A survey of mat-heuristics for combinatorial optimisation problems: Variants, trends and opportunities

ABSTRACT

This survey paper presents an overview of recent application of mat-heuristics on combinatorial optimisation problems (COPs) from 2018 to 2024. In this review, we categorise the mat-heuristics into six categories based on three integration types (loose, tight and multi) and two approaches (direct and decomposition). Descriptive statistics reveal that tight integration mat-heuristics are widely favoured. It is also observed that direct approaches are more commonly employed compared to decomposition approaches, perhaps due to the complexity involved in the latter. Next, we briefly present the mechanism of each mat-heuristic and its performance in a comparison to other state-of-the-art solution methodologies. CPLEX emerges as the predominant solver. Mat-heuristics have demonstrated their versatility across COPs, consistently achieving or setting new best-known solutions (BKS). We analyse highly effective mat-heuristics and outline the implementation strategies employed by those that managed to set new BKS. In addition, we discuss the advantages and challenges of utilising mat-heuristics as a solution methodology, as well as future research opportunities in this domain.