Use of Firefly Algorithm to optimize Social Projects to Minorities.

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Abstract. A controversial theme and frequently in public policy analysis is the allocation of funds for projects of minority groups. Public resources to finance social projects of this type are particularly scarce. Very often the relationship between the requested budget and what can be received is overwhelming, as is very unlikely to be as necessary as that can be awarded. In addition, strategic approaches, political and ideological permeate the decision-making on such assignments. To meet these regulatory criteria, underlying any prevailing public policy or government ideology, is clear that both must be appropriate to prioritize the development projects and project portfolios, these must be consistent with principles sound (for example, maximization of social benefits). Computation using bioinspired algorithms (In this case Firefly Algorithm) can be characterized as follows: 1) They can be no doubt profitable, but its benefits are indirect, perhaps only in the long run may be visible and difficult to quantify; 2) Apart from its potential contribution to economic welfare, are not intangible benefits, which must be considered to achieve a holistic view of their social impact. 3) Equity in relation to the magnitude of the impact of projects and social conditions of the beneficiaries should also be considered. The present study was conducted using an approach to intelligent optimization problem for the four minority at State of Chihuahua, México: Rarámuris, Mennonites, Mormons and Immigrants of the Federation.

Keywords: Intelligent Optimization, Project Portfolio Social and Decision Making.

1 Introduction

In the present study, we focused our attention on a specific problem, little known in the literature related to decision making about social portfolio known in English as "Social Portfolio Problem" based on a Social Modeling characterized by four minority. In this social representation is necessary to make a proper selection of projects to benefit from the portfolio of projects to optimize properly, the social benefit for each of the minorities with the aim of improving their living conditions in everyday aspects. Therefore we have created an intelligent tool to support decision taking based on a bioinspired algorithm called Firefly Algorithm, which facilitates the establishment of the proper selection of projects aimed at influencing the lives of individuals belonging to a minority given a set of actions. The proposed solution is an hybrid of two techniques: data mining (for data analysis of beneficial actions in the past) and bioinspired algorithm (to define the correct decision support based on social relationships and specific support of four minorities: Mennonites, Mormons, Rarámuris and Immigrants to Rarámuris Federation), as a result of social projects related to where they live, which are represented on the map. As described in [2] this bioinspired algorithm is able to select a limited set of projects. In this paper is used the type of project supported by the state government as described in [4], which is a repository of information about various possibilities to improve lives of individuals who constitutes a minority in Chihuahua [1]. Here each project is evaluated taking into account the different attributes similar as the proposed in [3 & 5]. The selection of each attribute and its visual representation to analyze the potential impact of social benefit, this representation requires the development of some similarity measures that permit identification and map locations [6].

Firefly Algorithm

The Algorithm "Firefly algorithm" (FA) is a metaheuristic algorithm, inspired by the flashing behavior of fireflies. The primary purpose for a firefly's flash is to act as a signal system to attract other fireflies. Xin-She Yang formulated this firefly algorithm by assuming [11]:

1. All the fireflies are unisexual, so any firefly can be attracted by either of the other fireflies.

2. Its appeal is proportional to the degree of brilliance, and for any two fireflies, the dimmest of them may be attracted by (and thus move toward) the brightest of them, however, the brightness may decrease as the distance is increased.

3. If there are no fireflies firefly brighter than a given, this will move randomly.

The brightness may be associated with the objective function.

Firefly Algorithm is a metaheuristic optimization algorithm inspired by nature.

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1) Objective function: f(x),    x = (x_1, x_2, ..., x_d);
2) Generate an initial population of fireflies x_i   (i = 1, 2, ..., n);.
3) Formulate light intensity I so that it is associated with f(x)
   (for example, for maximization problems, I ∝ f(x) or simply I = f(x);
4) Define absorption coefficient γ
While (t<MaxGeneration)
   for i=1:n (all n fireflies)
      for j=1:n (n fireflies)
         if (I_j > I_i),
          move firefly i towards j;
         end if
      Vary attractiveness with distance r via exp(−γ r);
      Evaluate new solutions and update light intensity;
      end for j
   end for i
   Rank fireflies and find the current best;
end while
Post-processing the results and visualization;
end
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The main formula update for any pair of two dragonflies are $\mathbf{x}_i$ and $\mathbf{x}_j$ is

$$\mathbf{x}_i^{t+1} = \mathbf{x}_i^t + \beta \exp[-\gamma r_{ij}^2] + \alpha_t \epsilon_t$$

where α_t is a parameter controlling the step size, while ϵ_t is a vector is drawn from a Gaussian distribution or otherwise.

