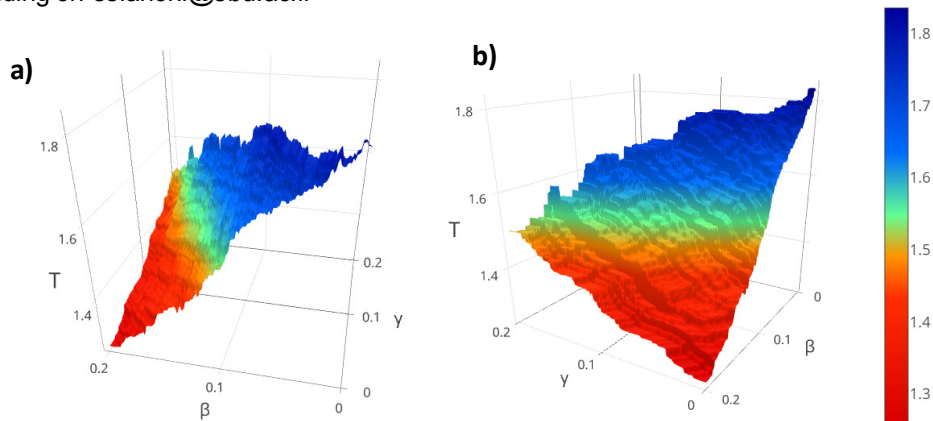


# Discovering overlapped protein complexes from weighted PPI networks by removing inter-module hubs

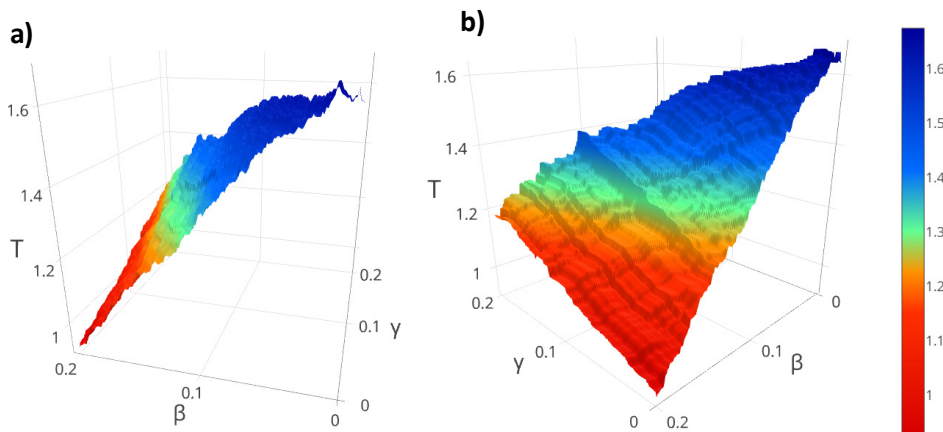
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<sup>1</sup>Department of Electrical and computer Engineering, Isfahan University of Technology, Isfahan, 1983963113, Iran., <sup>2</sup>Department of Computer Sciences, Faculty of Mathematics, Shahid Beheshti University, Tehran, 1983963113, Iran., <sup>3</sup>School of Biological Sciences, Institute for Research in Fundamental Sciences (IPM), Tehran, 193955746, Iran.

