THE PEACE MEDIATORS EFFECT IN SMALL GROUPS

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Madrid, February 19th, 2010
GISC Workshop

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SUMMARY

- Introduction: continuous opinion models
- From Deffuant to our model
- Mean-Field treatment
- Numerical results
- Adding the Peace Mediators: numerical results
- Conclusions and perspectives

Introduction

- Discrete opinion models:
  Scalar → Voter model (spin models)
  Vectorial → Axelrod model

- Continuous opinion models:
  Deffuant model

- In general, according to the values of the parameters, there is a consensus-disorder transition

Deffuant Model

- Elementary evolution rules:

$$O_i \to O_i + \mu (O_j - O_i)$$
$$O_j \to O_j + \mu (O_i - O_j)$$

- The agents interact only if $|O_i - O_j| < d$
- $O_i \in [0,1]$, are the opinions (i=1,...,N)
- $d \in [0,1]$ is the threshold
- $\mu \in [0,1]$ is the learning factor
- Final consensus for high values of *d* (details depend on the topology).

[Deffuant *et al.*, **Adv. Compl. Syst.**, 3, 87 (2000)]

Our model [Carletti *et al.*, EPJB 64, 285 (2008)]

Interaction between agents i and j takes place only if $|\Delta O_{ij}(1-\alpha_{ij})|<\sigma$, being σ social temperature

$$O_i \to O_i + \mu(O_j - O_i) \qquad [\alpha_{ij} > \alpha_c]$$

$$\alpha_{ij} \to \alpha_{ij} \pm \alpha_{ij}(1-\alpha_{ij}) \qquad [\Delta O_c - |\Delta O_{ij}| \gtrless 0]$$

Affinity matrix: $\alpha_{ij} \in [0,1]$. It measures how i "trusts" j.

ΔO_c and α_c are the thresholds.

Initial conditions: agents uniformly spaced in the opinion space [0,1]; affinity matrix entries picked at random.

Mean-field treatment

$$\frac{\partial P(x,t)}{\partial t} = \int_{[0,1]} dO_i \int_{|\Delta O_{ij}| < \frac{\sigma}{1-\alpha_{ij}}} dO_j \, P(O_i,t) P(O_j,t) [\delta(x - O_i + \mu \Delta O_{ij}) - \delta(x - O_i)]$$

$$\frac{d\alpha_{ij}(t)}{dt} = \Gamma(t) \cdot \alpha_{ij}(t) [1 - \alpha_{ij}(t)]$$

Where $P(x,t)dx$ is the fraction of agents having opinion in the range $[x, x+dx]$ at time t, and $\Gamma(t)$=sgn($|\Delta O_{ij}(t)| - \Delta O_c$). The social temperature is assumed to be small enough.

