Appendix

Robotic Disassembly Sequence Planning and Line Balancing - Research Trends Review and Bibliometric Analysis[1]

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[1] N Hartono and D T Pham (2023) Robotic Disassembly Sequence Planning and Line Balancing - Research Trends Review and Bibliometric Analysis. Lecture Notes in Mechanical Engineering, Springer.

List of Abbreviations

ABC Artificial Bee Colony.
ACO Ant Colony Optimisation.
AHP Analytical Hierarchy Process.
BA Bees Algorithm.
BCE Bi-criterion Evolution-based.
CAD Computer Aided Design.
CDG Constraint Decomposition Grid.
D-DQN Double DQN.
DQN Deep Q Network.
DSP Disassembly sequence planning.
DV Diversity Metric.
EDBA Enhanced Discrete Bees Algorithm.
EMOGA Extremal Multi-objective Genetic Algorithm.
GA Genetic Algorithm.
GD Generational Distance.
GOA Grasshopper Optimisation Algorithm.
HDA Hybrid Driving Algorithm.
HI: hypervolume indicator.
IACO Iterative Ant Colony Optimisation.
IBEA Indicator-Based Evolutionary Algorithm.
IDBA Improved Discrete Bees Algorithm.
IGD Inverted Generational Distance.
IGSA Improved Genetic Simulated Annealing.
IMMO Improved Multi-objective Multi-verse Optimisation.
ISIACO Interval Search Iterative Ant Colony Optimisation.
MALA Multi-objective Ant Lion Optimiser.
MBGA Many-objective Best-order-sort Genetic Algorithm.
MBOHHO Modified Bi-objective Harris Hawks Optimisation.
MILP Mixed Integer Linear Programming.
MO multi-objective.
MO-ND multi-objective non-dominated.
MOABC Multi-objective Artificial Bee Colony.
MOBA Multi-Objective Non-dominated Bees Algorithm.
MOCGA Multi-objective Cellular Genetic Algorithm.
MODGWO Multi-objective Discrete Gray Wolf Optimiser.
MOEA/D Multi-objective Evolutionary Algorithm based on decomposition.
MOEO Multi-objective Equilibrium Optimiser.
MOMVO Multi-objective Multi-Verse Optimise.
MOPSO Multiobjective Particle Swarm Optimisation.
NFE Number Function of Evaluation.
NP Non-Deterministic Polynomial.
NSGA-II Non-dominated Sorting Genetic Algorithm - II.
NSGA-III Non-dominated Sorting Genetic Algorithm - III.
NSHHO Multi-objective Non-sorted Harris Hawks Optimiser.
PBEA Problem-specific bi-criterion Evolutionary Algorithm.
PDSA-EA Evolutionary Simulated Annealing Algorithm using Pareto-domination based acceptance criterion.
PEI Performance Evaluation Index.
PESA-II Pareto Envelope-based Selection Algorithm - II.

PIMBO Pareto-improved Multi-objective Brainstorming Optimisation.
POSs Pareto optimal solutions
PRDQN Prioritised Experience Replay DQN. 22
PSO Particle Swarm Optimisation.
RDLB Robotic Disassembly Line Balancing.
RDSP Robotic Disassembly Sequence Planning.
RPD Relative Percentage Deviation.
RPF Ratio of the Pareto Front.
RS Random Search.
RSA Restarted Simulated Annealing.
SA Simulated Annealing.
SO single-objective.
SPEA-2 Strength Pareto Evolutionary Algorithm for Multi-objective Optimisation.
SPM Statistical Performance Metric.
SS Solution Spacing.
VR Virtual Reality.
VRP Vehicle Routing Problem.

