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A Fast Color Information Setup Using EP-Like PSO for Manipulator Grasping Color Objects

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How to separate useful information from the raw image data is an important issue to all the applications of visual servoing. Without accurate positions of objects, a manipulator cannot move to the right position and grasp the target what we want. This paper presents a novel approach to classify different color objects, obtain the target image, and build a lookup table based on the preceding information.

Finding appropriate HSV (Hue, Saturation, Value) thresholds, which will help manipulator to find the correct targets, is the main topic of this paper. We integrate particles swarm optimization (PSO) algorithm [1]-[2] with the evolutionary programming to realize an EPSO algorithm, which is shown in Fig. 1. The proposed EPSO method not only enhances learning speed, but also can solve local minimum problem.

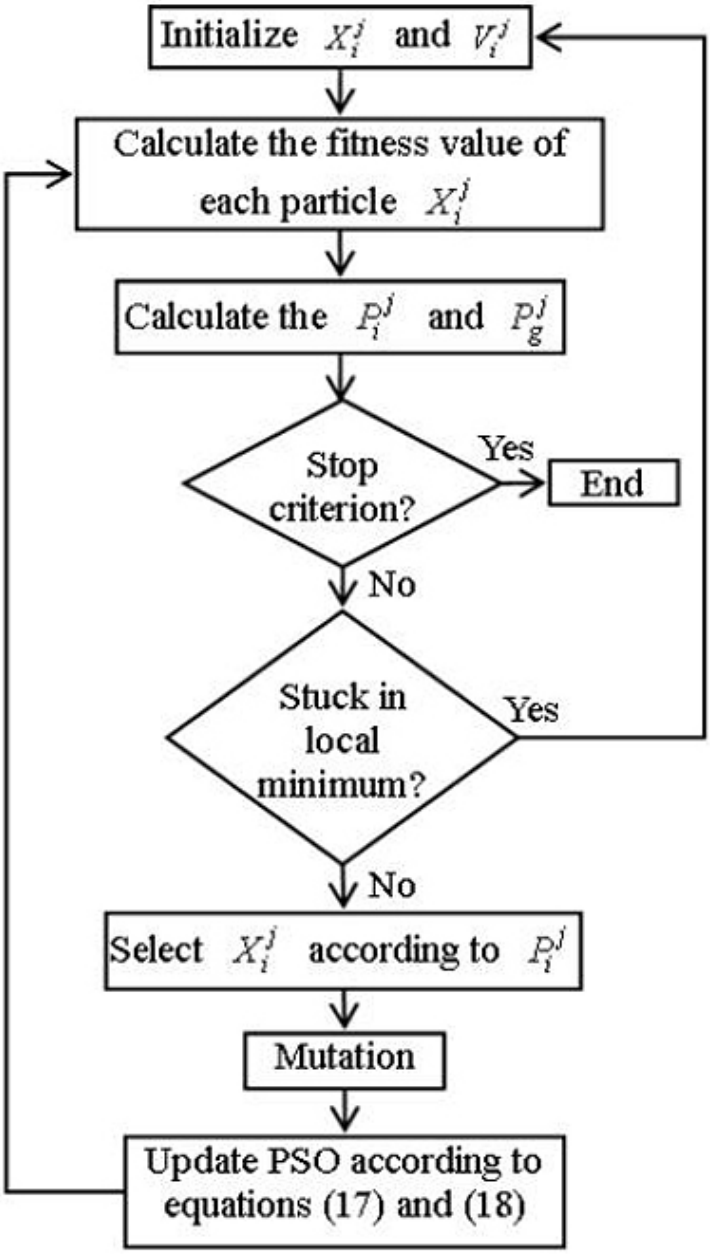

Figure 1. Flowchart of EPSO algorithm.

