Current Trends in Computational Modelling of Collective Behaviour: List of papers

Digital semester coordinates:
Tuesdays 15:15-16:45
Access link: https://bbb.uni-konstanz.de/b/tat-2tt-gux

Class schedule (to be updated):

Class	Date	Presenter	Contents	Presenter	Scribe
1	21.04.20	Instructors	General info about the course The first two speakers have chosen the papers.		
2	28.4.		**No meeting**		
3	5.5.		**Everyone has sent three papers of choice** Tanja: S(E)IR models with homogeneous spatial distribution - simulation and inference		
4	12.5.		**The final schedule is announced** Jacob: S(E)IR models over networks Stefano: spreading processes over multi-layered networks and centrality notions		
5	19.5.	Paper	The first paper presented by a student	**A**	
6	26.5.	Paper		**A**	
7	2.6.		**No Class**	**A**	
8	9.6.	Paper			
9	16.6.	..	**Feedback**		
10	23.6.	..			
11	30.6.	..			
12	07.07	No class	No class / answer questions about proposals		
13	14.07.		Proposal presentations and feedback **Proposal report is due** Summary, Feedback		

Course literature:

A pool of papers, focusing on computational modelling of spreading processes in collectives, such as epidemics. We broadly divide the papers into theoretical/model-driven (e.g. simulation, model reduction, parameter inference), experimental/data-driven (e.g. prediction and forecasting, quantitative behaviour classification via tracking, behavioural decomposition, hypothesis testing via experimental perturbations), and review papers.

Legend:

Yellow: This paper was presented during the Winter semester 2019/20
Blue: This paper was presented during the Summer Semester 2019

1. Model-driven/Theory

1. Wei, Xuetao & Valler, Nicholas & Prakash, B. & Neamtiu, Iulian & Faloutsos, Michalis & Faloutsos, Christos. (2012). Competing Memes Propagation on Networks: A Case Study of Composite Networks. ACM SIGCOMM Computer Communication Review. 42. 5-11.
2. Adam, David. "Special report: The simulations driving the world's response to COVID-19." *Nature* (2020).

   - an overview of papers for modelling the spread of Covid-19. Relevant references contained:
   a. Ferguson, N. M., et al. "Impact of non-pharmaceutical interventions (NPIs) to reduce COVID-19 mortality and healthcare demand. Imperial College COVID-19 Response Team." (2020). (epidemiological modeling paper)
   b. Ferguson, N.M., Cummings, D.A.T., Cauchemez, S., Fraser, C., Riley, S., Meeyai, A., Iamsirithaworn, S., Burke, D.S., 2005. Strategies for containing an emerging influenza pandemic in Southeast Asia. Nature 437, 209–214. https://doi.org/10.1038/nature04017
   c. Ferguson, N.M., Cummings, D.A.T., Fraser, C., Cajka, J.C., Cooley, P.C., Burke, D.S., 2006. Strategies for mitigating an influenza pandemic. Nature 442, 448–452. https://doi.org/10.1038/nature04795
   d. Flaxman, S., et al. 2020. Report 13: Estimating the number of infections and the impact of non-pharmaceutical interventions on COVID-19 in 11 European countries (Report), 35. https://doi.org/10.25561/77731
   e. Funk, S., Camacho, A., Kucharski, A.J., Lowe, R., Eggo, R.M., Edmunds, W.J., 2019. Assessing the performance of real-time epidemic forecasts: A case study of Ebola in the Western Area region of Sierra Leone, 2014-15. PLOS Computational Biology 15, e1006785. https://doi.org/10.1371/journal.pcbi.1006785
   f. Klepac, P., Kucharski, A.J., Conlan, A.J., Kissler, S., Tang, M., Fry, H., Gog, J.R., 2020. Contacts in context: large-scale setting-specific social mixing matrices from the BBC Pandemic project. medRxiv 2020.02.16.20023754. https://doi.org/10.1101/2020.02.16.20023754