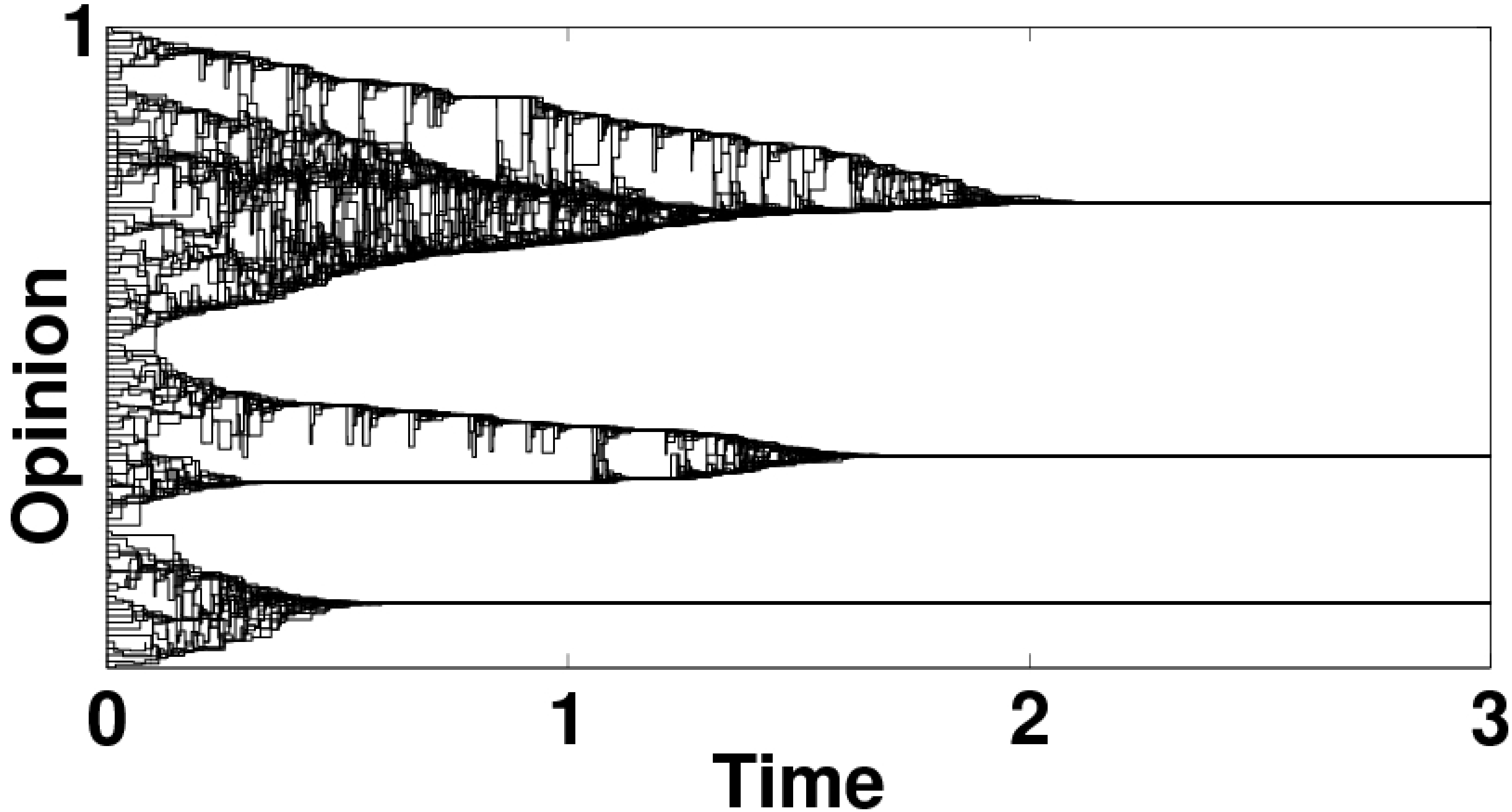
Notice: the first equation is formally similar to the one in *Ben-Naim, Krapivsky, Redner,* ***Physica D*** *183, 190 (2003)*

- At the initial stages of the dynamics, it makes sense to assume $\alpha_{ij} \approx \langle \alpha_{ij} \rangle$.
- It is crucial this quantity: $$\Delta = \frac{1 - \langle \alpha_{ij} \rangle}{\sigma}$$
- Following Ben-Naim *et al.*, it results

$$\Delta < \Delta_c \Rightarrow \ consensus$$

With $\boxed{\Delta_c = 1}$ in Ben-Naim's equation. In our case this critical value is not so well-defined (due to the approximation and to the several parameters involved), but qualitatively the same transition can be seen.

- The affinity matrix always ends up as a block-matrix, i.e. the final configuration is a disconnected network.



$$N = 100\,;\, \Delta O_c = 0.2\,;\, \alpha_c = \mu = 0.5\,;\, \sigma = 0.003\,;\, \langle \alpha_{ij} \rangle = 0.25$$

