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Lightweight Design of Main Girder of Bridge Erector Based on Enhanced BWO

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INTRODUCTION & AIM

Under the traditional design scheme, the design quantity of main girder of the bridge erector is redundant and there are many consumables, which will reduce the production efficiency, and the existing optimization methods have the problem of low convergence accuracy. An enhanced beluga whale optimization (EBWO) algorithm based on quadratic interpolation strategy was proposed, and lightweight design of main girder of the 600t bridge erector was carried out.

METHOD

The quadratic interpolation method can be used for curve fitting in a certain interval. In the process of solving the minimum point of the main function f(x), the quadratic interpolation polynomial is used to continuously approximate the function f(x) until the iteration converges to the optimal solution.

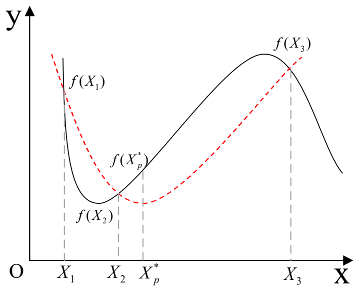

Fig. 1 Quadratic interpolation principle diagram

Establish an optimization model

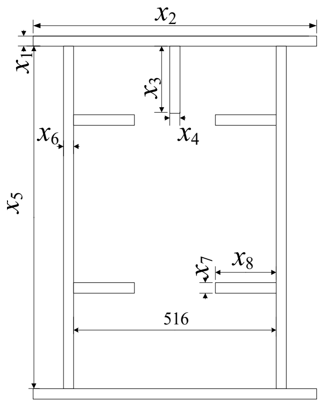

Fig. 2 Schematic diagram of section parameters of main girder

The optimization objective function is established as follows:

$$f(x) = 2x_1x_2 + x_3x_4 + 2x_5x_6 + 4x_7x_8$$

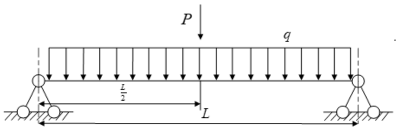

Fig. 3 Simplified force diagram of the main girder in the vertical plane

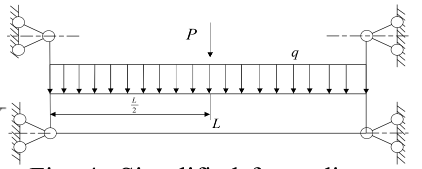

Fig. 4 Simplified force diagram of the main girder in the horizontal plane

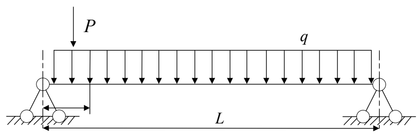

Fig. 5 Simplified force diagram of the main girder under eccentric loading condition at the span end

By analyzing the above stress conditions, the stress constraints are established.

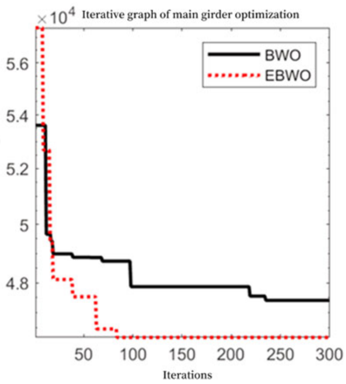

Fig. 6 Diagram of algorithm optimization iteration

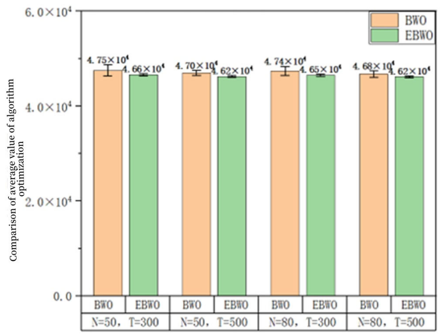

Fig. 7 Error bar chart of optimization results

CONCLUSION

Taking the main girder of bridge-erecting machine as the research object, according to the mechanical requirements and box girder design specifications, the minimum cross-sectional area of the main girder of bridge-erecting machine is solved under the given constraints. By comparing and analyzing the optimization results of 30 groups of BWO and EBWO, it is verified that EBWO has stronger optimization ability and robustness, and the weight is reduced by 19.3% compared with that before optimization, which further proves the feasibility of the scheme.

FUTURE WORK / REFERENCES

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