January-February 2020
ISSN: 0193-4120 Page No. 8349 - 8354

Automation of Collective Opinion and Management of the Resulting Chaos, Examples

K. A. Pupkov[a], IBRAHIM FADI[b], Abu-nidzhim R.Kh.Y[c]
[a]Automatic Control Systems Department Bauman Moscow State Technical University 2-nd Baumanskaya str, 5, Moscow, Russia, 105005
[b]Graduate Student of Mechanics and Mechatronics Department Peoples' Friendship University of Russia Ordzhonikidze str., 3, Moscow, Russia, 117923
[C]Vice Director of Innovative Engineering Technology InstitutePeoples' Friendship University of Russia Miklukho Maklay str., 6 Moscow, Russia, 117198

Article Info
Volume 82
Page Number: 8349 - 8354
Publication Issue:
January-February 2020

Article History
Article Received*: 18 May 2019*
Revised*: 14 July 2019*
Accepted*: 22 December 2019*
Publication*: 07 February 2020*

Abstract:
The importance of the work presented is that given the rapid development of science, we are in great need of new theories and systems of work, the phenomena surrounding us explain more accurately and objectively and give us a logical and scientific explanation, with some mathematical measurements that enable us to fully understand many things, Newton's laws that have fascinated the world for decades and gave scientific explanation to many of the ideas of the ancients, helped solve millions of problems and equations, and explained many of the phenomena that have occupied the human mind for centuries. Not Enough for our time going beyond them, we find ourselves in the world of relativity of Einstein, Maxwell and Schrodinger equations, obviously, they also describe only part of reality, so it was necessary to make greater efforts to formulate new theories and development of laws to suit the rapid development of our world, over the past years, scientists have sought to develop systems, programming, mathematical modeling, computer science, mechanization, etc., they developed more advanced theories in science, economics, politics, space, and mathematics as the chaos theory etc.

Keywords:*Automation; chaos; Convinced Elements; Butterfly Effect; Vote; Collective Opinion; intelligent agents; majority;.*

INTRODUCTION

The world around us is progressing, expanding in all fields and directions, every day there are large numbers of inventions and discoveries that make us feel proud of what mankind has reached[1], this speed and development is due to human dependence on mathematical modeling automation and computer science to do complex mathematical calculations and measurements, therefore imperative for us to use these new technologies in our studies, modeling the issues facing us and conceptualizing possible solutions, to study a group of elements maybe consisting of people or cars, economic factors, political, social, biological etc. We always strive to model it and give it a mathematical character to make it easier to understand on the one hand and to use mechanization to reach quick solutions to the problem and give thought about the future of this model [2]. Our study will be about a group D which contains of m homogeneous elements that represent a society, for some reason these elements will communicate in some way and there will be relations between them about a particular issue, the elements of this group must make a decision on the subject of what is being presented to the elements [3], result of this interaction between the elements it will be the final outcome for opinions of elements on the studied subject, that we will call the collective opinion, the collective opinion can be defined as a

January-February 2020
ISSN: 0193-4120 Page No. 8349 - 8354

set of tendencies that prevail in the society or group about a studied subject[4].

To study collective opinion for a group we will model the matter mathematically, suppose we have a group D, containing m of elements, we enter some initial information for this group for a particular matter, suppose each element of this group as an intelligent agent, it will have an initial value of 1 or 0, then there will be interactions and exchange of information between elements of this group, By dividing the D group into small groups, each contains three elements, the interaction between them is so-called vote, how voting happens? each element in a group D has an initial value entered as initial conditions, thus each element of small groups that contain three elements has an initial value, an item is selects randomly in each trilogy to do a process or to vote, this element changes its initial value given the value of the other two elements with him in the trio, but with the percentage $1-\varepsilon$, if the value of the other two elements is equal, the item changes its value to the value of the other two, otherwise, the voting will not take place, this process is taking place In the triads at the same time interval t, this vote is an exchange of information between the elements by majority, which in turn is repeats a number of times to get a certain result where most elements are close to a known value [5].

