Using Cultural Algorithms to determine concentrations of LiBr related with an Absorption System

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Abstract. Many problems involve not structured environments which can be solved from the perspective of Bioinspired Algorithms used in a plethora of application domains [7, 8]. In this research analyze a hybrid algorithm which permits obtain a sample of combinations from different components to improve the optimization of a Thermal Transformer which is used as a Heat Pump. This prototype takes as input data a set of concentrations (the Lithium Bromure –BrLi- and water to obtain the best refraction index) and analyzing the expectative of collaborative actions in this combination. Using a Cultural Algorithm will be possible generate and test a innovative method, guided by a set of construction heuristics obtained from the possibility of arrive at this ideal concentration, because the temperature varies the result of this refraction index, the prototype can operate in two modes: either generating an unrestricted concentration, or generating a concentration according to one of three predefined best paradigms built by the Space Population. Seven different construction heuristics are tested over different combinations of two sets of initial data, one obtained from the literature used in optics and other using previously samples obtained in the laboratory analysis. A set of numerical parameters are extracted from each test, and evaluated in search of significant correlations. The aim is to ascertain the relative importance of size of initial concentration and construction heuristics with respect to the general acceptability of resulting Thermal Transformer which are validated using Cultural Algorithms.

Keywords: Thermal Transformer, Optics and Cultural Algorithms.

1 Introduction

Nowadays the most important research is about obtain different energy sources, in this moment is a goal of AI community, the application of this kind of prototypes is very necessary but it has always been assigned a very low priority.

The application of the heat pumps has come increasing at present due to the high production costs from electrical energy, this because the heat pumps are thermal

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machines that have the capacity to extract heat of a source of low temperature to use it to higher temperatures, therefore are useful to also take advantage of the heat industrial remainder thus avoiding the contamination.

The operation of the heat pumps depends to a great extent on the cooling or "even mixture of work" that was used in the absorption system. Some heat pumps use the pair of Water Ammonia work, in which the ammonia is the fluid of work and the water the absorbent. Also the lithium salts can be used, most well-known is the mixture Lithium-Water Bromide, in which the water works like fluid of work and the BrLi like absorbent. In this research we had the opportunity to work with two lithium salts: the BrLi-Water mixture and the Carrol-Water mixture, of which a little will be spoken more ahead.

Practical applications in the area of Optics analysis, such as understand the better concentration and behavior of the refraction index and the way to provide more immediate rewards in the refraction index [1]. On one hand the automatic generation of Optics composition involves an advanced Environmental sense. On the other hand it involves an important amount of variability and sensibility. These ingredients are very difficult to characterize formally, and very little is known about how they might be treated algorithmically.

On the positive organize a concentration with different components not requiring an exaggerate precision. If one accepts that the main aim of a concentration is the collaborative work, the general problem becomes tractable. The present paper considers how the different parameters that can be controlled by a hybrid algorithm affect the acceptability of the result. The set of parameters to be monitored are: Each one component and the temperature. The elusive concept of acceptability of a concentration is determined by resorting to hand evaluation by a set of sample of BrLi. By searching for correlations between the stratagem and initial data used to generate the better composition and the positive or negative evaluation of the resulting of it which is obtained about the relative relevance of these parameters to the end result. The paper is organized as follows: in section 2 we analyze the Optics Analysis. In section 3 we described the proposed prototype, in section 4, the results are evaluated, the paper concludes with section 5 explain the conclusions obtained.

2 Optics Analysis

Transmittance versus Absorption

The name of light absorption occur in a material, when the phenomenon of the diminution of energy of a light wave when it propagates by means, due to the transformation of the wave in intrinsic energy of the substance as is shown in Figure 1. Then, we can understand that when realizing an absorption spectrometry, which we are measuring is the interaction that happens between the electromagnetic radiation and molecules or atoms of a chemical substance.

