An Efficient Quadratic Curve Approximation Using an Intelligent Genetic Algorithm

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1. INTRODUCTION

This paper proposes an efficient GA-based quadratic curve approach for solving the optimal shape approximation problems. To cope with the large parameter optimization problem, an intelligent genetic algorithm (IGA) [1] is applied for solving the shape approximation problem. The advantages of our method, IGA-based quadratic curve approach (QC-IGA), are the higher compression ratio and the higher quality. The performance of QC-IGA is compared to the quadratic curve (QC-GA) and polygon approximation approaches, YinGA [2] and EEA [3]. It is shown empirically that QC-IGA outperforms QC-GA, Yinga and EEA for solving shape approximation problems.

2. IGA-BASED QUADRATIC CURVE APPROXIMATION

It is important to find the criterion for approximating the original shape boundary. The fundamental problem is to locate the essential points in such a way that approximates the original shape boundary as good as possible. We use IGA to find those essential point. The objective function is to minimize the approximation error E_2 defined as follows:

$$E_2 = \sum_{j=1}^{K} \sum_{i=1}^{n} (n_{new\,i} - n_i)^2 \quad ,$$

where K is the number of essential poins, n is the number of points in *j*th segment, $n_{new\ i}$ are the new points that created by quadratic curve approximation in *j*th segment, and n_i are original points in *j*th segment. For each segment, the quadratic curve is obtained from minimizing the mean square error between the generated quadratic curve and the original shape. Note that no iteration is needed in deriving the quadratic curve and only little additional storage is needed for recording the quadratic curve than line segment. QC-IGA in herits of IGA can maintain the feasibility of chromosomes after crossover operations.

3. EXPERIMENTAL RESULTS

An USA map with 900 points [3] is used to demonstrate the efficiency of the proposed algorithm QC-IGA. The comparisons of all participated algorithms are reported in Fig. 1. Furthermore, various sizes of images are used to illustrate the merits of QC-IGA in solving the large shape approximation. The relationship pairs for the number of points and the average E_2 error ratio 'QC-IGA/YinGA' are (45, 54.3%), (60, 77.0%), (102, 35.0%), and (900, 27.0%) for polygons.

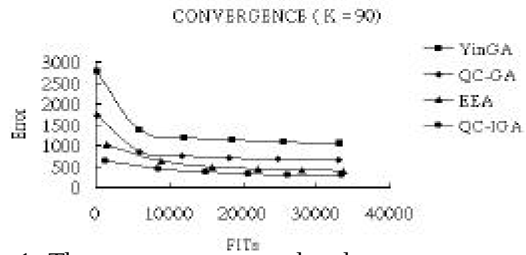

Fig. 1. The convergence speed and average accuracy of YinGA, QC-GA, EEA and QC-IGA. All results are reported under the same FITs with *K*' s value.

4. CONCLUSION

The IGA-based quadratic curve is superior in solving shape approximation problems, especially in solving large shape approximation problems. Therefore, QC-IGA combines the advantages of IGA and QC, which is a general method that can approximate the large image shape no matter the main segment is line or curve.

REFERENCES

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