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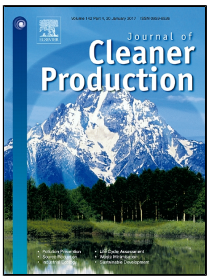

Integrated optimization of cutting parameters and scheduling for reducing carbon emissions

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Integrated optimization of cutting parameters and scheduling for reducing carbon emissions

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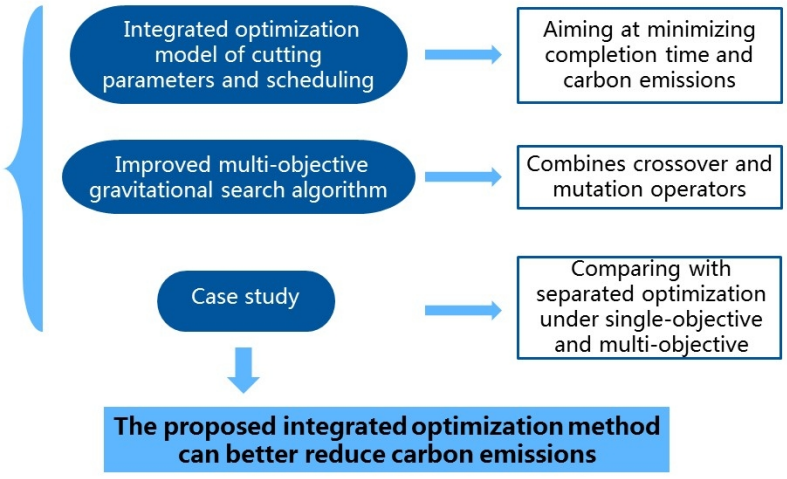
Abstract: In order to reduce carbon emissions in manufacturing processes and overcome the limitations of previous researches which optimized cutting parameters and scheduling independently and ignored their comprehensive effects on carbon emissions, an integrated optimization model of cutting parameters and scheduling is proposed to minimize completion time and carbon emissions in manufacturing processes. The proposed integrated model is based on the facts that machining time, cutting-tool wear and energy consumption of machine tools depend on cutting parameters, and further affect scheduling aiming at minimizing completion time and carbon emissions in manufacturing processes. Since cutting parameter optimization is a continuous optimization problem but scheduling optimization is a discrete optimization problem, it is very difficult to optimize both simultaneously. Therefore, an improved multi-objective gravitational search algorithm with a strong global search capability which combines crossover and mutation operators is designed to solve the proposed model. Any solution in the search space consists of two parts, Cutting parameters and job sequence. They are optimized simultaneously in each iteration in the proposed algorithm. Finally, three workpieces to be processed in two machines including turning and milling are taken as an example. It shows that the proposed integrated optimization can further reduce 2.9 percent of carbon emission and the 2.56 percent of completion time comparing to the traditional separated optimization. The validity of the proposed model and algorithm is verified by computational results.

Graphical Abstract:



Highlights:

1. An integrated optimization model of cutting parameters and scheduling is proposed to minimize the carbon emissions and completion time in the manufacturing process.
2. To optimize the cutting parameters and the scheduling at the same time, an improved