

OPTIMAL DESIGN OF SEAWEED COLLECTION CONVEYORS USING A MULTI-OBJECTIVE GENETIC ALGORITHM

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Abstract

Recently, South Korea suffered severe damage due to the influx of floating seaweed, such as *Sargassum horneri*. Transport inefficiency has been a problem for conventional seaweed collection conveyor belts, which is caused by seaweed entanglement in the gap between baffles and chain gear joints. This study proposes an unmanned, small-scale seaweed collection device and derives optimized designed parameters using NSGA-II(Non-dominated Sorting Genetic Algorithm II) to ensure maximum operational performance. This novel conveyor structure addresses the mechanical limitations identified in previous designs. The baffle angle, spacing, conveying speed, height, conveyor width, and baffle thickness is selected as key design parameters to reflect the shape and arrangement characteristics of the proposed conveyor structure. To quantitatively evaluate performance, a physical behavior model is constructed to calculate power consumption and mass flow rate according to changes in the design parameters mentioned.

A Pareto solution is derived through multi-objective optimization. Constraints are included such as geometric interference conditions, battery power constraints, structural strength conditions, and seaweed throughput matching conditions, and are structured to impose penalties on the corresponding violations. These solutions are naturally classified as dominated solutions during the evolution process, reducing their likelihood of being passed on to the next generation. From the solutions derived through the algorithm, parameters that satisfy all constraints are considered physically feasible. These solutions are confirmed to form a consistent distribution in the objective function space. The initial design point was established as a reference point for interpreting the optimization results, so that the subsequent final design selection was conducted by prioritizing design candidates that simultaneously improved both objective functions compared to the initial design. In particular, a utopia point-based optimal solution selection method was applied to select a balanced solution within the Pareto candidate set without directly assigning weights to the final solution. As a result, power consumption was reduced, and

mass flow rate increased compared to the initial design. This demonstrates improved collection performance under the same operating conditions, indicating that the research objectives were achieved. Future research will conduct experiments with this conveyor system in an actual marine environment and design a seaweed compressor and storage facility accordingly.