Juuso Pajasmaa juuso.p.pajasmaa@student.jyu.fi

TIES5830 Project description

1 Abstract

Shortly the problem is to create selection criterion for probabilistic online RVEA. In this selection criteria, instead of using mean posteori APD angles, I will compute the expected improvement of APD using exact APD computed from exact function evaluations. This expected improvement of APD will be used as the selection criteria in RVEA selection part.

2 Probabilistic RVEA

The implementation of selection for probabilistic RVEA uses two different subpopulations during selection, subpopulation and exact subpopulation. First subpopulation is using the Pwrong class to draw samples and then the ones that are close to the current reference vector will form that subpopulation. Exact subpopulation is formed similarly but instead of using samples, I am using the exact objective function values that are close to the current reference vector. This means sometimes that there is no exact subpopulation members.

To tackle this, first I just used the mean apd values to fill the selection in the case of no exact subpopulation members were found. This was somewhat decent but not the wanted approach. And as the figures 1 and 2 shows results looked very similar to just using mean apd values.

2.1 Using expected improvement of APD

The point was to compute the expected improvement of APD exact and use that as a selection criteria.

Currently there are following implementations.

When there are exact subpopulation members I calculate the expectation of exact APD improvement with

$$u(x) = max(0, f^* - a_j)$$

where f^* is the best exact APD value and a_j is the sampled apd value. Then I select the maximum of u in selection.

When encountering empty exact subpopulations one approach was just to the mean posteori APD angles instead. They also could be ignored, this did not work at all. After couple of iterations, evolvers populations were empty or mostly empty.

Other one, the suggested way, is using the expectation of APD for empty exact subpopulations. So I started to work on that. The calculation goes sameway but instead of using best exact APD value as f^* I just use best sampled APD value as f^*. Then I also tried taking mean of the results as best value aswell. This was experimental and it brought different results compared to using just the posteori mean apd. The figures 3, 4, 5, and 6 show these.

As of right now, in exact APD there is no optimizing the expected improvement, I just take the maximum APD exact and then select the corresponding individual. This should be done to my understanding, although the possible multimodality of the EI might be challenging and make iterations computationally heavy. The current way is pretty fast. It is notable also that with these methods in DL

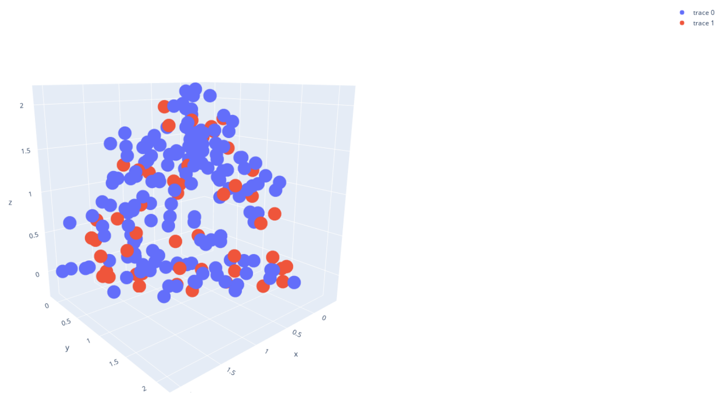

Figure 1: DTLZ7 with exact expected APD and using mean posteori APD when there are no exact subpopulation members

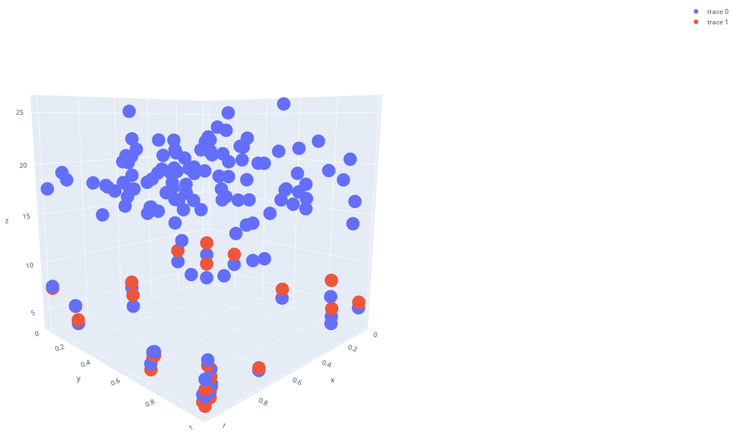

Figure 2: DTLZ7 with exact expected APD and using mean posteori APD when there are no exact subpopulation members

3 Testing and Results

Tested with DTLZ problems 2, DTLZ7. With 10 decision variables and 3 objectives and 109 individuals each case. After iterations were done, online evaluations of the non-duplicate individuals were done. In the plots the purple dots are the all of the archive objective values, so including the online with exact objective functions evaluated solutions. The orange dots are the Probabilistic RVEA evolvers populations objective values at the end of iterations. These are offline and have only been updated using the surrogate.