This can be demonstrated through the limiting case $\gamma \to 0$, the particle which corresponds to the standard PSO (Particle Swarm Optimization (PSO). In fact, if the inner loop (for j) is removed and the brightness I_j is replaced by the current global g^*, wholesale then essentially FA is becoming the standard PSO.

Implementation Guide

The term γ may be related to the scales of design variables. Ideally, the term β may be ordered, which requires the γ may be linked by ladders. For example, one possible choice is to use $\gamma = 1/\sqrt{L}$ where L is the average scale of the problem characterized. In the event that the scales vary significantly, γ can be considered as a vector to accommodate different levels in different dimensions. Similarly, α_t may also be linked with scales. For example, in $\alpha_t \leftarrow 0.01L\alpha_t$. It is worth noting that the above description does not include reduction of randomness. In fact, in the actual execution by most researchers, the movement of the firefly is gradually reduced by a reduction of the randomness of the type "annealing" as through $\alpha = \alpha_0\delta^t$ where $0 < \delta < 1(e.g.\delta = 0.97)$. In a problem with a high degree of difficulty, can be useful if some stages are increased, and then reduce it when necessary. This no monotonic variation of the algorithm will escape any local optimum when in the unlikely event that could get stuck if the chance is reduced too quickly. Parametric studies show that n (number of fireflies) should be 15 to 40 for most problems. An implementation on Python language is also available, although with limited functionality. Recent studies show that the algorithm is very efficient firefly, [11], and may outperform other metaheuristics based algorithms including particle swarm optimization (PSO). Most metaheuristic algorithms may have difficulty dealing with stochastic test functions, and it looks like fireflies algorithm can deal with stochastic test functions very efficiently. In addition, the FA algorithm is also better to deal with noisy optimization problems with the ease of implementation. Chatterjee et al. [12] shows that the algorithm exceeds firefly particle swarm optimization in some applications. Furthermore, the algorithm of fireflies can efficiently solve problems with non-convex complex nonlinear constraints. Further improvements in performance are possible with promising results.

2. Development of a planning horizon for a portfolio of social projects related to minorities.

A project is set to a particular action within a planning horizon associated with minorities to benefit from these projects that have been made, this should be established by the question: What social projects can be represented by an analysis of various aspects of social benefit?. To answer this question, we employed different analysis to place each project in terms of possessions and money that can be used for each project, and a bioinspired algorithm to optimized benefits to more individuals of each minority. This representation is mainly based on relationships between families that make up the minority. In this paper, we focus on a practical problem in the literature concerning the adequacy of the best portfolio of projects using a model created by the bioinspired algorithm that locates the different places where the population will benefit, which will address this portfolio projects, improve their social integration, which allows you to include every important aspect related to each project with respect to each other and their respective potential to potentiate the region, we use a specific time horizon (2012-2050), which indicates the ability to establish appropriate locations in the model, this allows for "social impact correspondence appropriate to each specific project" during the time horizon for the given set of projects. The solution to this problem could be given by a sequence of generations of optimal solutions, designated as "firefly", these solutions provide the best chance to benefit socially as many individuals of the minority. The particles in this case designated as "firefly", perform the analysis on weather (feasibility economic viability during the time horizon and ability of social return) regarding the appropriateness of each project according to the site will be developed to improve the lives of the people who make a determined minority, these projects have attributes with different ranges of intensity and magnitude associated with different attributes related to social benefits, and specific actions to be developed, after using the result of the algorithm, it is selected to determine the most appropriate project to determine the potential of executing the project, and finally offer automatically a "narrative script" associated with the Smart Tool to find the best project according to the model, justifying this with the selection determined by the bioinspired algorithm as in [10], according to the proposed model, for example, "Project # 7 must be executed in Rarámuri communities to generate self-employment, as their agricultural land receive little rain "and show the representation model, which is maintained by a repository in accordance with the necessary information [3] for further modification of the decision performed.

3. Intelligent system to support the proposed Decision Making.

A model with all the associated information with each of the projects to be used is objectively analyzed and placed on the map, where the project is planed to be implemented. The development of this model requires,

first, the conceptual development, and second, the development of measures that allow discrete mathematic ontological support for exploring human systems of the data (see Figure 2).

