Improving User-Interface of Interactive EC for Composition-Aid by means of Shopping Basket Procedure

Daichi Ando
Tokyo Metropolitan University
6-6, Asahigaoka, Hino
Tokyo, Japan
dandou@sd.tmu.ac.jp

ABSTRACT

The use of Interactive Evolutionary Computation(IEC) is suitable to the development of art-creation aid system for beginners. This is because of important features of IEC, like the ability of optimizing with ambiguous evaluation measures, and not requiring special knowledge about art-creation. With the popularity of Consumer Generated Media, many beginners in term of art-creation are interested in creating their own original art works. Thus developing of useful IEC system for musical creation is an urgent task. However, user-assist functions for IEC proposed in past works decrease the possibility of getting good unexpected results, which is an important feature of art-creation with IEC. In this paper, The author proposes a new IEC evaluation process named "Shopping Basket" procedure IEC. In the procedure, an user-assist function called Similarity-Based Reasoning allows for natural evaluation by the user. The function reduces user's burden without reducing the possibility of unexpected results. The author performs an experiment where subjects use the new interface to validate it. As a result of the experiment, the author concludes the the new interface is better to motivate users to compose with IEC system than the old interface.

Keywords

Interactive Evolutionary Computation, User-Interface, Composition Aid

1. INTRODUCTION

1.1 Composition-Aid IEC

In Interactive EC for art-creation by Dawkins[4], both advantages of the stochastic techniques have been consistent with the deterministic advantage.

In an IEC method, an initial population is generated randomly according to the user's instructions. Then the population converge based on the interactions between the user and the System. Eventually, the user get results that don't need to be corrected anymore. Also, IEC systems apply genetic operators, such as crossover and mutation, on a random basis, to allow the user to discover unexpected and potentially promising results from the stochastic methods.

Many gene representations and user-interfaces have been tried for application of IEC to composition assistance. A general review on the application of EC, especially GA and GP, to composition can be found in [2]. Also there are important studies about musical structural chromosome for composition[3, 5, 6, 7].

1.2 Problems of User-Interface of Composition-Aid IEC

1.2.1 Identifying individuals

In spite of their usefulness face poorly defined fitness functions, composition-aid systems from previous works have some issues regarding the user interface. The interface of most of these systems is constructed using only CUI. This is because the user interface for a basic IEC composition-aid system requires only two elements: one output, the piece playback, and one input, the fitness value. Also, most systems are built with only their own developer in mind, who usually is a composer who completely understands the gene representation and the composition process of their own system. In many cases, the system is designed only for their own creations. Thus expensive user-interfaces are not required for them.

When the system has a GUI interface, it consists only of a playback button (sometimes also a stop button) and a radio button to input the fitness value.

Consequently, there is a small number of works on IEC composition-aid systems. Among the most significant works the CoNGA[7] system uses a Multi-Field user-interface to combine small rhythms patterns and functions that connect these patterns.

The most important point of composition-aid IEC is that the object being generated is a time-based media. The key difference between the composition-aid IEC and IEC for normal art creation, such as computer graphics, is that the characteristics of time-based media cannot be properly displayed in a 2D user-interface.

The first means that to evaluate time-based media it is necessary to listen to the whole piece at least one time, if there is only a playback button on the IEC interface. In this way, it is difficult to identify different individuals at a glance. Therefore in music IEC, the user should listen all individuals carefully from begin to end, and so serious user's burden emerge.

By contrast, visual art can be displayed in such a way that the user can visualize all the individuals at the same time, and decide their fitness values at a glance.

1.2.2 Problems of Applying GA Scenario

Figure 1 shows a typical procedure named Genetic Algorithm Scenario to evaluate individuals on almost composition-aid IEC. The our developed interface is applied on the such like composition-aid IEC system.