g. Lourenco, J., Paton, R., Ghafari, M., Kraemer, M., Thompson, C., Simmonds, P., Klenerman, P., Gupta, S., 2020. Fundamental principles of epidemic spread highlight the immediate need for large-scale serological surveys to assess the stage of the SARS-CoV-2 epidemic. medRxiv 2020.03.24.20042291. https://doi.org/10.1101/2020.03.24.20042291
h. Prem, K., Liu, Y., Russell, T.W., Kucharski, A.J., Eggo, R.M., Davies, N., Flasche, S., Clifford, S., Pearson, C.A.B., Munday, J.D., Abbott, S., Gibbs, H., Rosello, A., Quilty, B.J., Jombart, T., Sun, F., Diamond, C., Gimma, A., Zandvoort, K. van, Funk, S., Jarvis, C.I., Edmunds, W.J., Bosse, N.I., Hellewell, J., Jit, M., Klepac, P., 2020. The effect of control strategies to reduce social mixing on outcomes of the COVID-19 epidemic in Wuhan, China: a modelling study. The Lancet Public Health 0. https://doi.org/10.1016/S2468-2667(20)30073-6
i. Walker, P.G., Whittaker, C., Watson, O., Baguelin, M., Ainslie, K.E.C., Bhatia, S., Bhatt, S., Boonyasiri, A., Boyd, O., Cattarino, L., 2020. The global impact of COVID-19 and strategies for mitigation and suppression. WHO Collaborating Centre for Infectious Disease Modelling, MRC Centre for Global Infectious Disease Analysis, Abdul Latif Jameel Institute for Disease and Emergency Analytics, Imperial College London.
j. Zhang, J., Litvinova, M., Liang, Y., Wang, Y., Wang, W., Zhao, S., Wu, Q., Merler, S., Viboud, C., Vespignani, A., Ajelli, M., Yu, H., 2020. Age profile of susceptibility, mixing, and social distancing shape the dynamics of the novel coronavirus disease 2019 outbreak in China. medRxiv 2020.03.19.20039107. https://doi.org/10.1101/2020.03.19.20039107

3. Kissler, S.M., Tedijanto, C., Goldstein, E., Grad, Y.H., Lipsitch, M., 2020. Projecting the transmission dynamics of SARS-CoV-2 through the postpandemic period. Science. https://doi.org/10.1126/science.abb5793
4. Ziff, Anna L., and Robert M. Ziff. "Fractal kinetics of COVID-19 pandemic." *medRxiv* (2020).
5. Granell, Clara & Gomez, Sergio & Arenas, Alex. (2013). Dynamical Interplay between Awareness and Epidemic Spreading in Multiplex Networks. Physical review letters. 111. 128701. 10.1103/PhysRevLett.111.128701.
6. Holme, P., 2016. Temporal network structures controlling disease spreading. Physical Review E 94. https://doi.org/10.1103/PhysRevE.94.022305
   (Considers disease spreading on time-aggregated versus temporal networks compared to static networks.)
7. Lion, S., Gandon, S., 2016. Spatial evolutionary epidemiology of spreading epidemics. Proc. R. Soc. B 283, 20161170. https://doi.org/10.1098/rspb.2016.1170 (Coupling of disease spread with movement (spatial differentiation of spread), and with pathogen evolution)
8. Pagliara, R., Leonard, N.E., 2019. Adaptive Susceptibility and Heterogeneity in Contagion Models on Networks. arXiv:1907.08829 [physics] (A model that generalizes the SI and SIR models - they call this "SIRI". Agents can have either partial immunity or compromised immunity, following infections. They show that depending on the parameter regimes there are 4 different behavioral regimes: Bistable, Endemic, Infection-free, Epidemic)