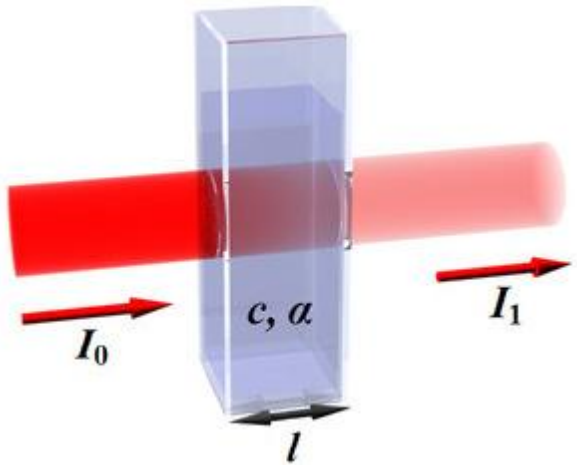

Fig. 1. Absorption Spectrometry.

The rank of wavelength available for this one type of measurements goes from the short length of ultraviolet (UV), to the infrared (NIR); by convenience it is divided in the UV ranks (190 to 380 nm), the region where the perception of the color by the human eye is realized, is known like visible region (380 to 780 nm), the near infrared (780 to 3000 nm) and the infrared to go (2,5 to 40 μm). The phantoms of the UV and twice do not have major specificity degree, thus in determined case could be discarded the use of spectrometer HP4000. Nevertheless, the measurements in the zone of the near infrared (NIR) are better to determine the purities and for many substances it is used to identify them. We define then transmittance and absorbance:

- ***Transmittance***

The optical transmittance that is defined as the fraction of incident light, to a specified wavelength, that happens through a sample, as is shown in equation 1.

It expression is:

$$\boldsymbol{T = \frac{I}{I_0}} \tag{1}$$

Where I_0 is the intensity of incident ray and I is the intensity of the light that comes from the sample. The transmittance of a sample normally is given as a percentage, defined like the equation 2:

$$\boldsymbol{T\% - \frac{I}{I_0} \times 100\%} \tag{2}$$

- ***Absorption***

Absorption (A) is defined as in the equation 3:

$$A = -log_{1_0} T = -log_{1_0} \frac{I}{I_0} \tag{3}$$

Where I is the intensity of the light with a specific wavelength and that (intensity of the transmitted light) is passed through a sample and I_0 is the intensity of the light before it enters the sample (intensity of the incident light). The absorbance measures frequently are used in analytical chemistry, since the absorbance is proportional to the thickness of a sample and the concentration of the substance in this one, in resistance to the transmittance I/ I_0, which exponentially varies with the thickness and the concentration.

- **Beer-Lambert Law**

In summary, the law explains that there is an exponential relation between the concentration of the substance and the transmission of the light through her, as well as between the transmission and the length of the body that the light crosses. If we know l and the concentration the substance it can be deduced to divide of the amount of transmitted or absorbed light. From the above one determined that the later tests will be all of absorbance. A concentration may be an unstructured sequence of components, but this paper is concerned specifically with a LiBr Concentration that makes use of known compound-multi strategy (issues with different refraction index). In such cases, the formal rules that govern the chosen Optics form can be used to guide the generation process. A thermal transformer consists of an adequate combination of Br and Li together (in which case the different concentration is usually organized) to obtain the better Refraction Index.

3 Description of Intelligence System

The prototype requires a set of initial data to start the generation process: a repository of samples and a set of temperature and humidity patterns associated with a concentration. The choice of alternate different level of concentration improves the skills of refraction index. The set of Optics patterns can be considered as a set of descriptions of best concentration in the literature, in the sense that it encodes information about important parameters (environmental attributes and combination of elements) while allowing a certain leeway in terms of specific content (particular skills) of the present solution. The set of initial data is obtained as follows. Given a set of combinations, it is split into value of each one according the velocity of increase their performance. All the issues in a repository will be included in the proposal concentration. The resulting values of the original elements are used to produce the reference patterns. In order to compare the effect of the choice of a element from an Optics Repository of quantity of an element, two distinct set of data are used to test the programs. The first set of data is obtained from a set of Optics patterns. The second set of data is taken randomly from an academic

work in the field of Optoelectronics. A certain concentration [4] of equivalent performance is chosen, their features are included, and a set of reference patterns is built with a required develop of properties and encoding the necessary information.