To evaluate all individuals with the existing GUI for composition-aid IEC , the user repeats (1) process in the figure. The (1)

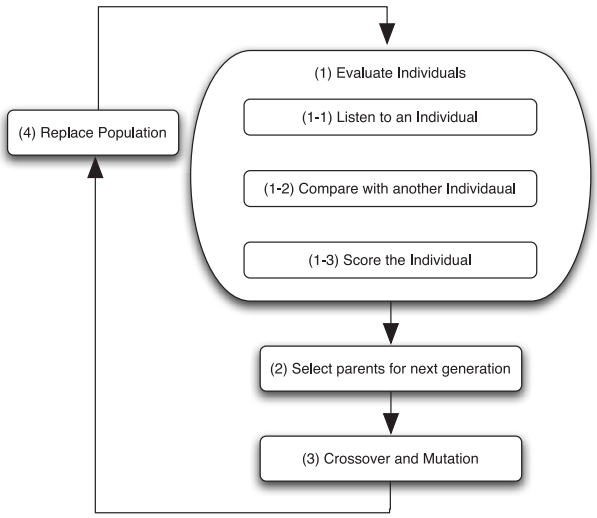

Figure 1: Procedure of traditional GA Scenario

process consists of not only 2 process, (1-1) Listen to an individual and (1-3) Score the individual. Almost the user compares the individual with another individuals to give score. The comparison process corresponds to the (1-2) process in the figure. Also these three processes are executed not always by turn. Sometime, an evaluated individual given score again after comparison with an another individual. The repeat processes in no particular order without serious burden is important for composition-aid IEC interface.

2. SHOPPING BASKET FOR COMPOSITION-AID IEC

2.1 Shopping Basket Procedure

To solve these problems of past systems, the author proposed a new interface "Shopping Basket" for musical composition-aid IEC. Shopping Basket improves procedure of evaluating individual, also the interface does not reduce unexpected good artistic results.

Features of the proposed interface are as follows:

1. Divided evaluating procedure based on Shopping Style to reduce evaluation, listening, burden.
2. Evaluating Individual with drag & drop area change.
3. Similarity based reasoning (SBR) by means of moving similar individuals into other areas at the same time. The SBR does not prevent that unexpected good artistic results emerge.

Figure 2 shows an overview of the Shopping Basket procedure IEC interface. Individuals are displayed as colored sphere icons. The user can listen individual, clicking the individual icons. Also the Shopping Basket interface is divided into five area. To evaluate individuals, the user should move individual icon into other areas by drag and drop.

The Shopping Basket procedure is based on moving state of goods in shopping basket. Figure 3 shows the proposed procedure, individual icon moving between areas is shown in the figure 2.

1. Listening to individuals lightly in "Un-evaluated Area" (1), moving un-favorite individuals to "Dust Box"(5) and favorite individuals to "Compare Area"(2).
2. Listening to individuals carefully in "Compare Area".

