Cycle Time Minimization in Production Line using Robust Hybrid Optimization Algorithm

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Product Background

Bio-inspired algorithms that have been introduced by mimicking the biological phenomenon of nature have widely implemented to cater various real-world problems. As example, memetic algorithm, EGSJAABC3 is applied for economic environmental dispatch (EED) optimization, Hybrid Pareto Grey Wolf Optimization to minimize emission of noise and carbon in U-shaped robotic assembly line and Polar Bear Optimization to optimize heat production. The results obtained from their research have clearly portrayed the robustness of bio-inspired algorithms to cater complex problems.

Assembly line, which is normally the last step of production that involves final assembly of the products. An assembly line generally consists of several workstations placed in sequential order. Each of the workstation is in charge to complete certain specific jobs. Hence, it is a must to make the best use of the efficiency of the assembly line. Cycle time minimization is part of the assembly line balancing problem due to its uncertainty that dependent on the number of manpower, material preparation and machine capacity. Cycle time basically means time needed to process a product using a specific task in a production line. This project proposes the application of new hybrid optimization algorithm named JAABC5-RRO to minimize cycle time to produce a new audio product on a production line in a production company.

Novelty/Originality/ Inventiveness

- New proposed hybrid bio-inspired optimization algorithm based on honeybees (JA-ABC5) and raven (RRO) will be implemented to minimize cycle time in a production line to produce an audio product.

Benefits

- The implementation of hybrid optimization algorithm to minimize cycle time shall increase the efficiency of the production line and facilitate the production planners in managing assembly processes on the production line.

Marketability & Commercialisation

- Production line
- Manufacturing industry

Publication

Review on Bio-inspired Algorithms Approach to Solve Assembly Line Balancing Problem, *IOP Conference Series: Materials Science and* Engineering, Vol. 689, 012027, 2019 (Scopus-indexed).

Achievement/Award

Silver medal in Citrex 2020

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Methodology

- **JAABC5-RRO**

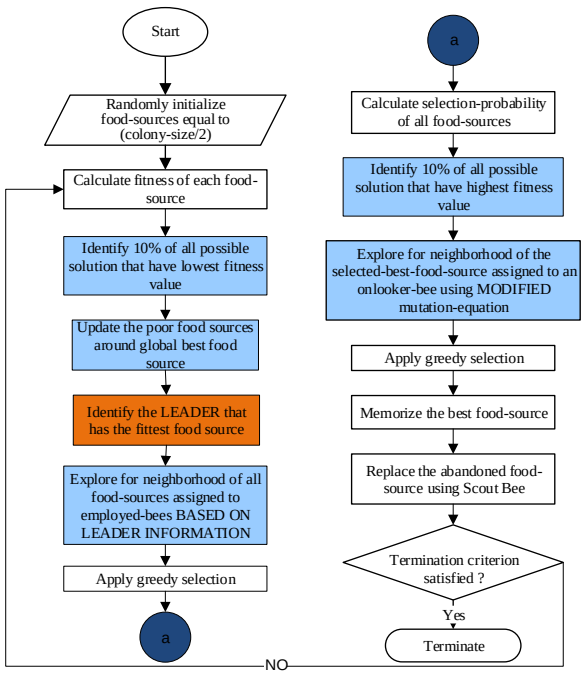

Figure 1 Flowchart of JAABC5-RRO

- **Cycle Time Minimization**

$$\min f(x) = 0.161x_1 + 0.654x_2 + 0.246x_3 + 0.201sig_x$$

$f(x)$ is the cycle time of new audio product in the production line
x_1 is the number of manpower needed to produce the new audio product
x_2 is the waiting time of material
x_3 machine breakdown rate
sig_j is the sigmoid value of *j*th hidden node

(Ahmarofi *et* al., 2020)

Results

Table 1 Value of cycle time and parameter acquired using JAAB5-RRO vs Conventional method (Ahmarofi *et* al., 2020)

Method	Cycle Time (s)	Manpower (person)	Waiting Time (hour)	Machine Breakdown Rate
Conventional	5.000	30	1	0.0013
JAABC5-RRO	**4.839**	**28**	1	0.0013

Discussion

- The results obtained in **Table 1** shows minimum value of cycle time achieve by JAABC5-RRO from optimum values of parameters; manpower, waiting time and machine breakdown rate compared to conventional method.
- JAABC5-RRO suggested that the optimum value of manpower is **28** persons that will give the minimum cycle time of 4.839s.
- The result suggests the efficiency of JAABC5-RRO as a robust optimization algorithm that capable to optimize real-world problem.