3.1 Hybrid Algorithm

The proposal algorithm is based on Cultural Algorithms which permit organize the best strategies to reach the best concentration using the different ways to obtain better refraction index [2,3]. Cultural Algorithms work together to find the optimal solution to a given problem and built a set of stratagems [5, 6] to analyze each group of skills associated to a Material. Generation starts with the selection of appropriated Optics patterns, based on criteria designed to ensure that there is a minimum of coherence across the elements in the concentration. From this pattern an empty draft of the current concentration is generated.

The elementary generation cycle can be described as follows:

1. Randomly choose from the given elements in the repository that matches the first category of the current concentration according at level related with the refraction index.
2. Append it to the draft of the current segment
3. Eliminate the corresponding noisy in the components from the current segment pattern
4. Test whether the resulting concentration draft satisfies the conditions of the strategy being used – and the required size of segment in number of different skills
5. If the conditions are satisfied, iterate from 1.
6. Concentration's issues that either violates the conditions to improve, or overshoot or fall short of the given number of value of modification are rejected

The generation of a specific material requires two additional features to be solved, both related to the restrictions imposed on each Optics patterns. One concerns the choice of best conditions to use for the next strategy related with the component. This issue is independent of the particular goal. The other concerns the different value of apportion in each element, and is governed by their particular skills.

4 Evaluation of results

Three different sets of experiments were carried out. In each experiment of the first set, the versions of the system corresponding to different strategies for the build to best material with more different components using Cultural Algorithms for improve their development because this technique can simulate an artificial society to evaluate the combinations and results of these. The experiments of the second set were designed to evaluate which of the strategies for validating the current draft to a proposal final composition gave better results using CAs. For both the first and the second sets of experiments, each component was evaluated attempted to generate

diverse scenarios related with concentration, operating in standard style mode. A set of 37 samples in the laboratory was used to provide initial data, and Optics patterns were respected. The third set of experiments was carried out using only a version of the system that combined the strategies that had obtained better results over the previous sets. Comparisons were established between results obtained for different combinations of initial data. In this set, each proposal concentration generates possible scenarios in the final result as the shown in Figure 2.

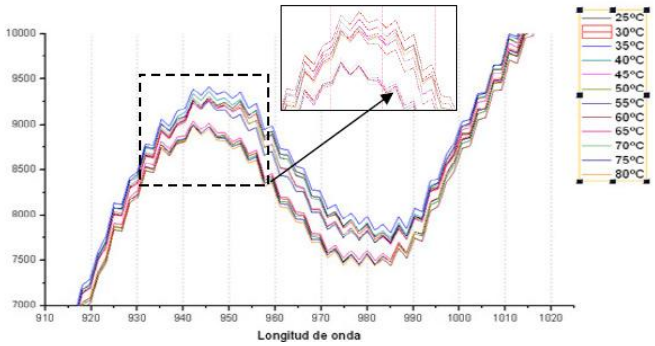

Fig. 2. - Results of environment with all the information about the performance on the time with different temperatures.

4.1 Acquisition of resources and Initial Data

Different resources for initial data (components and environmental attributes) extensions of Optics patterns search in this material, two possible ways of improve the component is determine which element is better obtain and the time to will obtain the better refraction index to develop skills and obtain best results. A total of 247 trials were carried out (37 different set of elements and 12 different combinations to organize). Many of the resulting material were either sustainable incorrect. For this reason, evaluation took place in two stages. During the first stage every resulting material was assigned three numbers: (1) number of issues in the component, (2) a value for its sustainable correctness, and (3) a value for its skills rating. These values are used as a first stage of filtering to avoid wasting evaluation effort on components that have poor skills or without sustainable value. Values were assigned on first inspection by one sample of evaluators (21 cultural algorithms' space population).

