Opinion Formation Models and Polarization on Social Networks

A.J. Morales[1], J. Borondo[1],J.C. Losada[1] and R.M. Benito[1]
[1]Grupo de Sistemas Complejos, Universidad Politécnica de Madrid, 28040 Madrid, Spain

Political polarization is a social phenomenon that has several consequences in peoples' lives and whose nature is not completely understood. We say that a population is perfectly polarized when divided in two groups of the same size and opposite opinions. Here, we propose a methodology to study and measure the emergence of polarization from social interactions. We begin by proposing a model to estimate opinions in which a minority of influential individuals propagate their opinions through a social network. The result of the model is an opinion probability density function. Next, we propose an index to quantify the extent to which the resulting distribution is polarized. Finally, we apply the proposed methodology to a Twitter conversation about the late Venezuelan president, Hugo Chávez, finding a good agreement between our results and offline data. Hence, we show that our methodology can detect different degrees of polarization, depending on the structure of the network. We demonstrate that the polarization in social media emerges from the influence [1] of opinion leaders [2] that dominate interactions [3].

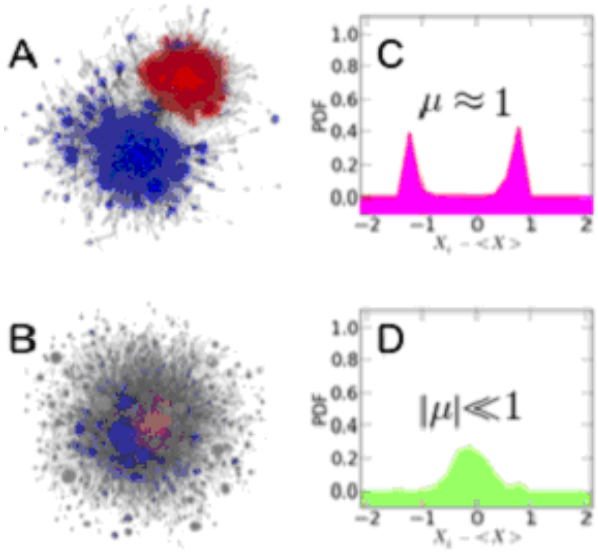

Figure 1: Visualizations of two examples of the result of the opinion formation model to the Venezuelan dataset for polarized (A) and non polarized (B) networks. Nodes have been colored according to their estimated opinion. C and D represent the resulting opinion distributions got from the networks A and B, respectively.

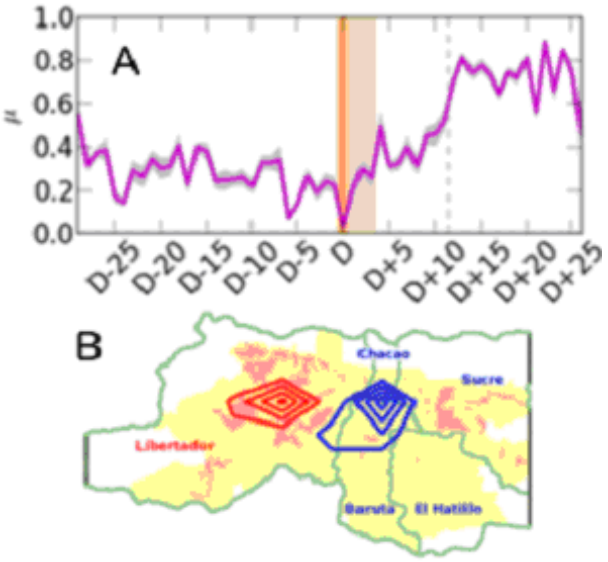

Figure 2: **(A)** shows the time evolution of the polarization index during a two month period of a Twitter conversation. Day D indicates when the President's death was anounced, and when polarization reached its minimuim value. The dashed line indicates the day when new elections were convoked and when polarization reached its maximum values. **(B)** Geographical polarization in the city of Caracas. Contour lines represent the density functions of the probability that a tweet associated with the officialism (red) or the opposition (blue) had been posted by a geolocated user at a given position (latitude and longitude). These contours have been superimposed to the map of Caracas, Venezuela. Labels indicate the name of the municipality, and the color indicates the ruling party according to the 2013 Venezuelan local elections (red for the officialism party and blue for the opposition parties). White represents unpopulated areas, yellow urbanized areas, and pink the poorer neighborhoods.

[1] A.J. Morales, J. Borondo, J.C. Losada and R.M. Benito. *Efficiency of human activity on information spreading on Twitter*. Social Networks **39**, 1-11 (2014).

[2] J. Borondo, A.J. Morales, R.M. Benito and J.C. Losada. *Multiple leaders on a multilayer social media*. Chaos, Solitons and Fractals **72**, 90-98 (2015).

[3] J. Morales, J. Borondo, J. C. Losada, and R. M. Benito. *Measuring political polarization: Twitter shows the two sides of venezuela*. Chaos **25**, 033114 (2015).