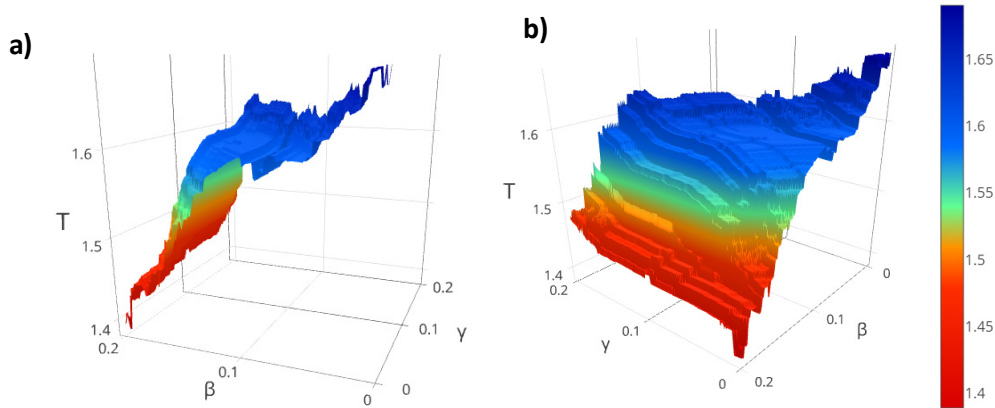
\*corresponding ch-eslahchi@sbu.ac.ir



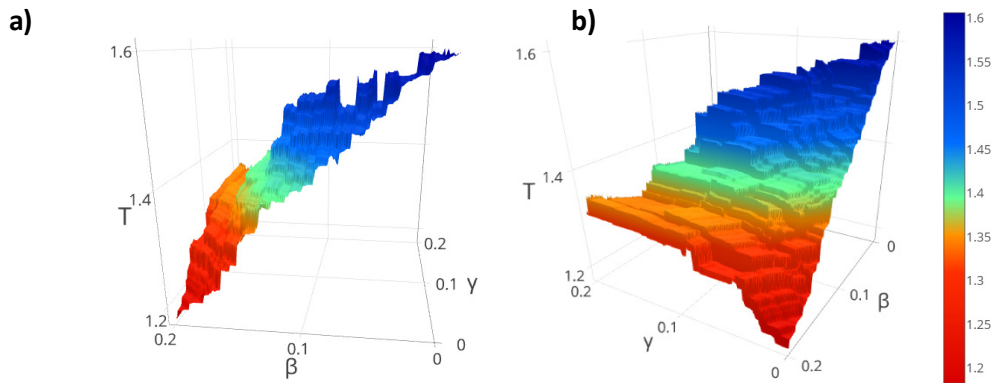
**Supplementary Figure 1. Performance of IMHRC for the different values of  $\beta$  and  $\gamma$  on the Krogan Core dataset and the SGD gold standard.** The  $\beta$  and  $\gamma$  axes indicate the number of hubs that have been removed and put back, respectively. The T axis specifies the performance of method. a) Side view of surface is shown in this figure. b) Front view of surface is shown in this figure.



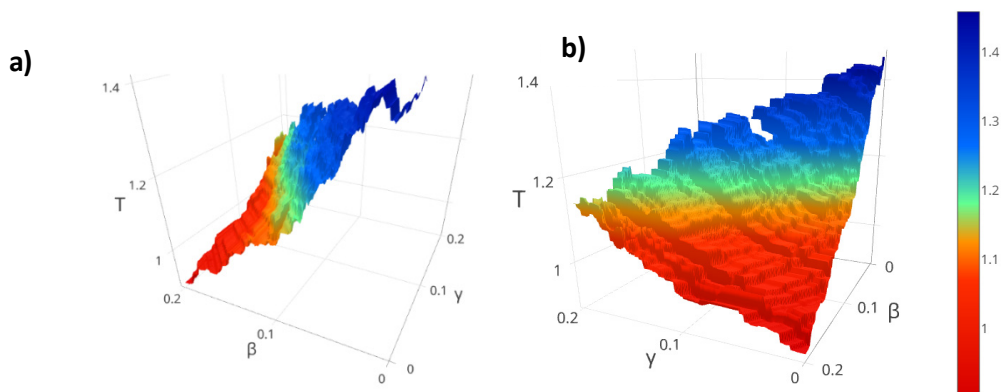
**Supplementary Figure 2. Performance of IMHRC for the different values of  $\beta$  and  $\gamma$  on the Krogan Extended dataset and the SGD gold standard.** The  $\beta$  and  $\gamma$  axes indicate the number of hubs that have been removed and put back, respectively. The T axis specifies the performance of method. a) Side view of surface is shown in this figure. b) Front view of surface is shown in this figure.



