

## An approach for early stage of opinion formation

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In this work we propose to calculate the opinion for a pair of individuals using the model of XY 2D magnets. Here the opinion observable is described with a two dimensional vector  $O$ , and the issue asked on the society is described with the vector  $F$ . The temperature is defined as proposed by Stauffer (Stauffer, 2007). Assuming that initially the opinion agents strive to find an agreement with an only with its nearest neighbor which practically could be the closest relative, only two opinions will interact directly in this stage which we call the early stage of opinion formation. The common opinion of pair after the agreement between its individuals is represented with the sum of two individual opinion vectors. This agreement process is driven by satisfaction (happiness or unhappiness) which is measured using the energy-like function (utility) in the term of Stauffer description (Stauffer, 2007). So, we start from the Hamiltonian of 2D XY magnets proposed in (Ciftja, 2016) say  $H = \frac{J}{2}(O^2 - 2) - \cos \phi(O^* f)$  where an  $O = O_1 + O_2$  and  $f$  are algebraic values of  $O$  and  $F$  whereas  $\phi$  is the angle between them. Considering that the satisfaction or unhappiness might not be additive, we propose to add an extra term in the Hamiltonian similarly as of q-addition used in Tsallis statistics for other observables (Tsallis, 2009) so  $H = \frac{J}{2}(O^2 - 2) - \cos \phi(O + f) + \alpha \frac{J}{2} \cos \phi(O^* f)$ . Using this last, we perform the standard statistical mechanics calculation to evaluate the opinion value  $O$ , and afterwards analyze its behavior according to  $\alpha$  value. Particularly we obtain that for specific choice of parameter  $\alpha$ , the opinion found for ferromagnetic-like interaction will be similar with anti ferromagnetic ones and vice-versa. It seems that changing the structure of the satisfaction in those systems represented in  $\alpha$ -parameter could result in a final agreement between initially adversaries opinions and vice versa. Next, for the all society composed by  $n$ -pairs we presume that inner satisfaction for each one represented in quantity  $\frac{J}{2}(O^2 - 2)$ , would have specific relationship with the exterior satisfaction term  $\cos \phi(O^* f)$ , therefore so we apply uniformly distributed  $\alpha$ -values for each and analyze the distribution of the opinion values in this society again. Herein, in the case of moderate temperature and exterior field, we obtained a near to power law distribution for opinions values. Other scenarios have been analyzed too. In a final conclusion we propose to use the opinion values as found herein instead of randomly chosen in some standard approaches as Deffuants model for example (Castellano, 2009).

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