9. Sah, P., Leu, S.T., Cross, P.C., Hudson, P.J., Bansal, S., 2017. Unraveling the disease consequences and mechanisms of modular structure in animal social networks. Proceedings of the National Academy of Sciences 114, 4165–4170. https://doi.org/10.1073/pnas.1613616114
   - Construct a model to represent different animal social networks, and conclude that “lowering of disease burden in highly modular social networks is driven by two mechanisms of modular organization: net- work fragmentation and subgroup cohesion.”
10. Zhong, Y.D., Leonard, N.E., 2019. A Continuous Threshold Model of Cascade Dynamics. IEEE 6.
   - A threshold-based model of decision making, that generalizes the linear threshold model to continuous dynamics. The generalization behaves in one limit as a linear model, and the other as a threshold model.
11. Couzin, Iain D., Jens Krause, Richard James, Graeme M. Ruxton, and Nigel R. Franks. 2002. “Collective Memory and Spatial Sorting in Animal Groups.” Journal of Theoretical Biology218 (1): 1–11. https://doi.org/10.1006/jtbi.2002.3065.
12. Watts & Strogatz: Collective dynamics of small world network, 1998, https://www.nature.com/articles/30918 - a classic
13. Kao et al. Collective learning and optimal consensus decisions in animal groups, 2014 https://journals.plos.org/ploscompbiol/article?id=10.1371/journal.pcbi.1003762
14. Thomas Schelling: Dynamic models of segregation, 1971 (a classic) https://www.stat.berkeley.edu/~aldous/157/Papers/Schelling_Seg_Models.pdf
15. Mark S. Granovetter: The strength of weak ties, 1973 (another classic) https://www.cs.cmu.edu/~jure/pub/papers/granovetter73ties.pdf
16. Boutillier, Pierre, et al. "The Kappa platform for rule-based modeling." Bioinformatics 34.13 (2018): i583-i592. (modelling language based on site-graph rewriting)
17. Danos, Vincent, et al. "Rule-based modelling and model perturbation." *Transactions on Computational Systems Biology XI*. Springer, Berlin, Heidelberg, 2009. 116-137. (modelling language based on site-graph rewriting)
18. Henzinger, Thomas A., Barbara Jobstmann, and Verena Wolf. "Formalisms for specifying Markovian population models." *International Workshop on Reachability Problems*. Springer, Berlin, Heidelberg, 2009. (different syntaxes for modelling Markovian population models, emphasises the importance of choice of syntax)
19. Großmann, Gerrit, and Luca Bortolussi. "Reducing spreading processes on networks to Markov population models." *International Conference on Quantitative Evaluation of Systems*. Springer, Cham, 2019. (spreading processes on networks: reduction)
20. KhudaBukhsh, Wasiur R., et al. "Approximate lumpability for Markovian agent-based models using local symmetries." *Journal of Applied Probability* 56.3 (2019): 647-671. (spreading processes on networks: reduction)
21. Bartocci, Ezio, et al. "Monitoring mobile and spatially distributed cyber-physical systems." *Proceedings of the 15th ACM-IEEE International Conference on Formal Methods and Models for System Design*. ACM, 2017. (Logic for expressing temporal properties)
22. Kelly R. Finn, Matthew J. Silk, Mason A. Porter and Noa Pinter-Wollman. 2019. “The use of multilayer network analysis in animal behaviour”. Animal Behaviour 149 (2019) 7-22. https://www.math.ucla.edu/~mason/papers/Finn-etal2019.pdf

23. Becker, Joshua, Devon Brackbill, and Damon Centola. 2017. "Network Dynamics of Social Influence in the Wisdom of Crowds." *Proceedings of the National Academy of Sciences*, June, 201615978. https://doi.org/10.1073/pnas.1615978114.
24. Dodds, Peter Sheridan, and Duncan J. Watts. 2004. "Universal Behavior in a Generalized Model of Contagion." *Physical Review Letters* 92 (21): 218701. https://doi.org/10.1103/PhysRevLett.92.218701.