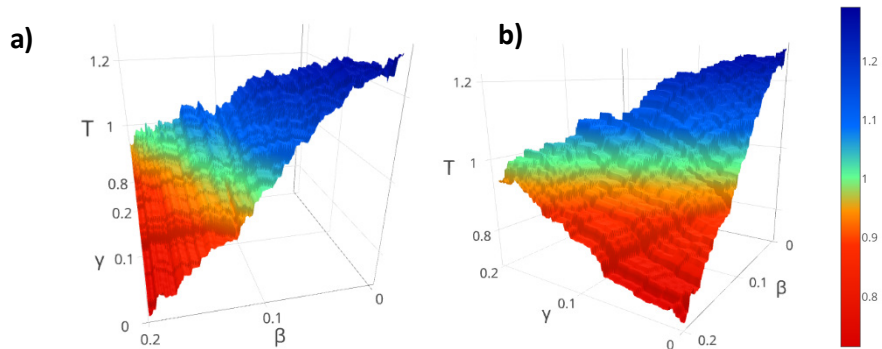
**Supplementary Figure 3. Performance of IMHRC for the different values of  $\beta$  and  $\gamma$  on the Collins dataset and the MIPS gold standard.** The  $\beta$  and  $\gamma$  axes indicate the number of hubs that have been removed and put back, respectively. The  $T$  axis specifies the performance of method. a) Side view of surface is shown in this figure. b) Front view of surface is shown in this figure.



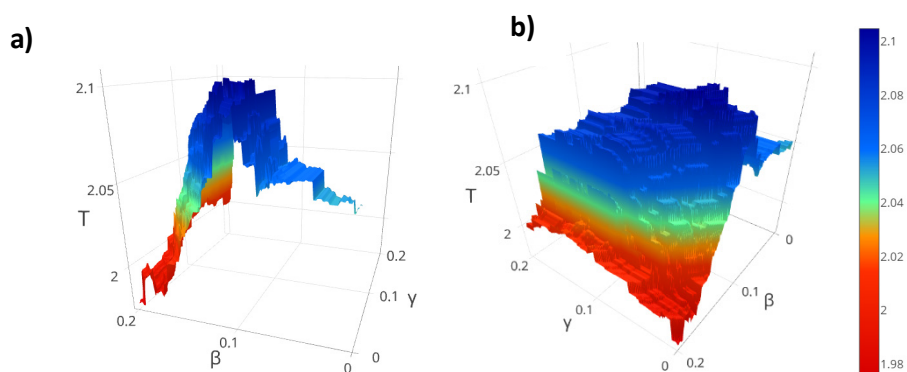
**Supplementary Figure 4. Performance of IMHRC for the different values of  $\beta$  and  $\gamma$  on the Gavin dataset and the MIPS gold standard.** The  $\beta$  and  $\gamma$  axes indicate the number of hubs that have been removed and put back, respectively. The  $T$  axis specifies the performance of method. a) Side view of surface is shown in this figure. b) Front view of surface is shown in this figure.



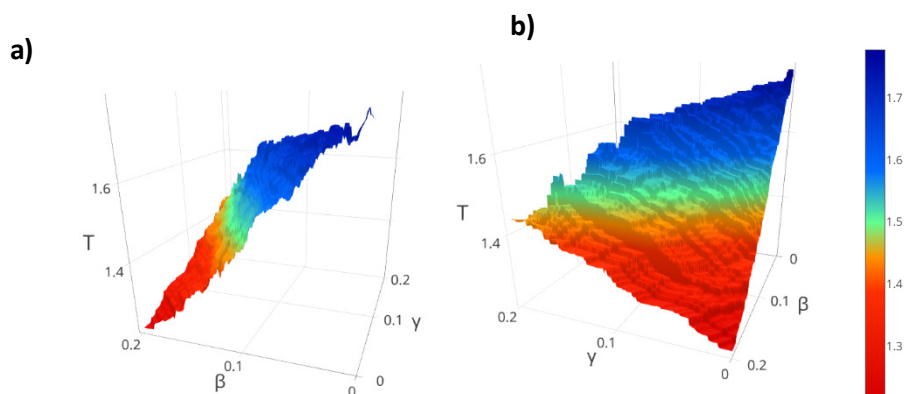
**Supplementary Figure 5. Performance of IMHRC for the different values of  $\beta$  and  $\gamma$  on the Krogan Core dataset and the MIPS gold standard.** The  $\beta$  and  $\gamma$  axes indicate the number of hubs that have been removed and put back, respectively. The  $T$  axis specifies the performance of method. a) Side view of surface is shown in this figure. b) Front view of surface is shown in this figure.