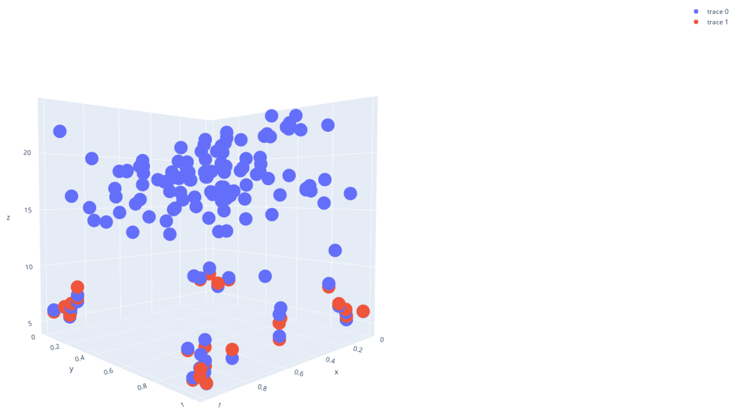

Figure 3: DTLZ7 with exact expected APD and using max expected APD when there are no exact subpopulation members

4 Summary

Using the mentioned expectation of APD in both subpopulations showed not as good results regarding to converging to the Pareto front. There is probably problem with the implementation or the current implementation idea is just bad. Goal was to use something else than mean posteori APD for cases when there was no exact subpopulation members. Ignoring subpopulations where there was no exact members led to population quickly disappearing and only leaving 2 individuals per selection who were picked randomly from the population.

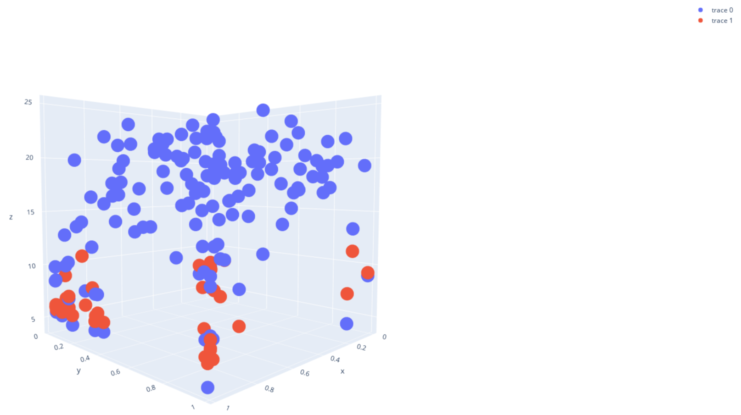

Figure 4: DTLZ7 with exact expected APD and using mean expected APD when there are no exact subpopulation members

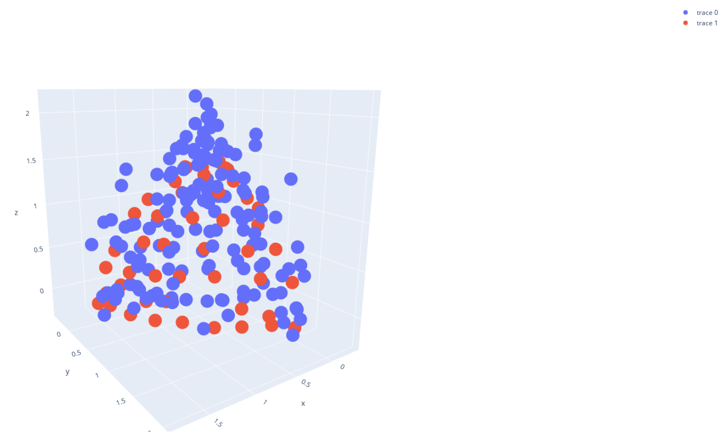

Figure 5: DTLZ7 with exact expected APD and using max expected APD when there are no exact subpopulation members

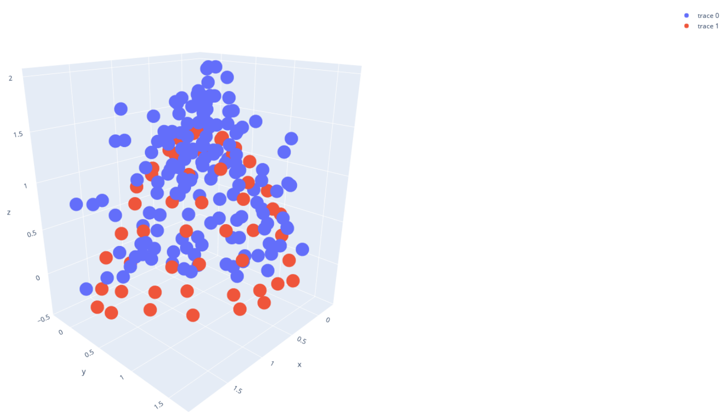

Figure 6: DTLZ7 with exact expected APD and using mean expected APD when there are no exact subpopulation members