2. Data-driven/Experiment:

25. Colman, E., Colizza, V., Hanks, E.M., Modlmeier, A.P., Hughes, D.P., Bansal, S., 2020. Social fluidity mobilizes contagion in human and animal populations. bioRxiv 170266. https://doi.org/10.1101/170266 (Apply model to social interaction data of animals and humans)
26. Colman, E., Spies, K., Bansal, S., 2018. The reachability of contagion in temporal contact networks: how disease latency can exploit the rhythm of human behavior. BMC Infectious Diseases 18, 219. https://doi.org/10.1186/s12879-018-3117-6 (Uses data collected from face-to-face social interactions, and runs simulations on this network)
27. Hasenjager, M.J., Hoppitt, W., Leadbeater, E., 2020. Network-based diffusion analysis reveals context-specific dominance of dance communication in foraging honeybees. Nat Commun 11, 1–9. https://doi.org/10.1038/s41467-020-14410-0 (They apply NBDA -network based diffusion analysis- to analyze transmission of information in honeybees, comparing the effectiveness of transmission via dances, or via trophollaxis - by using a dynamic multi-layer network.)
28. Reyes, O., Lee, E.C., Sah, P., Viboud, C., Chandra, S., Bansal, S., 2018. Spatiotemporal Patterns and Diffusion of the 1918 Influenza Pandemic in British India. Am J Epidemiol 187, 2550–2560. https://doi.org/10.1093/aje/kwy209 (Uses historical data to analyze disease spread in a certain case study)
29. Berman, G. J., D. M. Choi, W. Bialek, and J. W. Shaevitz. 2014. "Mapping the Stereotyped Behaviour of Freely Moving Fruit Flies." Journal of The Royal Society Interface11 (99): 20140672–20140672. https://doi.org/10.1098/rsif.2014.0672.
30. M. Ballerini, N. Cabibbo, R. Candelier, A. Cavagna, E. Cisbani, I. Giardina, V. Lecomte, A. Orlandi, G. Parisi, A. Procaccini, M. Viale, and V. Zdravkovic: "Interaction ruling animal collective behavior depends on topological rather than metric distance: Evidence from a field study", 2008, https://www.pnas.org/content/105/4/1232.short
31. Alahi, Alexandre, Kratarth Goel, Vignesh Ramanathan, Alexandre Robicquet, Li Fei-Fei, and Silvio Savarese. 2016. "Social Lstm: Human Trajectory Prediction in Crowded Spaces." In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, 961–971. http://www.cv-foundation.org/openaccess/content_cvpr_2016/html/Alahi_Social_LSTM_Human_CVPR_2016_paper.html.
32. Pérez-Escudero A, de Polavieja GG (2011) Collective animal behavior from Bayesian estimation and probability matching. PLoS Comput Biol 7(11):e1002282. (also model)

33. Couzin et al. 2011 Uninformed individuals promote democratic consensus in animal groups (also model)
34. Nagy et al. 2010 https://www.nature.com/articles/nature08891
35. Seeley et al. 2011: "Stop Signals Provide Cross Inhibition in Collective Decision-Making by Honeybee Swarms" (this one is mainly experimental but there is a model too, and then there are more follow-ups on the model in other papers too)
36. Flack A, Nagy M, Fiedler W, Couzin ID, Wikelski M. From local collective behavior to global migratory patterns in white storks. Science (New York, N.Y.). 360: 911-914. PMID 29798883 DOI: 10.1126/science.aap7781
37. Salganik et al 2006: "Experimental Study of Inequality and Unpredictability in an Artificial Cultural Market", http://science.sciencemag.org/content/311/5762/854
38. Aplin et al. 2015: Experimentally induced innovations lead to persistent culture via conformity in wild birds, https://www.nature.com/articles/nature13998

3. Review papers

1. Bródka, Piotr & Musial, Katarzyna & Jankowski, J.. (2020). Interacting spreading processes in multilayer networks: a systematic review. IEEE Access. PP. 1-1. 10.1109/ACCESS.2020.2965547.
2. Keeling, M.J., Eames, K.T.D., 2005. Networks and epidemic models. Journal of The Royal Society Interface 2, 295–307. https://doi.org/10.1098/rsif.2005.0051
3. White, L.A., Forester, J.D., Craft, M.E., 2015. Using contact networks to explore mechanisms of parasite transmission in wildlife. Biological Reviews 92, 389–409. https://doi.org/10.1111/brv.12236