MULTI OBJECTIVE DISCRETE PARTICLE SWARM OPTIMISATION (MODPSO) ALGORITHM FOR INTEGRATED ASSEMBLY SEQUENCE PLANNING AND ASSEMBLY LINE BALANCING

Assembly sequence planning(ASP) and assembly line balancing(ALB) are both important factors that affect the assembly efficiency and costs. In most of the research that were published majority of them addressed these two separately. In this paper, this study addresses to solve both these problems simultaneously using the proposed MODPSO.

ASP – focuses on scheduling the task in an optimised sequence that satisfies the task precedence relations and reduces the number of direction changes and tool changes to perform these tasks.

ALB – focuses on assigning the optimum sequence found by ASP technique to workstations and minimised the cycle time and distributes the workload evenly between these stations.

Integration of these two problems into one gained interest of many manufacturers as they reduce the planning time greatly with reduced search space and increases the quality of the assembly line and minimises the planning errors. The previous studies that were made on this field were elaborated in this paper that includes the previously used techniques such as Ant colony optimisation (ACO), Hybrid genetic algorithms (hGA), Multi objective PSO (MOPSO), etc.., In most of the papers published earlier, multiple objectives were combined into a single objective to reduce the problem complexity. This paper used pareto based approach and uses crowding distance (CD) to find the best solution among the pareto set.

**Proposed MODPSO:**

**1.Initialisation –** The number of particles and number of iterations are initialised and a topological sort technique is used to produce a feasible sequence from given precedence matrix.

**2.Evaluation –** Each particle is evaluated against each objective and non dominated sorting technique is used to find the best solution from the population.

**3.Update Pbest and Gbest –** Pbest and Gbest are chosen using crowding distance (CD). The calculation of crowding distance is shown in the paper with the assumptions made by the researcher.

**4.Operators used to update Pbest and Gbest –** Subtraction, addition, multiplication operators that are used in the standard PSO algorithms to update the swarm cannot be used here as it is a discrete problem rather than a continuous variable problem. Separate set of rules to carry out these operations are detailed with an example in this paper.

The proposed MODPSO, was compared against several other algorithms such as ACO, MOPSO, GA, NSGA-II, etc.., The performance indicators that were used are number of non-dominated solution in pareto optimal set, error ratio, generational distance, spacing and maximum spread. They conclude that the proposed algorithm outperforms the other algorithms in all those indicated performance factors. Further, a statistical test was conducted and the results showed significant improvements compared to other algorithms.