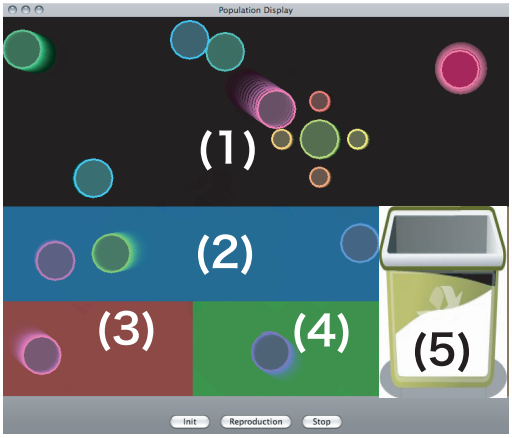

Figure 2: Overview of Shopping Basket IEC Interface

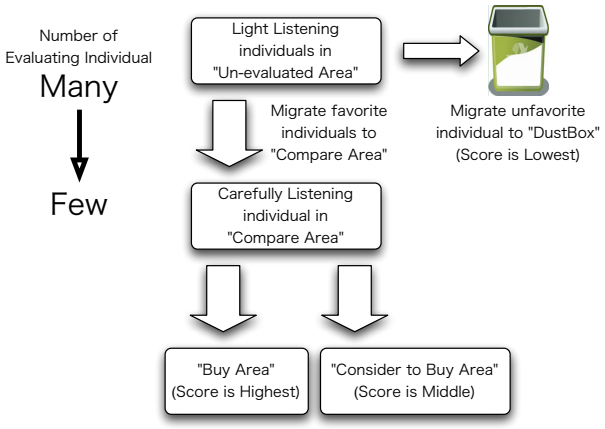

Figure 3: Evaluating Procedure of Shopping Basket

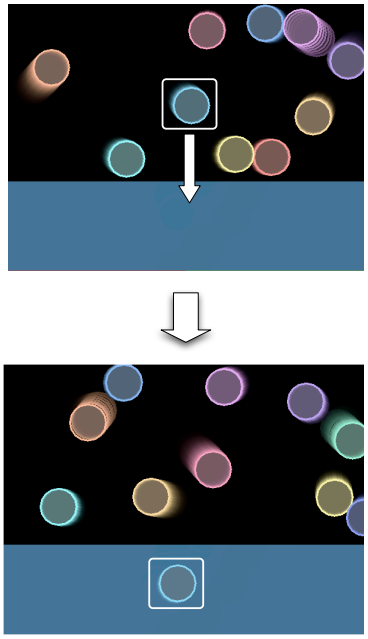

Figure 4: Evaluation - changing area in Shopping Basket

3. Move favorite individuals to "Buy Area"(3).
4. Move not so favorite individuals to "Consider to Buy Area"(4).
5. Indicate system to reproduction.

Score, fitness, which given individuals in "Buy Area" is highest, in "Consider to Buy Area" is middle. Individuals in "Dust Box" are given lowest score.

Figure 4 shows area change movement of individual icon to evaluate. In this case, the user drags an individual icons in white frame at the upper figure, then drops the icon into bottom area in the lower figure.

Most difference between the proposed the Shopping Basket evaluating procedure and the traditional GA Scenario procedure that shown as figure 1 is listening burden of the user. In the GA Scenario procedure, all individuals should be listened very carefully any number of times. However, in the proposed procedure, un-favorite individuals are removed in the first process of the procedure without carefully listening. Thus the user can pay attention to only few their favorite individuals.

Also in the GA Scenario procedure, as mentioned before in section 1.2.2, the user should re-decide fitness score over and over, (1) process in figure 1 repeated by the user. This is due to that fitness score is relative evaluation in a population; therefore measure of fitness score is fluctuating sharply evaluating in a generation in the GA Scenario. On the other hand, in the Shopping Basket, evaluation procedure is not repeated. The user marks fitness on individuals as absolute scale naturally. The author expects that this difference that the actual number of times the user listening individuals is useful for reducing user's burden. It is notable that the number of times to evaluate is treated as a measure for efficiency tests of non-interactive EC algorithms.

In addition, there is another difference is that the area change evaluation. In the traditional GA Scenario, the user should give fitness score to every individual. The author expects that the evaluation by means of area change of individual icon that reduces user's mental burden. This is due to some our preliminary experiments results about IEC suggests such possibility.

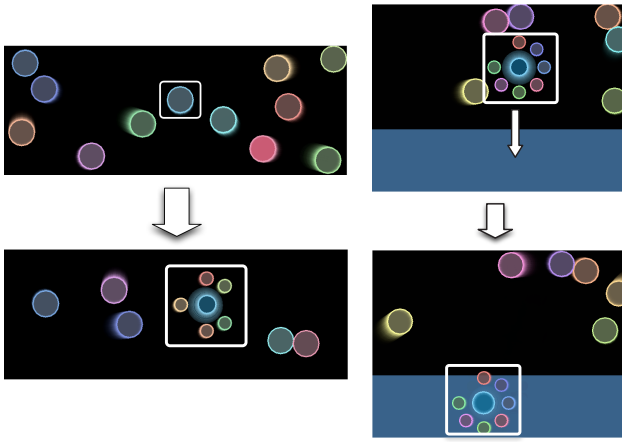

Figure 5: SBR : Function to draw similar individuals up to the target individual, then change area simultaneously with similar individuals.

2.2 Similarity-Based Reasoning

Figure 5 shows work flow of Similarity-based Reasoning (SBR) function. The user can draw similar individuals up to the target individual. In the left-up figure, a target individual is displayed walled in white frame, then similar individuals in same area are drawn up to the target individual as shown in the left-down figure. Then, the user can move all individual that drawn up into other area simultaneously as shown in the right figure.

It means that the user can give the same fitness to similar individuals at once. This function works as SBR. Also the user can listen the drawn up individuals at any time by mouse over action. This means that the user does not failed to catch unexpected good results.

3. VALIDATION OF SHOPPING BASKET

3.1 Experimental Detail

The author performed an experiment where subjects use the proposed interface to validate that the proposed interface and evaluation procedure, the area change of individual icon, the shopping basket procedure and SBR provides functions which reduce user's burden by means of a subjective questionnaire testing.