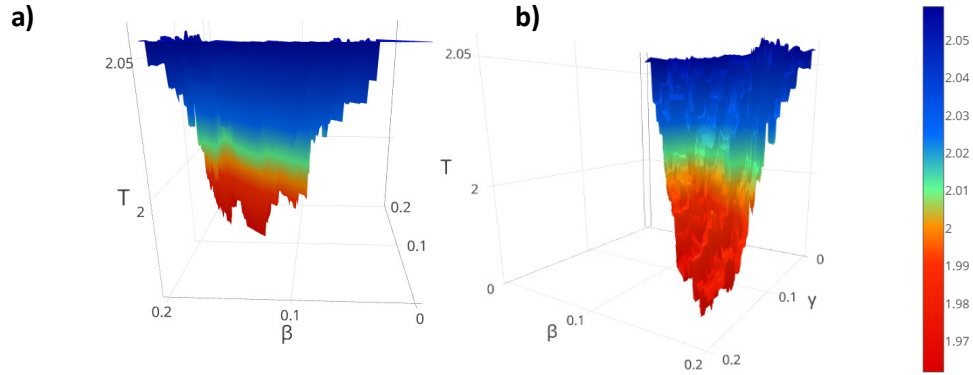
**Supplementary Figure 6. Performance of IMHRC for the different values of  $\beta$  and  $\gamma$  on the Krogan Extended dataset and the MIPS gold standard.** The  $\beta$  and  $\gamma$  axes indicate the number of hubs that have been removed and put back, respectively. The T axis specifies the performance of method. a) Side view of surface is shown in this figure. b) Front view of surface is shown in this figure.



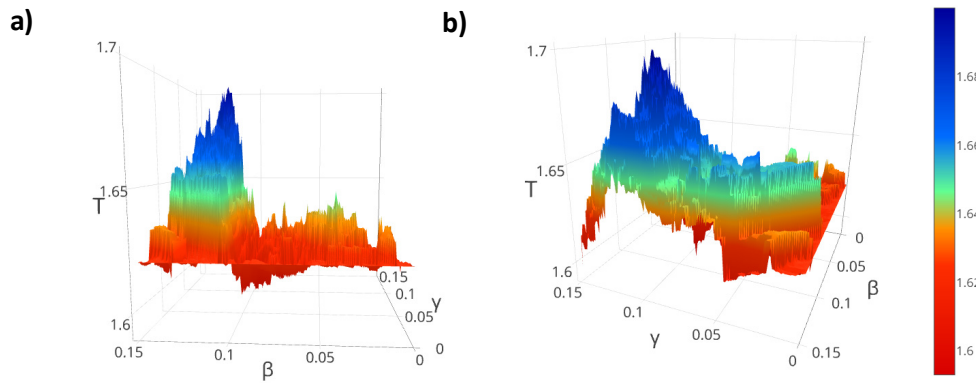
**Supplementary Figure 7. Performance of ClusterONE for the different values of  $\beta$  and  $\gamma$  on the Collins dataset and the SGD gold standard.** The  $\beta$  and  $\gamma$  axes indicate the number of hubs that have been removed and put back, respectively. The T axis specifies the performance of method. a) Side view of surface is shown in this figure. b) Front view of surface is shown in this figure.



