Discerning media bias within a network of political allies and opponents: the idealized example of a biased coin

Keywords: Agent-based modeling, Antagonistic interaction, Bayesian inference, Media bias, Opinion dynamics

Extended Abstract

Perceptions of the political bias of a media organization can be shaped from the supply side, via published media products (e.g. daily newspaper editorials), and from the demand side, when consumers react to media products not only based on their own independent assessment but also by observing the opinions of political allies and opponents (e.g. as expressed on social media). To model the above scenario, a network of Bayesian learners is constructed, where the beliefs of each agent on the bias follow a probability distribution function (PDF). The Bayesian framework allows for the uncertainty associated with the agents' opinions to be explicitly tracked. It also generalizes many Bayesian models in the literature by allowing for antagonistic interactions [1].

For tractability, the complex problem of inferring the political bias of a media organization is idealized as a problem of inferring the bias of a coin. The beliefs of each agent are iteratively updated through observations of two signals, (i) the coin toss, and (ii) "peer pressure" from political allies and opponents. Agents strive to increase (decrease) the overlap of their beliefs with their allies (opponents), by moving their belief PDF towards (away from) their allies (opponents). Numerical simulations are performed on networks with between two and 100 agents, and repeated up to 10^5 times with randomized initial beliefs, coin tosses and network structures to ensure statistical significance.

Numerical simulations reveal the following key findings, illustrated in Figure 1. The findings are counterintuitive and involve interesting social implications. (i) Antagonistic interactions between opponents "lock out" some agents from the truth, which causes them to converge onto the wrong conclusion quicker than agents that converge onto the truth. Quantitatively, the wrong conclusion is reached first $\approx 76\%$ of the time and $\sim 10^3$ time steps quicker on average than the right conclusion, for randomized opponents-only networks with 100 agents. (ii) Turbulent nonconvergence, where some agents cannot "make up their mind" and vacillate in their beliefs, occurs only in networks with a mixture of allies and opponents, not when the network contains only allies or only opponents. The prevalence of turbulent nonconvergence in randomized networks with 100 agents is consistent with the social science theory of structural balance, where turbulent nonconvergence is most frequent in structurally unbalanced networks, followed by weakly balanced networks (which includes opponents-only networks) and strongly balanced networks (which includes allies-only networks) [2]. (iii) The phenomenon of long-term intermittency is observed, where some agents cycle between eras of stability, where their beliefs do not change for many (more than 100) time steps, and eras of turbulence, where their beliefs fluctuate from one time step to the next [3].

References

[1] Nicholas Kah Yean Low and Andrew Melatos. "Discerning media bias within a network of political allies and opponents: The idealized example of a biased coin". In: *Physica A: Statistical Mechanics and its Applications* 590 (2022), p. 126722.

[2] James A Davis. "Clustering and structural balance in graphs". In: *Human relations* 20.2 (1967), pp. 181–187.

[3] Nicholas Kah Yean Low and Andrew Melatos. "Vacillating about media bias: Changing one's mind intermittently within a network of political allies and opponents". In: *Physica A: Statistical Mechanics and its Applications* 604 (2022), p. 127829.

...

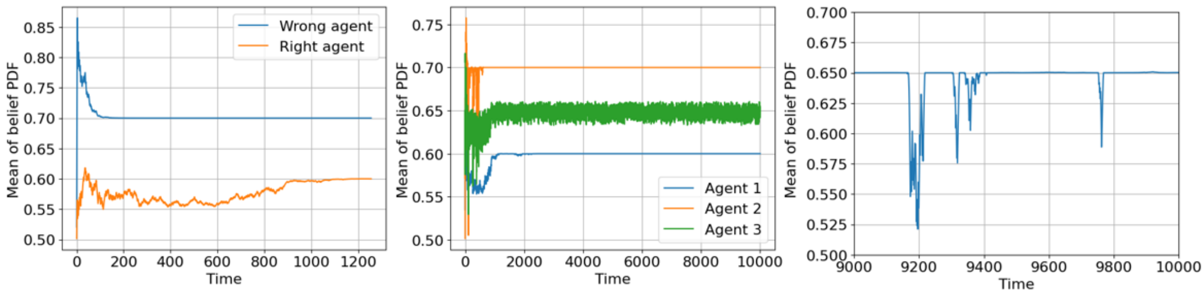

Figure 1: Evolution of the mean of the belief PDF of agents in three different networks showing three different model predictions: (left) a pair of opponents causing the wrong conclusion to be reached first, (middle) an unbalanced triad displaying turbulent nonconvergence, where agent 3 is allied to agents 1 and 2, while agents 1 and 2 are mutually opposed, and (right) one particular agent exhibiting intermittency in an 100-agent network, where half of the links are antagonistic.