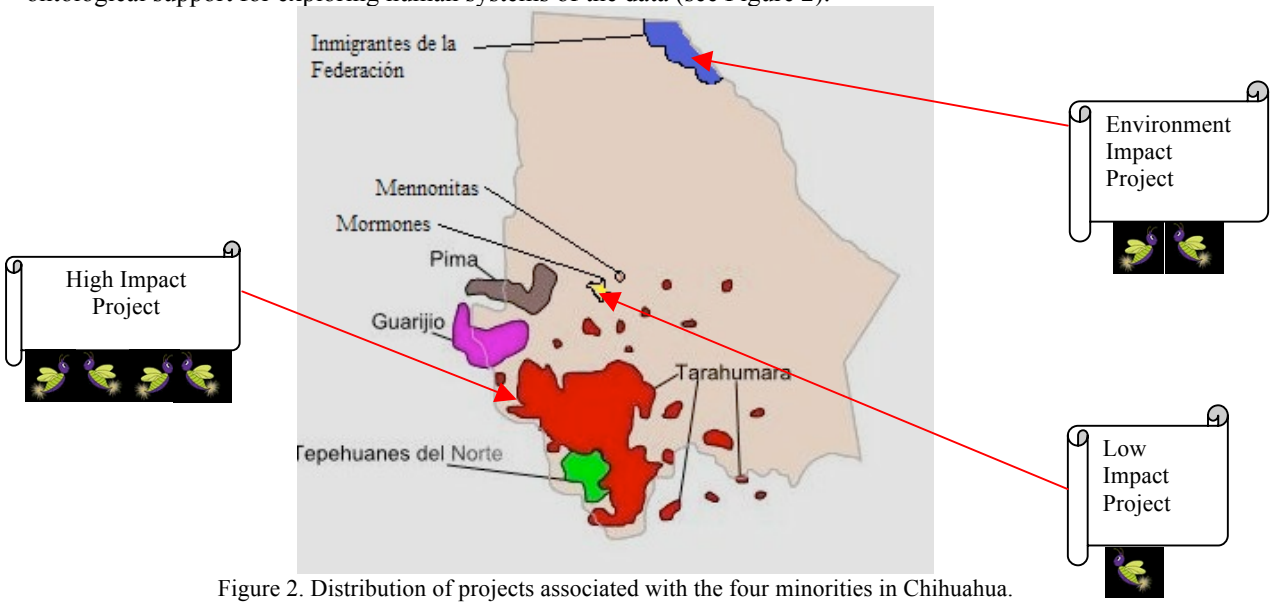

Figure 2. Distribution of projects associated with the four minorities in Chihuahua.

It aims to improve the equation (1), this describes the value of K as the feasibility to develop a social project associated with a minority in a specific place where target people live.

$$K = IS\ [\ (PE - IE)^{PCM}\ ] \pm RSLP \qquad (1)$$

Where:
IS = Social Impact of the Project.
PE = Economic potential of the project.
IE = Ecological Impact.
PCM = Minority Cultural Preservation, since the project does not affect the culture associated with the minority.
RSLP = Social return of long-term project, meaning that the project changed over time the situation of the minority.

Table 1. Multivariable analysis with information related to a project for every minority, including its various attributes.

Kind of project	Minority	Social Impact of the Project	Economic Potential of the Project	Ecological Impact	Cultural preservation	Social return
Self-Employment	Immigrants from the Federation	0.788	0.778	0.734	0.674	0.814
Self-Employment	Mennonite	0.619	0.912	0.673	0.728	0.972
Self-Employment	Mormons	0.687	0.632	0.589	0.682	0.915
Self-Employment	Rarámuris	0.895	0.837	0.715	0.629	0.885

4. Experimental Analysis.

The main experiment consisted in detail each of the attributes related to the project portfolio, and give an initial population of 50 fireflies, and a stop condition of 25 comparisons, or that the objective function is fulfilled previously established, this allowed us to generate different scenarios regarding time horizons, which was obtained after comparing different brightness levels associated with each project (cultural and social similarities in each community, and to determine the relationships between each of them in relation to time for develop the project), when it comes to maximizing value, this indicates the potential to affect lives of people in each minority, and this represents the number of persons benefiting from this decision that

determine the magnitude involving the company. The developed tool can properly classify each project according to the group in more detail for further analysis (see Figure 3).

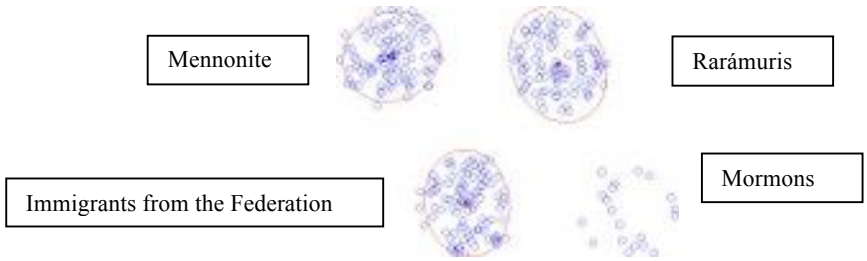

Figure 3. Competition of projects to be selected, using the proposed algorithm.