$$\Rightarrow\ \Delta = 250 \gg 1$$

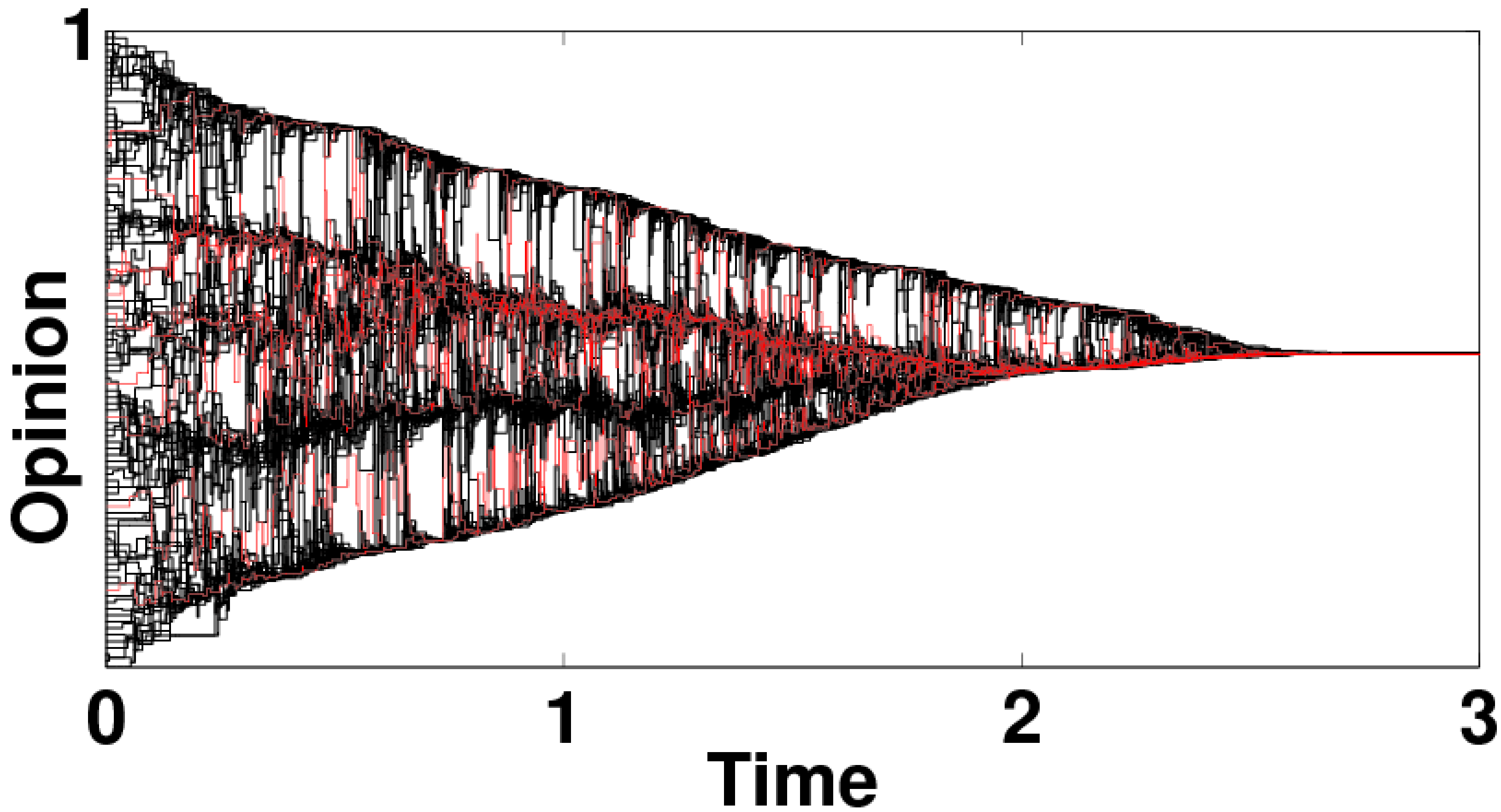
Adding the "Peace Mediators"

- "*Diplomats*" - they have a bigger opinion threshold with respect to normal agents: $\Delta O_c' > \Delta O_c$.

- "*Auctoritates*" - agents have a bigger affinity with an auctoritas than with the normal ones: $\alpha_{ia} > \alpha_{ij} \forall a, j$.