A component is considered weakly connected itself, if it can be parsed in some way as a set of independent elements. A final component is considered strongly connected if at least some of the elements join together into a variety of skills that make Optics sense.

Performance rating was subjectively evaluated on the following scale:

1. Nonfunctional
2. Mediocre

3. Acceptable
4. Pleasing
5. Adequate

4.2 Discussion of the Results

The results contain an enormous amount of information, only part of which has been analyzed at this stage. However, some very interesting conclusions can be drawn from the resulting facts. Since it had been assumed that the first choice of Optics patterns (for example the stability of the produced material) plays an important role in determining the quality of Refraction index. This hypothesis is validated by the fact that only seven of the 45 acceptable proposal materials were generated using the set of initial data (the best combination of components is reach after 247 days search the better combination, for this reason is better use our proposal Hybrid Algorithm which obtain a better solution in 19 days). Overall, only nine of the combinations that were tried managed to produce a material that went into the final selection. Of these, only one of them was not using an extended version of the original repository (obtaining recommendation from randomly combination in the past). However, that very one did produce the top scoring materials according to the evaluation of properties. This suggests that in general terms the system performs better with a wider choice of options of elements and their development when are together, unless the random factor in the generation process actually comes up with a material that closely mirrors the first randomly (which is what happened in this case). While it is clear that recovering the first material organized to give an acceptable result, this is hardly a desirable solution. Two of the combinations that produced most top scoring materials were working with repositories that had been extended with extra values related with environmental properties as is analyzed in Figure 3. These conditions tend to appear more often than others in the final material. However, it produces very interesting results from an Optics point of view. While no way has been found yet to evaluate this fact numerically, it has been observed informally by many of the evaluators and it should be taken into account for further analysis.

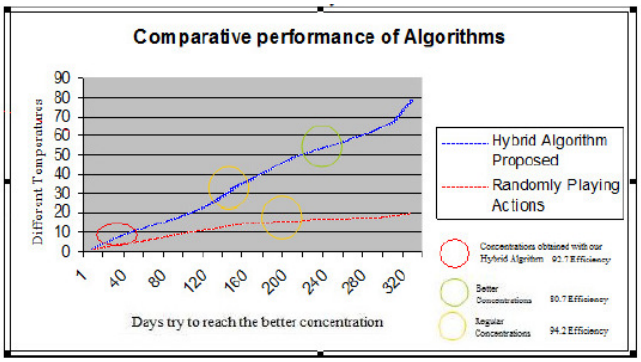

Fig. 3. Comparative Analysis of Hybrid Algorithm proposed and randomly selection actions in the search of an adequate combination.

Conclusions

The present experiment is intended as preliminary work in a project in developing Optics knowledge based on Evolving Compute. The results obtained will help to discriminate between the different possible strategies and stratagems to obtain a better concentration. Additional knowledge and heuristics governing the selection of appropriate patterns to follow a given group of samples might be used either to guide in the construction of a better refraction index or to eliminate poor results. Several interesting insights have been obtained from the analysis of the results presented here. Better heuristics must be developed to select of appropriate pattern for the next concentration [9]. Optics patterns should be distinguished in some way according to whether they are beginning, middle or end sections of a combination of two elements. The evaluation procedures are still subject to a great deal of improvement. In a matter where subjective opinion of the person in the laboratory, special effort must be made to devise an evaluation procedure that provides a rigorous rating without interfering with the environment attitude of the evaluator as user of this kind of components to improve [10]. A future research is analyzed the variations of this component using another Artificial Intelligence technique named: Case-based reasoning [11] to reach the top level of efficiency and try to improve the energy obtained developed by this.

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