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A Neighborhood Search Heuristic for PCB Placement Sequence Optimization

R Krishnan, D Li, and SW Yoon

Department of Systems Science and Industrial Engineering
State University of New York at Binghamton
Binghamton, NY 13902

Corresponding author's Email: yoons@binghamton.edu

Abstract: This paper addresses a neighborhood search algorithm for placement optimization in printed circuit board (PCB) assembly process. Especially, a single gantry rotary type surface mounting machine (SMD) with multiple heads was studied in this research. Production efficiency is an important research area in the rapidly growing electronics manufacturing industry. Therefore, the objective of this research is to minimize the distance traveled by the rotary head while assembling components on the PCB. The PCB placement optimization problem is formulated as a vehicle routing problem (VRP); i.e., the gantry head and feeder slots are represented as vehicles and depots respectively. In order to solve the given problem, a neighborhood search algorithm has been proposed, which has two phases. It starts with finding an initial tour determined by the nearest neighbor (NN) search algorithm and improves through 2-opt pairwise heuristic algorithm, which mainly exchange two edges within the initial tour to reduce the total distance. This edge exchange process is repeated until no further improvements can be made. The proposed algorithm was experimented with randomly generated sample problems. Experimental results indicate that the proposed algorithm could yield a local optimal solution in a short period of time. For the future work, the performance of the proposed algorithm can be evaluated with other heuristics algorithms, such as simulated annealing, generic algorithm, tabu search algorithm, and Lin-Kernighan heuristic algorithm.

Keywords: Surface mounting machine, PCB assembly, Nearest neighbor search, 2-opt pairwise exchange