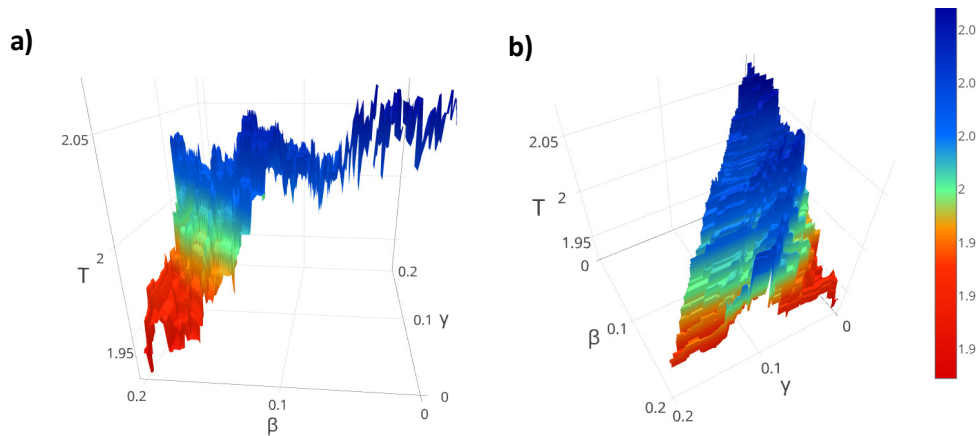
**Supplementary Figure 8. Performance of ClusterONE for the different values of  $\beta$  and  $\gamma$  on the Krogan Core dataset and the SGD gold standard.** The  $\beta$  and  $\gamma$  axes indicate the number of hubs that have been removed and put back, respectively. The T axis specifies the performance of method. a) Side view of surface is shown in this figure. b) Front view of surface is shown in this figure.



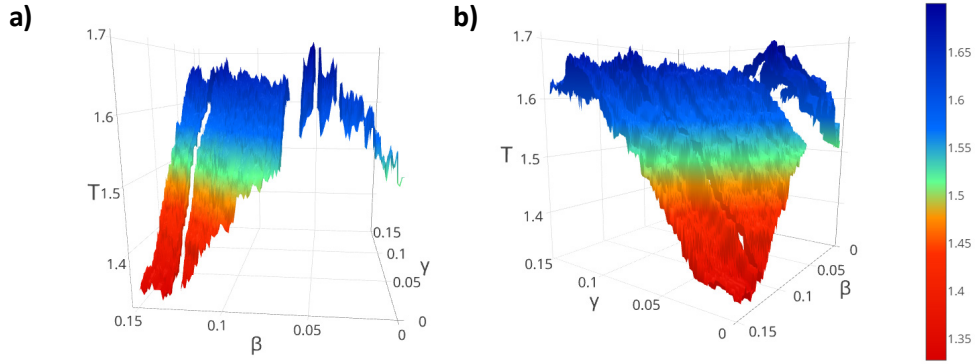
**Supplementary Figure 9. Performance of MCL for the different values of  $\beta$  and  $\gamma$  on the Collins dataset and the SGD gold standard.** The  $\beta$  and  $\gamma$  axes indicate the number of hubs that have been removed and put back, respectively. The T axis specifies the performance of method. a) Side view of surface is shown in this figure. b) Another side view of surface is shown in this figure.



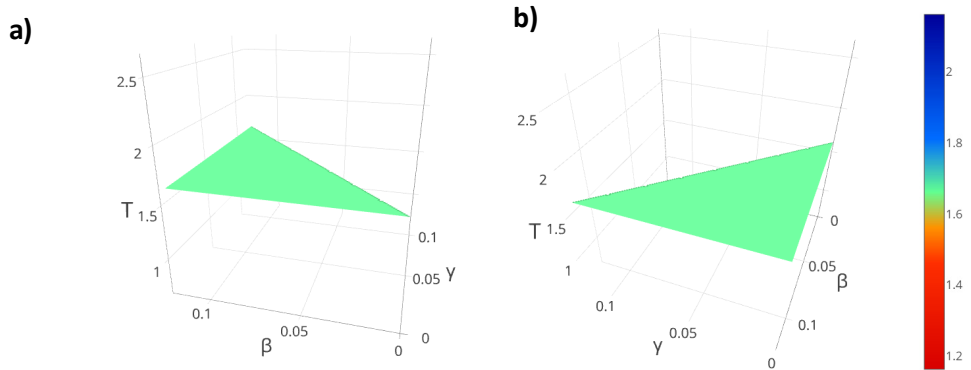
**Supplementary Figure 10. Performance of MCL for the different values of  $\beta$  and  $\gamma$  on the Krogan Core dataset and the SGD gold standard.** The  $\beta$  and  $\gamma$  axes indicate the number of hubs that have been removed and put back, respectively. The T axis specifies the performance of method. a) Side view of surface is shown in this figure. b) Front view of surface is shown in this figure.