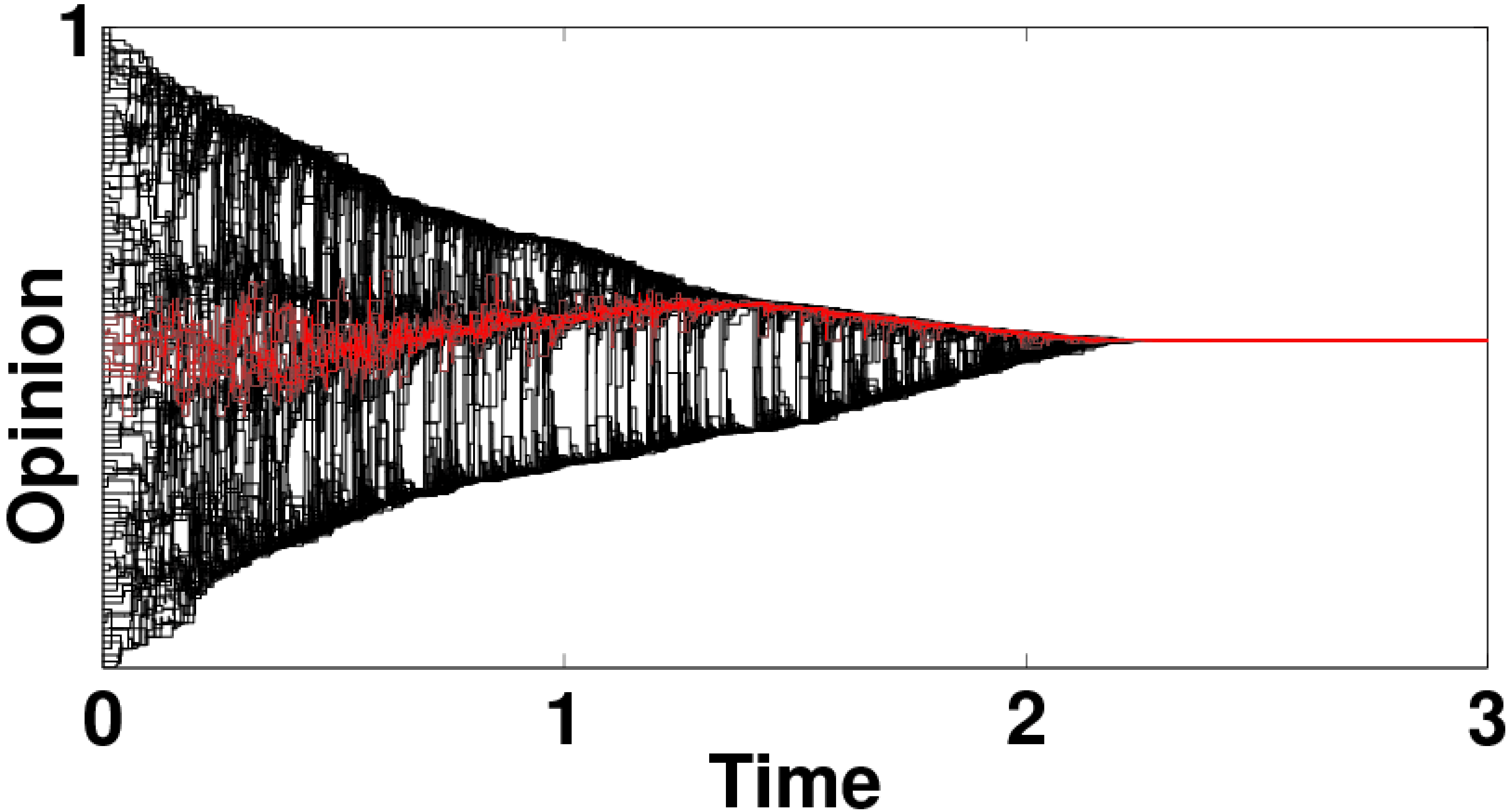
What happens inserting such PMs in our model?
(Diplomats and auctoritates were always put in the system separately)
They should promote the final consensus.