Through experiments, we demonstrate that our approach is reliable and can be used in real-time systems. From Tables 1-2, we find that EPSO is faster and less failure than PSO. The comparison among the PSO methods and the EPSO methods is shown in Fig. 2(a), and Fig. 2(b) shows that a partially enlarged figure for first 40 iterations. Besides, the developed robot arm has won the championship in the autonomous pick-and-place manipulator competition for the consecutive three years in TIROS. The real-time competition results are demonstrated in Fig. 3.

Table 1.

Experimental results of different colors in 100 runs for PSO

Color	Avg. iterations	Std.	Avg. Time (sec.)	Failure
Red	27.89	29.26	3.43±3.37	10
Green	27.02	36.47	3.19±4.08	19
Blue	7.24	10.31	1.05±1.81	1
Yellow	14.85	17.76	2.68±3.4	3

Table 2.

Experimental results of different colors in 100 runs for EPSO

Color	Avg. iterations	Std.	Avg. Time (sec.)	Failure
Red	10.49	8.19	2.14±1.60	0
Green	6.20	5.09	1.24±0.94	0
Blue	4.38	3.84	0.95±0.74	0
Yellow	5.19	4.19	1.17±0.85	0

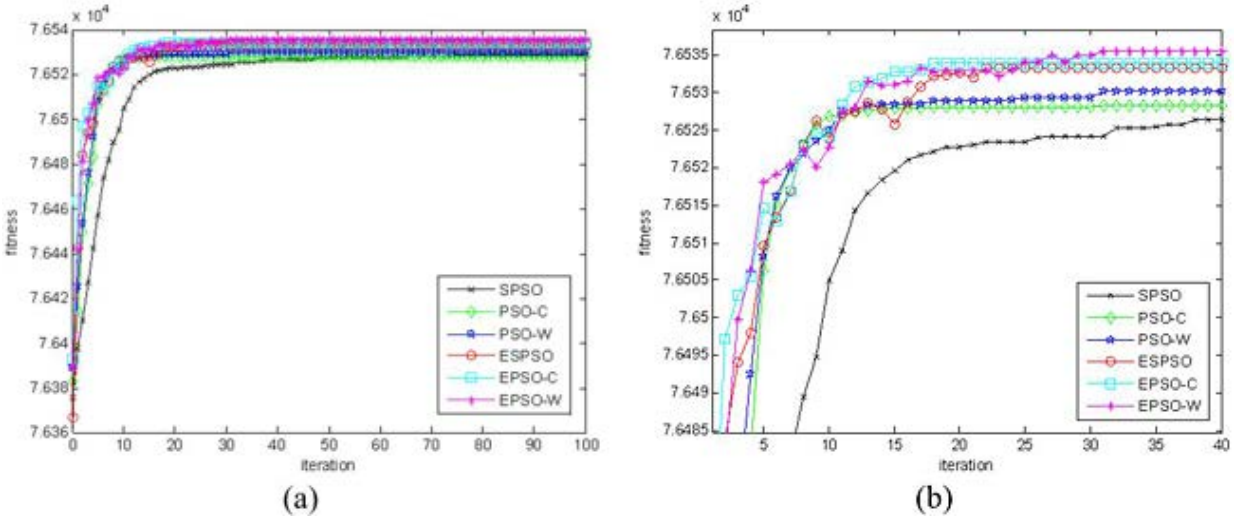

Figure 2. (a) Comparison among the PSO methods and the EPSO methods.
(b) A partially enlarged figure for first 40 iterations.