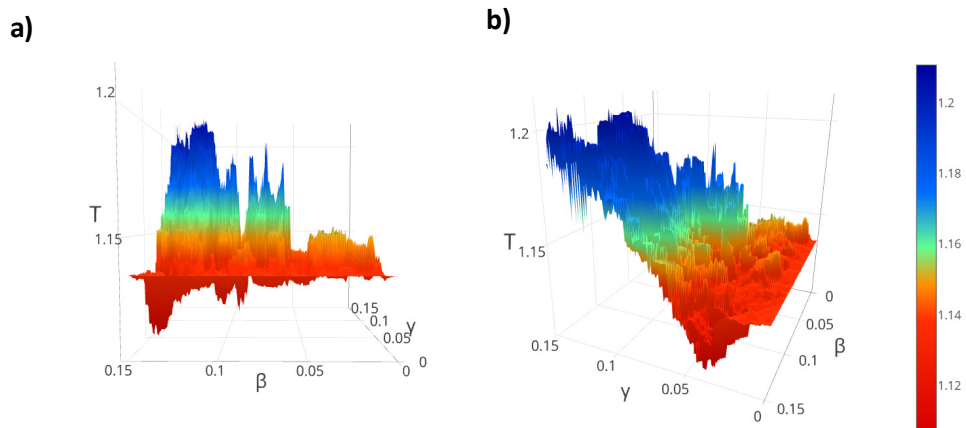
**Supplementary Figure 11. Performance of AP for the different values of  $\beta$  and  $\gamma$  on the Collins dataset and the SGD gold standard.** The  $\beta$  and  $\gamma$  axes indicate the number of hubs that have been removed and put back, respectively. The T axis specifies the performance of method. a) Side view of surface is shown in this figure. b) Front view of surface is shown in this figure.



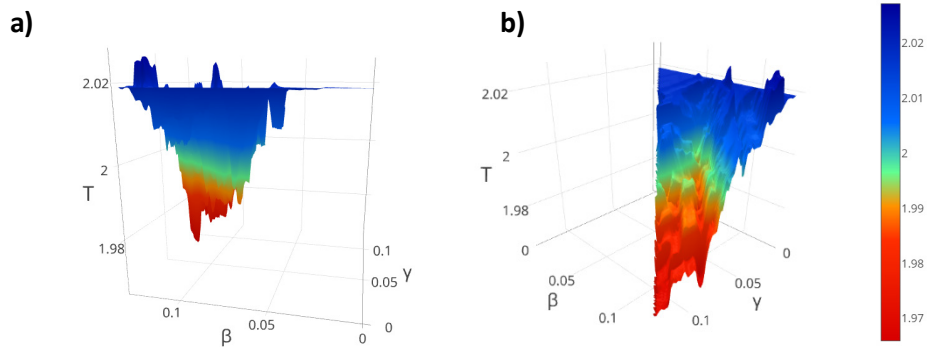
**Supplementary Figure 12. Performance of AP for the different values of  $\beta$  and  $\gamma$  on the Krogan Core dataset and the SGD gold standard.** The  $\beta$  and  $\gamma$  axes indicate the number of hubs that have been removed and put back, respectively. The T axis specifies the performance of method. a) Side view of surface is shown in this figure. b) Front view of surface is shown in this figure.



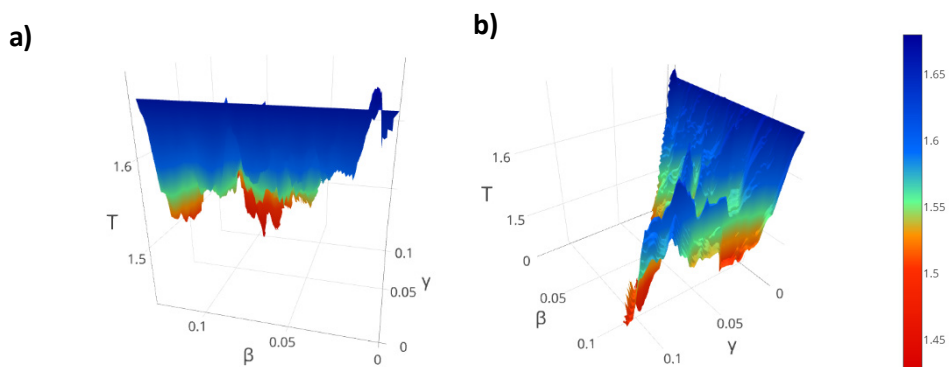
**Supplementary Figure 13. Performance of CFinder for the different values of  $\beta$  and  $\gamma$  on the Collins dataset and the SGD gold standard.** The  $\beta$  and  $\gamma$  axes indicate the number of hubs that have been removed and put back, respectively. The T axis specifies the performance of method. a) Side view of surface is shown in this figure. b) Front view of surface is shown in this figure.