System with *diplomats*



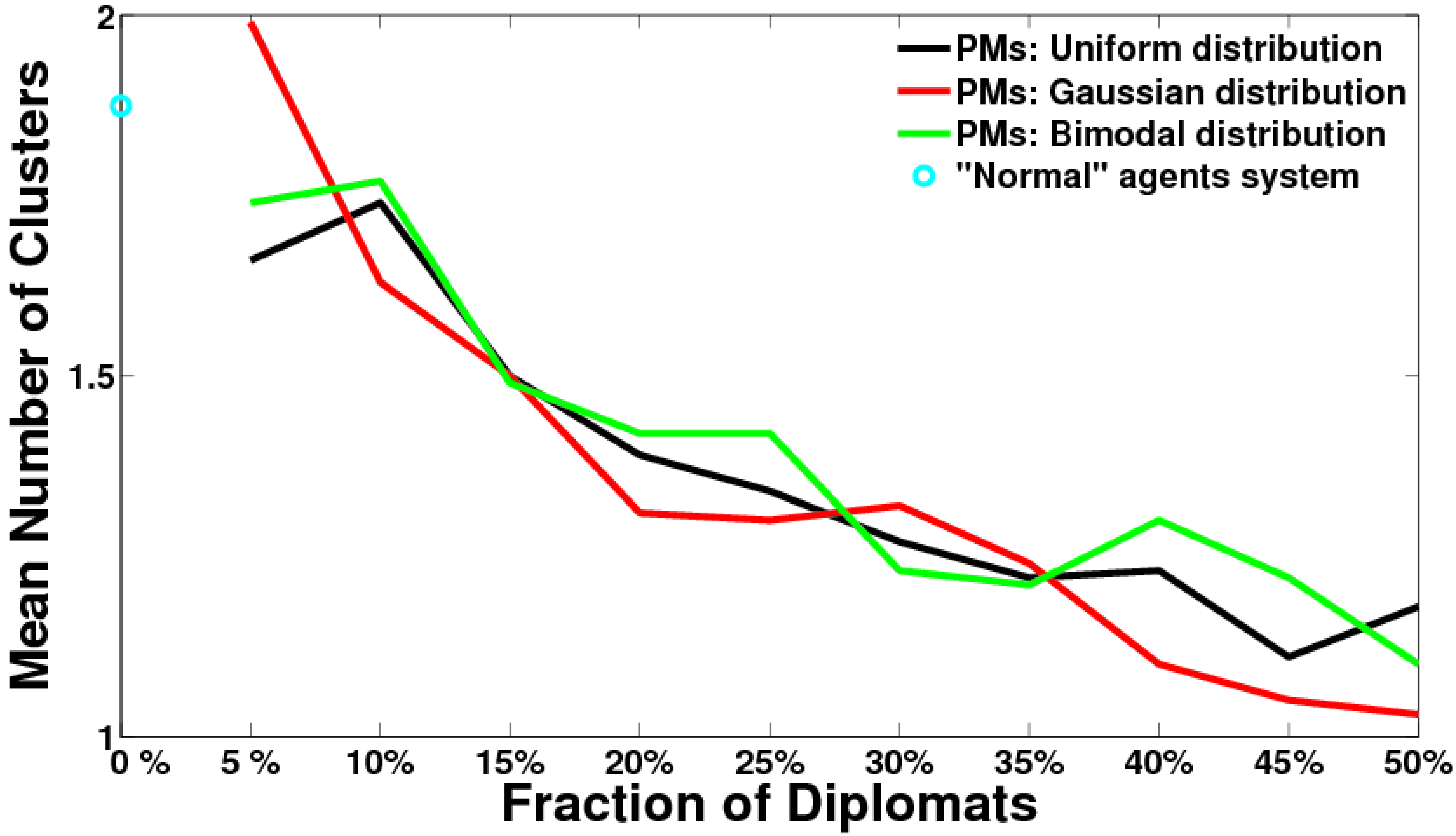
Same parameters of the first picture, plus the 10% of diplomats with ΔO_c=0.5 instead of 0.2

System with *auctoritates*



Same parameters of the first picture, plus the 10% of *auctoritates* such that $\alpha_{ia}=0.75\ \forall\ i,a$

