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APPLICATION OF PARTICLE SWARM OPTIMIZATION-BASED CLUSTERING METHOD TO REDUCE SMT SETUP TIME FOR INDUSTRIAL PC MANUFACTURER IN TAIWAN

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Abstract. *This study intends to propose a two-stage clustering algorithm which consists of adaptive resonance theory 2 (ART2) neural network and binary particle swarm K-means optimization (BPSKO) algorithm for grouping the orders together in order to reduce the SMT setup time. The BPSKO algorithm integrates both the particle swarm optimization algorithm and K-means algorithm. Besides, roulette selection operator is applied for avoiding premature convergence. Simulation results using four data sets, Iris, Wine, Vowel, and Glass are very promising. The results for an international industrial personal computer (PC) manufacturer show that the proposed algorithm, ART2+BPSKO, is superior to continuous particle swarm optimization algorithm. Through order clustering, scheduling orders belonging to the same cluster together can reduce the production time as well as the machine idle time.*

Keywords: Clustering analysis, SMT production system, ART2 neural network, Particle swarm optimization algorithm

1. **Introduction.** One of the characteristics of industrial personal computer (PC) industry is its high-mix low-volume, or high customization. It is totally different from that of regular PC manufacturing. This is also the biggest challenge that the industrial PC industry has to confront with. In this industry, printed circuit board (PCB) assembly is a fundamental manufacturing process, in which surface mount technology (SMT) plays a very important role. By applying the SMT production system, not only there can be more components on the limited space of a PCB, but also the production efficiency and product stability can be enhanced. However, the high-mix low-volume production style is still an issue for the SMT production system. In this production system, frequent production line-change is a very serious bottleneck because production labor must prepare for the materials and also bind these materials before line-change, which is very time-consuming. If production labor cannot complete these tasks before the next order starts, it would cause idle time for these expensive machines and decrease the production capability utilization. Currently, this problem is frequently encountered in the SMT production system, and the only way it can be handled is to prepare for more materials and increase the binding labors. Thus, how to reduce the setup time for SMT line-change operation is a very important issue. The SMT manufacturing process is illustrated in Figure 1.