To automate the above and mathematically model it, as follows:

After dividing Group D to groups, suppose that the random element that will vote in each triplet is α, his value changes at every moment in time t between 0 or 1 by a majority, $\alpha=\alpha(t)$, this mean that $\alpha(t)=0$ or $\alpha(t)=1$ at every moment time t, so the following function $\alpha(t+1)$ can be defined in moment $t+1$ in each trilogy after the majority vote as follows [6]:

$$\alpha(t+1)=F(\alpha(t),\beta(t),\gamma(t)) \quad t=0, 1, 2, \dots \quad (1)$$

$\beta(t)$ _ Input variable, that takes two values 0 or 1;

$\gamma(t)$ _ Input variable, that takes two values 0 or 1;

F _ Function that give us the result of voting in each trilogy at every moment time t;

F _ It can be defined as:

$$\left.\begin{array}{l} F(\varphi(t),1,0)=F(\varphi(t),0,1)=\varphi(t) \\ F(\varphi(t),1,1)=F(\varphi(t),0,0)=1 \end{array}\right\rangle \dots(2)$$

With a probability $(1-\varepsilon)$

ε – The percentage of error during voting;

Let us define the functions:

$\lambda(t)$ _ The function which constitutes the percentage of intelligent agents in group D, which have the value 1 at the moment time t, $0\le\lambda(t)\le1$;

E _ The function that we can find out the change in the proportion of intelligent agents that have the value 1 at each moment time t in group D;

Thus, in the initial conditions, we divide the group D which containing m intelligent agents at moment time t = 0 to groups, each group contains r intelligent agents, h agents of r agents have value 1, at the beginning of time we have $\lambda(0)=\lambda_0$ for all elements of group D, note that in each group of groups the probability that each group contains an intelligent agents with a value 1 it has binomial distribution which is given by the equation $C_r^h\lambda_0(1-\lambda_0)^{r-h}$ [7](in each group), Thus the mathematical expression that expresses the state of change in the ratio of smart elements in all groups at the next moment t = 1 will take the following form

Thus, the mathematical expression, which expresses the state of change in the percentage of intelligent agents that has a value of 1 in all groups (r groups) at the next moment t = 1; $E(\lambda_0)$ will take the following form:

January-February 2020
ISSN: 0193-4120 Page No. 8349 - 8354

$$\lambda(1) = \mathrm{E}(\lambda_0) =$$

$$= \lambda_0 + \frac{1}{r}\left[(1-\varepsilon)\sum_{h>\frac{r}{2}}(C_r^h \lambda_0^h (1-\lambda_0)^{r-h}(1-\frac{h}{r}) + \varepsilon\sum_{h\le\frac{r}{2}} C_r^h \lambda_0^h (1-\lambda_0)^{r-h}(1-\frac{h}{r}) - (1-\varepsilon)\sum_{h<\frac{r}{2}} C_r^h \lambda_0^h (1-\lambda_0)^{r-h}(\frac{h}{r}) - \varepsilon\sum_{h\ge\frac{r}{2}} C_r^h \lambda_0^h (1-\lambda_0)^{r-h}(\frac{h}{r})\right]$$

...(3)

Previous mathematical form gives us how the ratio of intelligent agents which have a value 1 changes at the moment in next initial conditions in the group D, mean at the moment t+1.

Thus, from form (3) we get the following mathematical equation:

Previous mathematical form gives us how the ratio of intelligent agents which have a value 1 changes at the in next moment of initial conditions in the group D, mean at the moment t+1.

Thus, from relationship 1 we get the following mathematical equation:

$$\lambda(t+1) = -\frac{2}{3}(1-2\varepsilon)\lambda^3(t) + (1-2\varepsilon)\lambda^2(t) + \frac{2}{3}\lambda(t) + \frac{\varepsilon}{3}$$

;…(4)

Equation (4) is a rough equation, giving us the ratio of intelligent elements that have a value 1 at any moment time t+1.