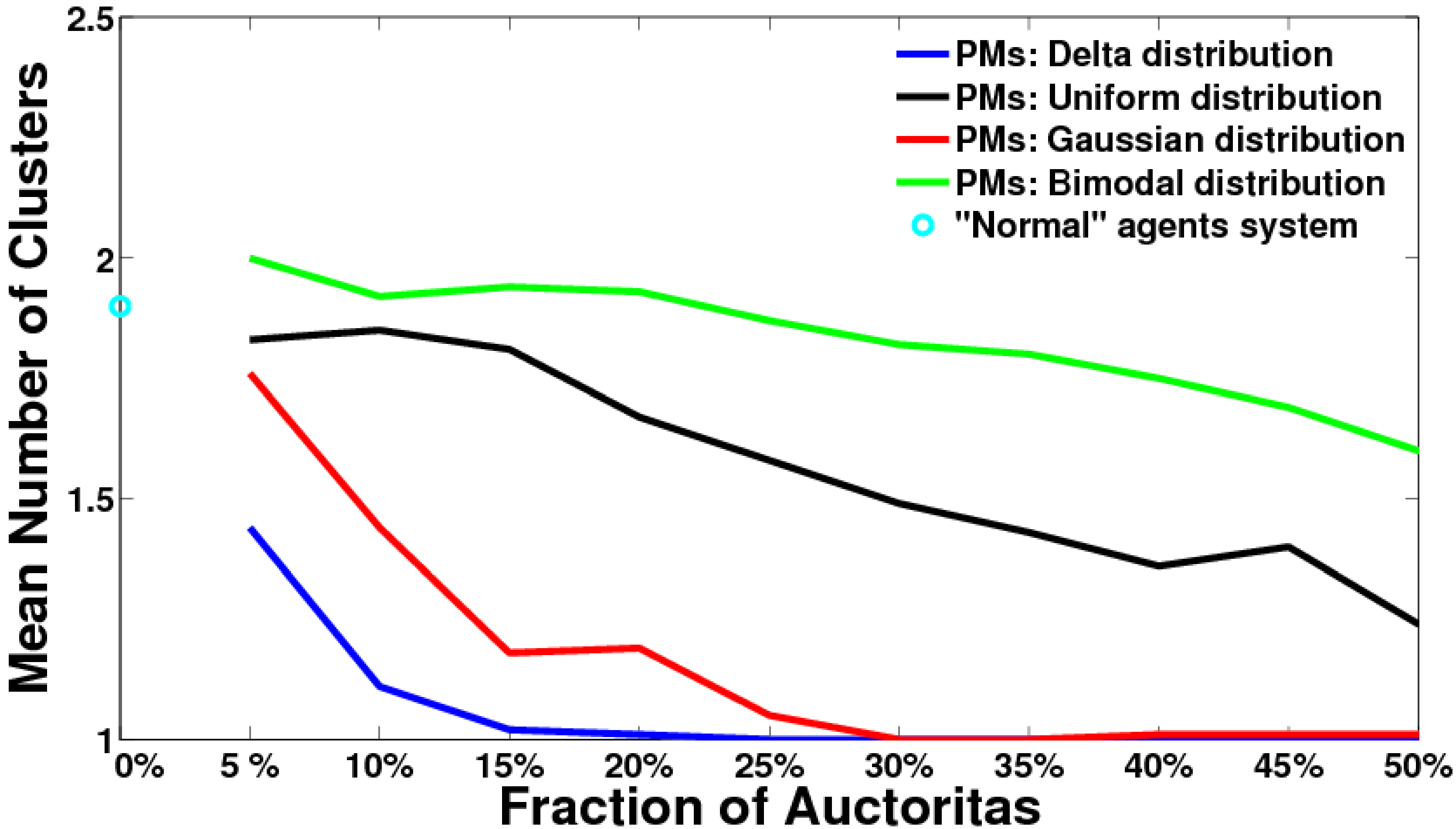
Diplomats: results



$$N = 100\,;\, \Delta O_c = 0.2\,;\, \alpha_c = \mu = 0.5\,;\, \sigma = 0.003\,;\, \langle \alpha_{ij} \rangle = 0.25$$

diplomats with ΔO_c=0.5; averages over *S*=100 realizations

Auctoritates: results



$$N = 100\,;\, \Delta O_c = 0.2\,;\, \alpha_c = \mu = 0.5\,;\, \sigma = 0.003\,;\, \langle \alpha_{ij} \rangle = 0.25$$

auctoritates such that α_{ia}=0.75; averages over S=100 realiz.

Final considerations and perspectives

- *Diplomats* have an important effect in promoting consensus when are distributed along the system and there is a great deal of them;
- *Auctoritates* have an effective role in promoting consensus when localized in the middle of the system, in this case a small number of them is enough to reach more easily the consensus;
- A system with *diplomats* such that the average opinion's threshold is $<\Delta O_c'>$ behaves like a system with no PMs but $\Delta O_c = <\Delta O_c'>$;
- A system with *auctoritates* such that $<\alpha_{ij}> = \alpha'$ still promotes consensus better than a system with the same average affinity but no PMs;

- The effect of PMs is to unify a disconnected network in a totally connected one;
- Up to date, all the numerical results have been collected for small groups (in particular N=100): what happens in bigger systems, and in general for $N \rightarrow +\infty$?
- Is it possible to get some theoretical interpretation also for systems with PMs?
- What happens if PMs act on a system already put on a social network?

References: Guazzini, Barnabei, Carletti, Bagnoli and Vilone, arXiv:0907.3228[physics.soc-ph]; Bagnoli, Vilone et al., *in preparation*.

THE END