Echo chambers

January 2025

1 Context - similar models

1. Other examples of opinion models are: Sznajd model, voter model, majority rule model, bounded confidence model. For all those models the **consensus state**, in which all agents share the same opinion, is reached for a value of the tolerance parameter big enough.
2. Non-consensus opinion model (NCO)

2 Model setting and Methods

1. The simulation is set up on a free-scale network with 2000 nodes.
2. Each node $i \in 1, ..., N$ represents an agent with an opinion, denoted as x_i. Opinions are uniformly distributed on $[0, 1]$.
3. ϵ, $\mu \in$ [0,0.5]. μ is a convergence parameter, it plays an important role in tuning the number of final opinion peaks. ϵ is a tolerance parameter. It indicates a threshold for the opinions to be considered discordant.
4. Simulation is performed for $T = 10^5$ time steps.
5. Given the **distribution** of opinions obtained by the simulations, they compute the number of peaks of opinions as the local maxima in the distribution of frequencies of opinions. They divide the interval [0, 1] in 100 bins of length 0.01 and consider the frequencies of values falling in each interval. Two peaks are separate if the distance between the middle points of the respective bins is smaller than 0.1.
6. All results are averaged over 5 repetitions.

3 Unbounded Confidence Model

1. Interactions are allowed between every randomly chosen pair of nodes (i,j).
2. If two agents have **concordant** opinions, i.e. if $|x_i - x_j|_\tau < \epsilon$, we adjust x_i and x_j as follows:
$$\begin{cases} x_i = x_i + \mu(x_j - x_i), \\ x_j = x_j + \mu(x_i - x_j), \end{cases} \tag{1}$$
3. If their opinions are **discordant**, i.e. if $|x_i - x_j|_\tau \geq \epsilon$, we update the opinions as follows:
$$\begin{cases} x_i = x_i - \mu\left[x_j - x_i - \rho(x_j - x_i)\right], \\ x_j = x_j - \mu\left[x_i - x_j - \rho(x_i - x_j)\right], \end{cases} \tag{2}$$
4. In the equations above the distance between opinions x_i and x_j is measured as $|x_i - x_j|_\tau$. This τ - distance is defined as:
$$|x_i - x_j|_\tau = |x_i - x_j - \rho(x_i - x_j)| \tag{3}$$
Where ρ used in the equation above is defined as:
$$\rho(x) = \begin{cases} -1, & \text{if } x \in [-1, -0.5), \\ 0, & \text{if } x \in [-0.5, 0.5], \\ 1, & \text{if } x \in (0.5, 1]. \end{cases} \tag{4}$$

4 Rewiring of Unbounded Confidence Model

The rewiring only happens for two nodes with discordant opinions. If $|x_i - x_j|_\tau \geq \epsilon$ then two steps are followed. Firstly, the opinion is updated according to equation Equation 2. Secondly, the link between i and j is broken and a new link is created between i and a randomly chosen node (excluding i and j).

5 Phase transition - hints in the paper

1. "Also, we observe that for the RUCM there is a direct transition from many opinions to two opinions, as well as from two opinions to consensus" (p. 4)
2. "The dependence of the number of final peaks on the μ parameter is stronger for the RUCM, where we observe a clear transition from many opinions to exactly two on the diagonal." (p.5)

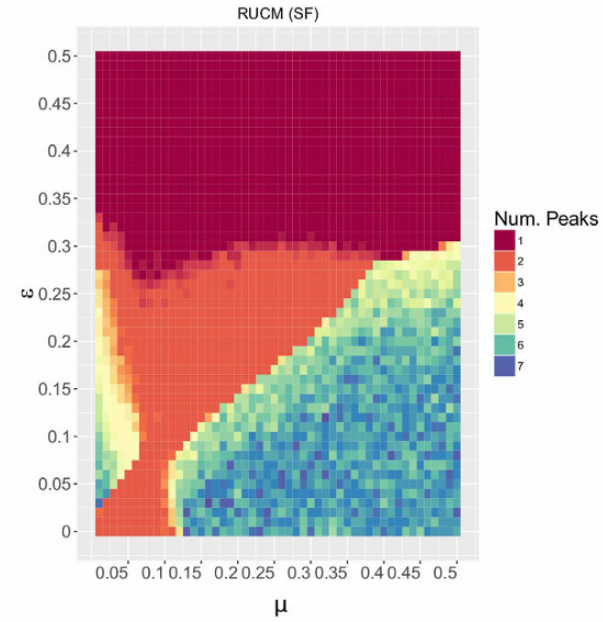

Figure 1: Final distribution of peaks for Rewired Unbounded Confidence Model