To study the change in voting between the moments t & t+1 we study the function:

$$\sigma(t) = \lambda(t+1) - \lambda(t)$$

The analytical study shows that for $\sigma(t) = 0$, the equation has solutions only if $\varepsilon < \frac{1}{6}$

For $\varepsilon < \frac{1}{6}$ there are three stationary points:

$\lambda_b = \frac{1}{2}$ (is unstable stationary point),

$$\lambda_{a,c} = \frac{1}{2} \mp \frac{1}{2}\sqrt{\frac{1-6\varepsilon}{1-2\varepsilon}},$$

in this study we were able to monitor changes in any group D, that are happening as a result of interaction and exchange of information between the elements of this group by modeling it like intelligent agents and automate it in mathematical form, and we were able to find the mathematical equation, which shows the changes in ratios of the values that elements have in the group.

Study the properties and the factors affecting on equation (4)

We try by studying the properties of the equation to reach some factors, that give us the ability to influence on the information exchange process (vote) and thus, influence the final results of collective opinion which gives us the ability to direct and control it, by checking equation (4), two elements ε and λ , are determines the result of vote process

Therefore, we will see the impact of these two factors on the process of information transfer and the formation of public opinion, to illustrate how the change in ε and λ affects the behavior of the equation we will show examples:

Example 1- self –driving car:

Many factors affects on the self-driving car that are obtained through a large number of advance information, cameras and sensors fixed on it, which share information between them and intersect their data so that the car can determine its destination, where the exchange of data between these elements, each of which can Think of it as an intelligent agent, thus, these elements constitute a combination of intelligent agents that can determine the mechanism works of self-driving car, as a result of the exchange of information between them, suppose the number of these factors is 99 at the moment t the car must make a decision to make a turn or stop, at this moment all agents must exchange information to make a final decision, can this decision be made or not ??? At the beginning of time each of the agents submits his data, each has this data, with the decision and

January-February 2020
ISSN: 0193-4120 Page No. 8349 - 8354

assuming it has a value of 1 or against decision assuming it has the value 0, assuming percentage of intelligent agents which have the value 1 at the moment time t=0 $\lambda_0 = 49{,}5\%$(percentage of agents who want to turn the car), to compare the results of the exchange of information between agents in two cases, we assume in the first case that $\varepsilon = 0.1$ (Fig.1.1) and in the second case $\varepsilon = 0.1$ (Fig.1.2),we vote in both cases, assuming the vote takes place 150 times:

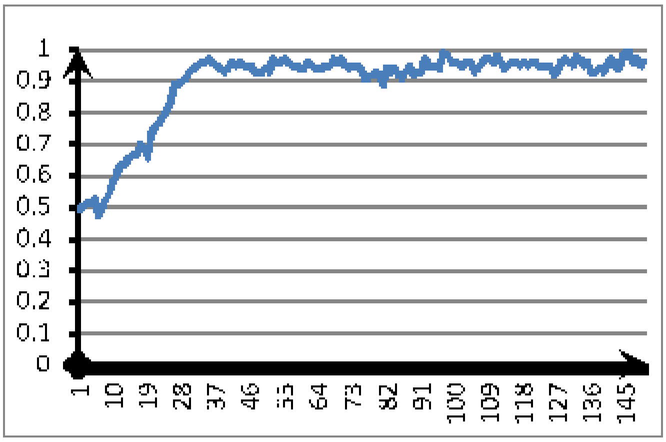

Fig.1.2 voting when

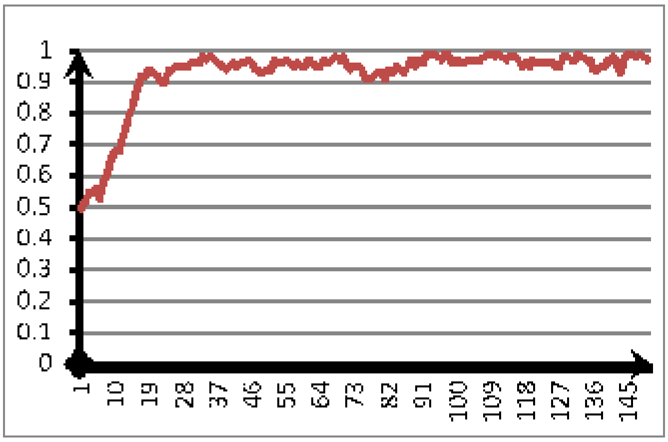

Fig.1.1 voting when

By comparison we find in the first case (Fig.1.1) we can say that the larger ε need more time to finish the vote therefore, we need more time to obtain a collective decision of agents, nor we very close to the point of stability as in the second case (Fig.1.2), when ε smallerthe time that we need for voting to get a collective decision close to the stability point be less, therefore, less time that means speed in performance, also when it is ε smaller we are getting closer to the point of stability and we get better results which is better quality and stronger collective decision for agents.

This means, whenever ε less, we can get quick voting and more accurate results[8].

Example2: Returning to the idea of the previous example1 (self –driving car):

We know that each element has a point of view that is either 0 or 1 that it uses when voting, so during voting all elements have the same voting power, but nevertheless in some cases there are some elements that have more power during the vote, suppose the car is traveling, at the moment What if the car reaches a red traffic light it is normal to park the car, but what if the car that is traveling behind our car is traveling too fast and cannot stop behind us, and that our parking may cause great damage to the cars ? Here it is necessary to take a decision that minimizes the damage as much as possible and therefore by passing the red signal is better than standing on it and therefore in this case must drive the car knowing that the violation occurred to avoid harm. But what if people started walking on the pedestrian walkway? Here we have to stand in any case knowing the damage to the car and the other car behind it, this means that sometimes the weight of some agents, must be weighed on the opinion of other agents, knowing that all elements have the same value opinion either 0 or 1.

This means that in some cases there are some elements that do not change their opinion by majority during the vote, although according to the function they have to change their opinion, so we will see if we have some agents that don't change their opinion during the vote, here assuming that the agents are divided into two parts, part are voting by majority and a small percentage of it doesn't commit to vote by majority for some reason, so in this case we have λ_0 divided into two parts:

TEST Engineering & Management

January-February 2020
ISSN: 0193-4120 Page No. 8349 - 8354

So we're talking about convinced agents, who don't change their opinions in voting by the majority, this means, the intelligent agents group D which include m elements divides to two groups: $D_m = D_n + D_c$;

Where:

D_n_ Normal intelligent agents _ Agents who change their opinions in voting by the majority, with percent (1-ε);

G_c_ convinced intelligent agents_ Agents who never don't change their opinions in voting by the majority, with percent (1-ε);

Accordingly λ_0 will be divided also to two groups $\lambda_0 = \lambda_{0n} + \lambda_{0c}$.

Where: λ_{0n} _ A Share normal intelligent agent in the group consists of k agents;

λ_{0c} _ A Share convinced intelligent agents in the group consists of k agents,

So the approximate equation (1) describing the voting process

Thus the equation takes the following form:

$$\lambda(t+1) = -\frac{2}{3}(1-2\varepsilon)\lambda_n^3(t) + (-2\lambda_c(t)+1)(1-2\varepsilon)\lambda_n^2(t) + [2(1-2$$

$$+[-\frac{2}{3}(1-2\varepsilon)\lambda_c^3(t) + (1-2\varepsilon)\lambda_c^2(t) + \frac{2}{3}\lambda_c(t)] + \frac{\varepsilon}{3} ......(4)$$

$$\lambda_c(t) = c\,\text{Const.} \quad 0 \le c \le 1$$

Example2- for the same car that in the first example when we have 99 agents who effects in the car decision and we have the same ε for all agents ε =0.05, in the first case at the beginning time we have λ_0 =50.5 %, in second case λ_0 =50.5 % but some of agents are convinced λ_{0c} =5.05% so we will see the deference between two cases, we calculate according 3, 4 assuming the vote takes place 150 times, we found:

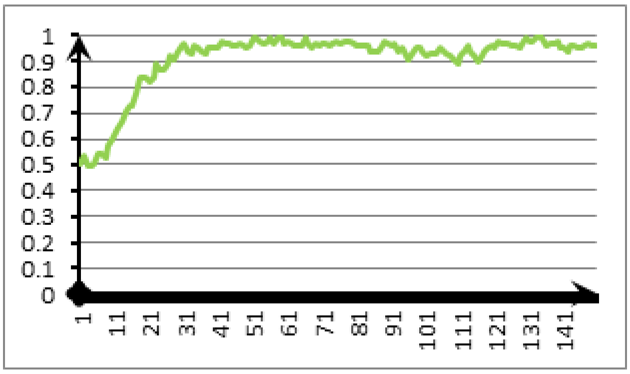

Fig.2.1 the graph of voting withaout convinced agents

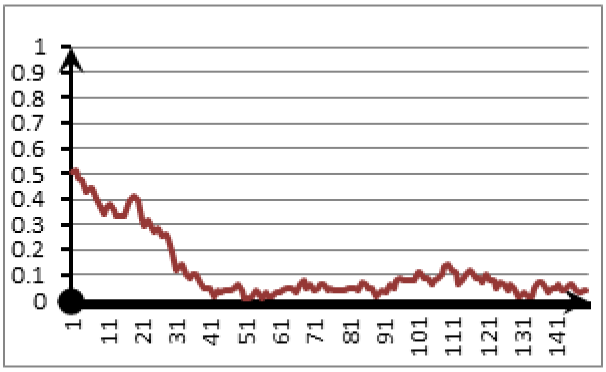

Fig.2.2 the graph of voting when we had a 5.05 convinced agents

Comparison the first case (Fig.2.1) and second case (Fig.2.2) shows us clearly that having convinced agents they have radically changed the voting result, therefore the majority in collective opinion.

This significant change in collective opinion of the elements called the butterfly effect and enters into chaos theory research, that is, a small change in the initial conditions gives a big change to the final results.

From first and second example we find, the equation (4) which represents the change of collective opinion, is influenced by the initial conditions, whether by the percentage of error during the vote or because of the presence of convincing elements whose presence caused a chaos effect and fundamentally changed the results, and thus from the above we can influence collective opinion in any area and that by changing the values and percentages of the satisfied elements as well as the percentage of error committed during the vote process, this is mean management of the resulting chaos[10]. We hope these results can be used to influence genetic diseases, semiconductors, domestication of wild animals and other fields.

January-February 2020
ISSN: 0193-4120 Page No. 8349 - 8354

REFERENCES

1. K.A. Pupkov, Ibrahim Fadi, VIII International science-practical conference ENGINEERING SYSTEMS-2015, Moscow April 20-22, 2015,p.228-232.
2. Marker, David (2002). Model Theory: An Introduction. Graduate Texts in Mathematics. 217. Springer. ISBN 0-387-98760-6.
3. Stefanyuk V. L. The local organization of intelligent systems. M .: FIZMATLIT, 2004., p.328.
4. Moussaid M, Garnier S, Theraulaz G, Helbing D (2009) Collective information processing and pattern formation in swarms, flocks, and crowds. Topics in Cognitive Science 1: 1–29.
5. K.A. Pupkov, Ibrahim Fadi, XII International Symposium Intelligent Systems INTELS 2016, 5-7 October 2016, Moscow, Russia.
6. K.A. Pupkov, Ibrahim Fadi, Newspaper of Computer and Information Technologies No. 8, 2019 p.32-38
7. https://en.wikipedia.org/wiki/Binomial_distributi on.
8. K.A. Pupkov, I. Fadi , Collective Opinion Formation as a Set of Intelligent Agents to Achieve the Goal, Procedia Computer Science 150 (2019) p.216–222.
9. K.A. Pupkov, I. Fadi, The Chaotic Influence of Convinced Elements on Routing Collective Opinion and Appearance of Butterfly Effect, International Journal of Innovative Technology and Exploring Engineering(TM), p. 1329-1331.
10. Edward Ott, Chaos in dynamical systems, University of Maryland, College Park,