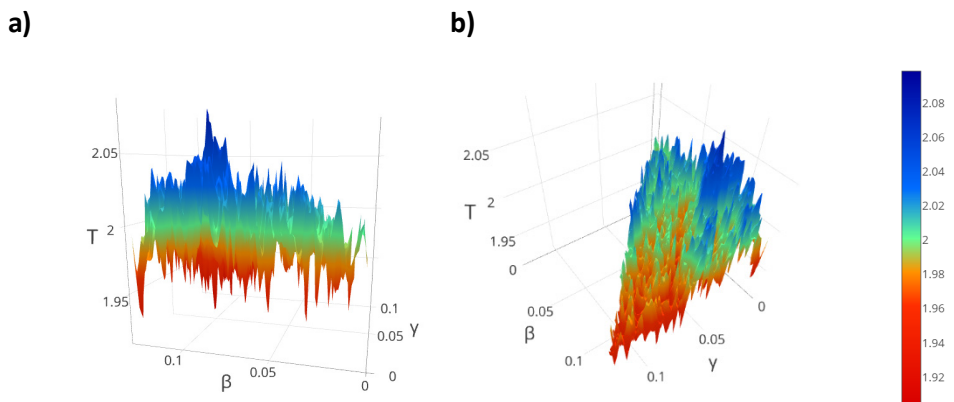
**Supplementary Figure 14. Performance of CFinder for the different values of  $\beta$  and  $\gamma$  on the Krogan Core dataset and the SGD gold standard.** The  $\beta$  and  $\gamma$  axes indicate the number of hubs that have been removed and put back, respectively. The T axis specifies the performance of method. a) Side view of surface is shown in this figure. b) Front view of surface is shown in this figure.



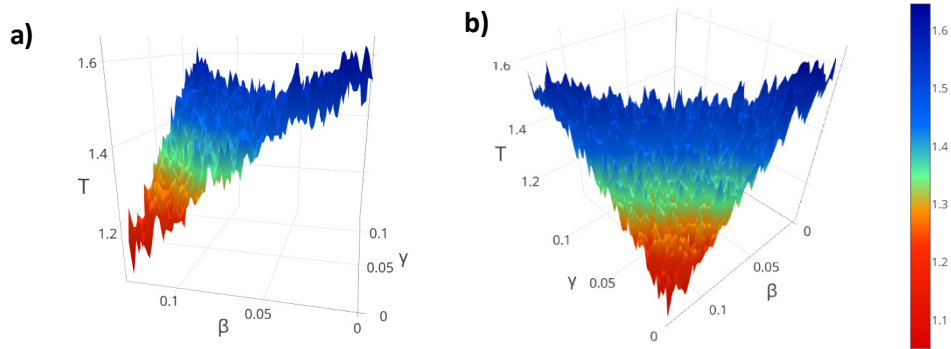
**Supplementary Figure 15. Performance of CMC for the different values of  $\beta$  and  $\gamma$  on the Collins dataset and the SGD gold standard.** The  $\beta$  and  $\gamma$  axes indicate the number of hubs that have been removed and put back, respectively. The  $T$  axis specifies the performance of method. a) Side view of surface is shown in this figure. b) Front view of surface is shown in this figure.