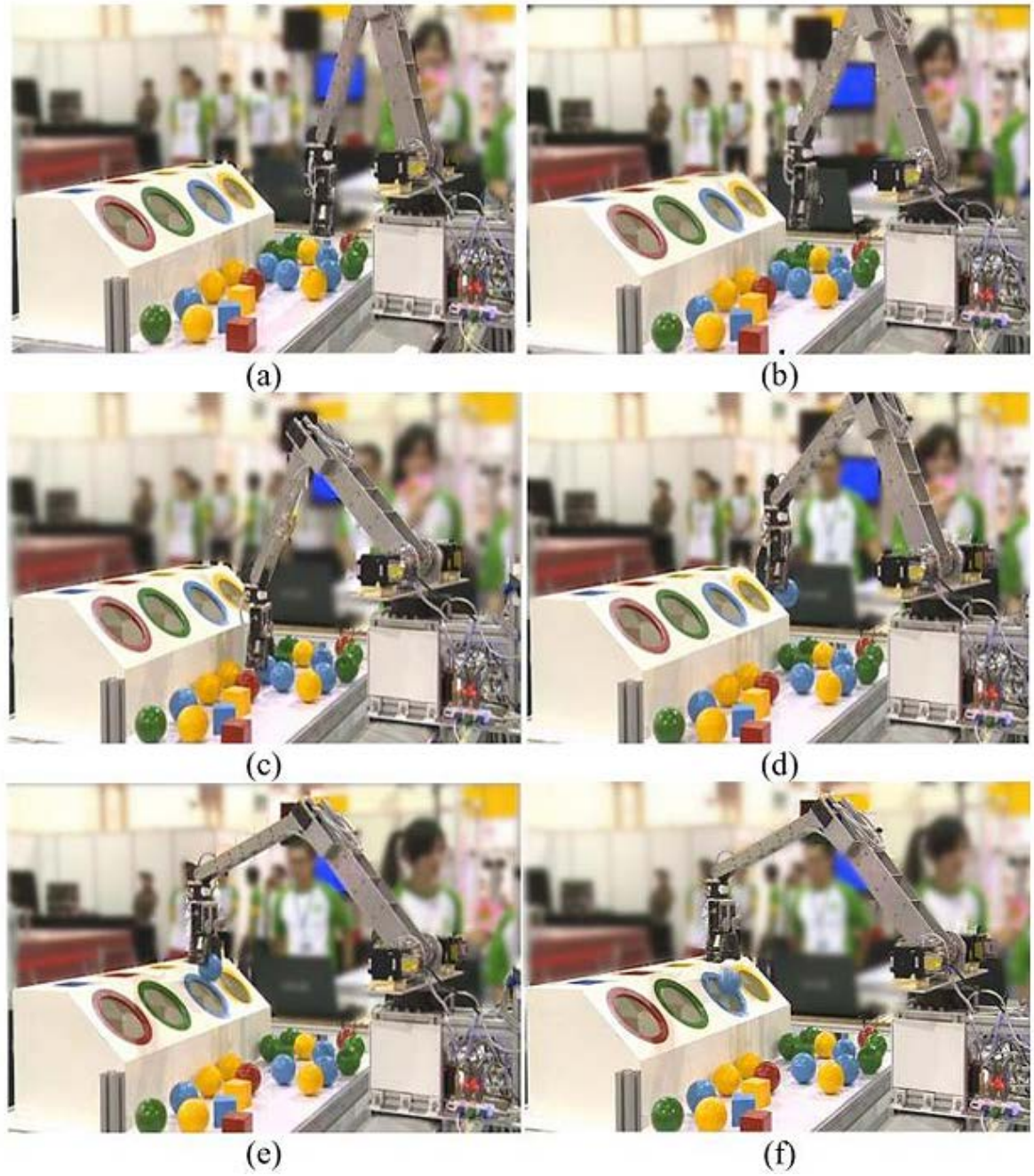

Figure 3. Manipulator grasps the softball and puts it into the correct hole of the box.

References:

1. R. Eberchart and J. Kennedy, “A new optimizer using particle swarm theory,” in Proc. 6th Int. Symp. Micro Machine and Human Science, Nagoya, Japan, Oct. 1995, pp. 39-43.
2. J. Kennedy and R. Eberhart, “Particle swarm optimization,” in Proc. IEEE Int. Conf. Neural Networks, 1995, pp. 1942–1948.