As composition-aid EC engine, "CACIE" system[1] was used. CACIE is a one of IEC composition-aid system by means of Interactive Genetic Programming.

To make comparative study, two exists user-interfaces are used.

The first one is "Ordinary" type interface which applies normal IEC into the music creation, shown as figure 6. Only two functions, "Play" button to listen individual and slider to which give fitness, are provided by the interface.

The second one is "Circle" type interface, shown as figure 7, which individuals are displayed as sphere icon too. Also playback function is provided as clicking individual icon the same as the Shopping Basket. However, there is differences between the Shopping Basket and the Circle type interface about how to give the fitness. In Circle type interface, the position of an individual icon, its distance from the center of the circle, determines the fitness value of that individual. A higher fitness degree is indicated by a position nearer the

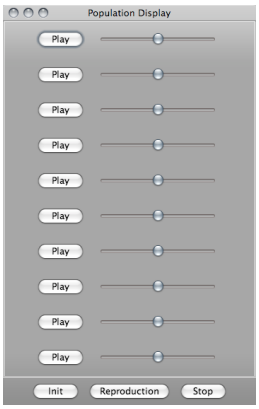

Figure 6: "Ordinary" type interface.

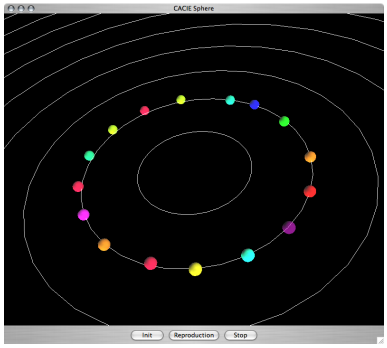

Figure 7: "Circle" type interface.

center of the circle, and a lower fitness value is indicated by moving the individual away from the center. The initial position indicates a neutral fitness value. It means that clear difference between the Shopping Basket and the Circle type is that existing of divided areas.

The number of subject is ten. Each subject had tests the three interfaces in random order. Each after of test for one interface, subject filled out the questionnaire.

3.2 Subjective Questionnaire

Each question of the questionnaire is as follows:

1. It was difficult to distinguish each individual.
2. I listened individuals without stress.
3. I could identify each individual easily, it was easy to listen to compare individuals.
4. Action of evaluation was easy to understand.
5. I was lost in thought to evaluate for a long time.
6. I enjoyed this composition time.
7. I hope to use this interface to composition.

Each subject answered these questions in 5 degree, 1.Strongly Agree, 2.Agree, 3.Cannot judge, 4.Disagree, 5.Strongly Disagree.

Figure 8 shows result of questionnaire that average of score of all subjects. Also results of applying ANOVA(5%) to the questionnaire answers are shown in table 1, three significant differences between the proposed Shopping Basket and the others are occurred. Total ANOVA result shows that the Shopping Basket surpass other interfaces.

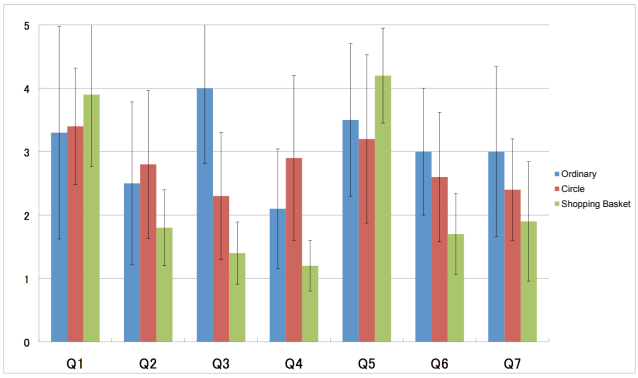

Figure 8: Result of questionnaire. Average of each questions are displayed. Error bar means standard deviation.

Q3	Shopping Basket = Circle < Ordinary
Q4	Shopping Basket < Circle = Ordinary
Q6	Shopping Basket < Circle = Ordinary

Table 1: Result of ANOVA(5%). These 3 questions have significant differences.

4. CONCLUSION

In this paper, the author has presented improvements interface of composition-aid IEC by means of Shopping Basket procedure. As the result of subjective evaluation experiment, the proposed Shopping Basket reduces user's burden was confirmed.

The theme that reducing user's burden without filtering unexpected results have been critical theme of studies about composition-aid IEC. We need to continue to study about user-interface to realize composition-aid IEC for actual use.

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