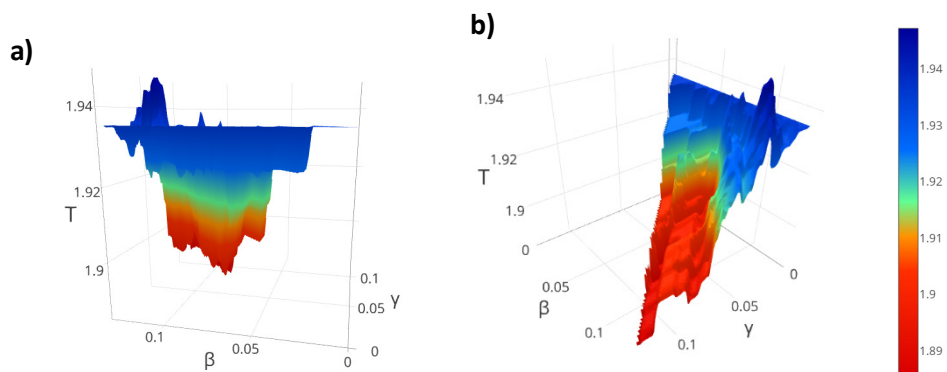
**Supplementary Figure 16. Performance of CMC for the different values of  $\beta$  and  $\gamma$  on the Krogan Core dataset and the SGD gold standard.** The  $\beta$  and  $\gamma$  axes indicate the number of hubs that have been removed and put back, respectively. The  $T$  axis specifies the performance of method. a) Side view of surface is shown in this figure. b) Front view of surface is shown in this figure.



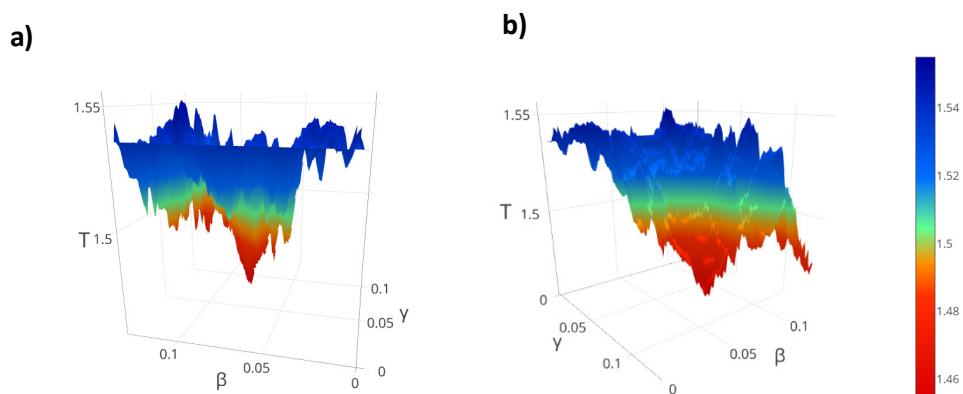
**Supplementary Figure 17. Performance of RNSC for the different values of  $\beta$  and  $\gamma$  on the Collins dataset and the SGD gold standard.** The  $\beta$  and  $\gamma$  axes indicate the number of hubs that have been removed and put back, respectively. The  $T$  axis specifies the performance of method. a) Side view of surface is shown in this figure. b) Front view of surface is shown in this figure.



**Supplementary Figure 18. Performance of RNSC for the different values of  $\beta$  and  $\gamma$  on the Krogan Core dataset and the SGD gold standard.** The  $\beta$  and  $\gamma$  axes indicate the number of hubs that have been removed and put back, respectively. The T axis specifies the performance of method. a) Side view of surface is shown in this figure. b) Front view of surface is shown in this figure.



**Supplementary Figure 19. Performance of RRW for the different values of  $\beta$  and  $\gamma$  on the Collins dataset and the SGD gold standard.** The  $\beta$  and  $\gamma$  axes indicate the number of hubs that have been removed and put back, respectively. The T axis specifies the performance of method. a) Side view of surface is shown in this figure. b) Front view of surface is shown in this figure.



**Supplementary Figure 20. Performance of RRW for the different values of  $\beta$  and  $\gamma$  on the Krogan Core dataset and the SGD gold standard.** The  $\beta$  and  $\gamma$  axes indicate the number of hubs that have been removed and put back, respectively. The T axis specifies the performance of method. a) Side view of surface is shown in this figure. b) Another side view of surface is shown in this figure.