Figure 3 analyzes each project and analyzed the potential to run a specific project for use later to solve the objective function. The analysis algorithm called "Firefly Algorithm" confirms the decision to select different projects with different characteristics, so the proposed hybrid algorithm includes analysis of historical data (data mining) and the selection made with the bioinspired Firefly Algorithm.

With the information obtained with our experiments, we generated a ranking of the various projects, this should be considered an adequate social and cultural collective imagination, which combines several features that do not affect the traditional culture of each minority and reduce the ecological impact of each project. Figure 4 describes information related to the attributes associated with each of the possible projects, as shown below.

Figure 4. An incremental temporal graph, which describes each of the competing projects to be implemented and their attributes (selected at least seven specific comparative) to get the most benefit target population to be based on the number of restrictions for each, and the value of the tuning range to meet the objective function.

5. Conclusions

Using the optimization algorithm called "Firefly Algorithm", we have substantially improved the understanding for the exchange of "best paradigm", because we determine properly the time horizons and where the target population could benefit more according to their attributes. This allowed us to understand that the concept of "selection of a specific location is important for improving economic and social benefits for a project" is useful for a decision support system and decision taking, which exists based on the determination of acceptance function of this algorithm. This bioinspired algorithm provides a powerful alternative to optimization problems and decision taking. For these reasons we agree this technique provides a fairly comprehensive with the cultural phenomenon they represent [8]. This technique allowed us to include the possibility of generating experiential knowledge created by the community of actors in a given application domain. The analysis of the level and degree of cognitive knowledge of each community is an aspect to be evaluated as future work. The answer may be found between the communication similarity between two different cultures and how they are perceived. In addition to understanding the real similarities, are different societies based on the features that make and allow keep your own identity, which is developed over time [7]. The "Firefly Algorithm" is a powerful tool, but leaves out many elements of cultural analysis, which provides a chance to innovate new algorithms to rescue of the complexity, chaotic relationships, and social and cultural rights; in this research is possible to construct different scenarios over time according to the execution of each project. Furthermore, this approach opens the possibility to analyze in future work, how to maximize the characteristics of where the project will be implemented to improve the social productivity in places with populations similar to those in Chihuahua but using different techniques related to logistics as in [9].

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References

1. López, A. et al.: Adaptive Objective Space Partitioning Using Conflict Information for Many-Objective Optimization. EMO 2011 (2011) 151-165.
2. Desmond, A. and Moore J.: Darwin - la vida de un evolucionista atormentado. Generación Editorial, São Paulo, Brazil. (1995).
3. Ochoa, A. et al.: Baharastar - Simulador de Algoritmos Culturales para la Minería de Datos Social in Proceedings of COMCEV'2007 (2007).
4. Programa de Procampo en el Estado de México (2012). http://www.sagarpa.gob.mx/Paginas/default.aspx
5. Callogerodóttir, Z.; and Ochoa, A.: Optimization Problem Solving using Predator/Prey Games and Cultural Algorithms. NDAM'2003, Reykiavik; Iceland. (2007).
6. Tang, H. et al.: The Emergence of Social Network Hierarchy Using Cultural Algorithms. VLDB'06, Seoul, Korea. (2006).
7. Vukčević, I.; and Ochoa, A.: Similar cultural relationships in Montenegro. JASSS'2005, England. (2005).
8. Zuckermann, D.: Culture and Organizations, London: McGraw-Hill (1991).
9. Reynolds, R.G.: Networks Do Matter: The Socially Motivated Design of a 3D Race Controller Using Cultural Algorithms. IJSIR Vol. 1, No. 1 (2010) 17-41.
10. Ochoa, A. et al.: Dyoram's representation using mosaic image. The International Journal of Virtual Reality, Vol. 8 (2009)
11. Yang, X. S. (2009). "Firefly algorithms for multimodal optimization". *Stochastic Algorithms: Foundations and Applications, SAGA 2009*. Lecture Notes in Computer Sciences. 5792. pp. 169–178.arXiv:1003.1466.
12. Chatterjee, A.; Mahanti, G. K.; and Chatterjee, A. (2012). Design of a fully digital controlled reconfigurable-switched beam concentric ring array antenna using firefly and particle swarm optimization algorithm, Progress in Electromagnetic Research B, Vol. 36, 113-131.