MODAPTO [101091996]: Modular Manufacturing and Distributed Control via Interoperable Digital Twins

5.5.1 Metaheuristics Overview

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Metaheuristics are advanced optimization methods designed to find good solutions without checking every possible option. Instead of guaranteeing the absolute best result, they aim for solutions that are close to optimal and can be computed quickly. This makes them well-suited for real-world scheduling problems, especially when systems face constant changes or disruptions.

These methods are generally categorized into two types. Search-based methods work with a single solution, gradually improving it through small changes. Examples include simulated annealing (SA) and tabu search (TS). Population-based methods, like genetic algorithms (GA) and particle swarm optimization (PSO), work with multiple solutions at once and evolve them over time to find better results.

One of the main strengths of metaheuristics is their adaptability. They can be applied to many types of scheduling problems without major changes, from simple to highly complex systems. Their ability to handle different constraints, objectives, and problem sizes makes them a valuable tool in modern production planning.

Although metaheuristics do not always deliver the perfect solution, their balance of speed, flexibility, and solution quality makes them an effective approach for scheduling in dynamic and uncertain environments.

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