A distributed multiple ant colony algorithm to solve a steel industry scheduling problem

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Abstract. The production of steel is a very complex process, with several stages involved in its transformation from coal and iron ore to many potential steel formats. Within current digitalization initiatives, there is a wide range of combinatorial problems alongside the process where optimization techniques, and particularly metaheuristics, have proven its importance to enhance daily results. These solutions provide several advantages such as objective criteria to optimize the operations independently of subjective human opinion, fast reaction under sudden incidents, avoid human errors, and powerful computation capacities to explore solutions. In the industry, disruptions are unfortunately common events, such as arrivals of urgent orders or machine breakdowns, making recalculations imperative, while foremen wait for new instructions to operate. Hence, it is mandatory to exploit as much as possible the anytime behavior of metaheuristics, to find good solutions faster. Parallelization is a powerful tool to achieve this objective and is an inherent property of metaheuristics, opening a wide range of possibilities to accelerate the calculations, reducing computation time and assuring a good solution to face incidents. In this study, we present preliminary results on the application of a distributed architecture of multiple ant colonies on a real-word problem with the aim of optimizing the schedule of coils in a production facility. Different strategies in number of colonies and threads are tested to assess the impact in the solution efficiency and computing time. The proposed algorithm is compared to the single-colony solution that is currently in operation proving better results in the problem instances evaluated. Current conclusions on performance improvement are the basis of future research on data sharing strategies among the distributed colonies to perform an adaptive collaborative optimization.