Table A.1. Robotic Disassembly Sequence Planning (until May 2023)

Author(s)	Approach	RDSP objective(s)	Single/ Multi	Output	Performance Measurement
Suzuki et al. [36]	Petri Net	learning control scheme	n.a.	simulation	n.a.
Sundaram et al. [37]	Motion planning	min disassembly steps	n.a.	disassembly tree	n.a.
Baeza et al. [38]	Contact surface and unnamed Heuristic	disassembly movement	n.a.	disassembly movement and sequence	n.a.
Puente et al. [39]	Vision system	flexible automatic disassembly	n.a.	simulation	n.a.
Uhlmann et al. [40]	Control system	feasibility of disassembly concept	n.a.	pilot disassembly system	n.a.
Kim et al. [41]	Control system	automatic sequence generation	n.a.	automated disassembly control concept	n.a.
Gil et al. [42]	Visual-force control system	a collaborative robotic system with multiple sensor	n.a.	experiment validation	n.a.
Elsayed et al. [43]	Genetic Algorithm**	disassembly sequence generation	n.a.	intelligent automated disassembly cell	n.a.
Elsayed et al. [27]	Genetic Algorithm**	min time	SO	disassembly time, sequence, detection time	n.a.
Vongbunyong et al. [44]	Cognitive robotics	skill transfer from human to robot	n.a.	cognitive robotic disassembly experiment	n.a.
Popescu et al. [45]	Software	automatic generation	n.a.	generate sequence from CAD	n.a.
Alshibli et al. [46]	Robot sensory system, Tabu search, Genetic Algorithm**	min makespan	MO	run time	run time****
Friedrich et al. [47]	CAD and Vision	automated planning system	n.a.	experiment validation	n.a.
Vongbunyong et al. [48]	Vision system	skill tranfer from human to robot	n.a.	process demonstration platform	n.a.
Friedrich et al. [49]	Djikstra, A*nearest neighbour, A* minimum spanning tree, nearest neighbour	min time	SO	path planning	path, success rate, deviation, detection time***
Parsa and Saadat [50]	Genetic Algorithm**	min time	SO	disassembly sequence, tools, destructive/non	n.a.
Wang et al. [51]	Matrix manipulation	detect subassemblies automatically	n.a.	automatic detection of subassembly using matrix	n.a.
Laursen et al. [52]	Programming language	programming model to reverse assembly	n.a.	domain specific language	n.a.
Liu et al. [8]	Bees Algorithm, Genetic Algorithm, Simulated Annealing**	min time	SO	disassembly sequence, direction	average fitness value and run time***
Costa et al. [53]	Branch and Bound and CAD automatic generation	min cost	SO	disassembly sequence	n.a.

Author(s)	Approach	RDSP objective(s)	Single/ Multi	Output	Performance Measurement
Alshibli et al. [32]	Simulated Annealing** and AHP (for environmental, economic, social criteria)	min time	SO	disassembly sequence, method, recovery option	n.a.
DiFillippo and Jouaneh [54]	Vision and force system	fastest time	n.a.	cognitive system framework	n.a.
Laili et al. [23]	Greedy search, Genetic Algorithm, Bees Algorithm**	min time (re-planning)	SO	rapid subassembly detection and sequence	time***
Zhang et al. [55]	Hybrid A* and Genetic Algorithm** \& obstacle avoidance	min path	SO	experiment on reduction gearbox	convergence speed, run time
Lan et al. [56]	Search for separable pairs \& divide and conquer	avoid interlocking	n.a.	disassembly sequence	n.a.
Ramirez et al. [57]	Constructive greedy, hill climbing, Genetic Algorithm**	max profit	SO	disassembly sequence	graphical results
Chen et al. [17]	Bees Algorithm**	min time	SO	disassembly sequence	fitness value and run time***
Watanabe and Inada [58]	Reinforcement Learning	min time	SO	experiment to validate concept	n.a.
Wang et al.[59]	Matrix manipulation	representation matrix for complex disassembly	n.a.	mathematical representation	n.a.
Malekkhouyan et al. [33]	VRP and DSP using Mix Integer Linear Programming, Grasshopper Optimisation Algorithm**	min transportation cost, robot and truck carbon footprint, time	MO	disassembly sequence	range
Laili et al. [24]	IBEA, MOEA/D, NSGA-II, NSGA-III, Dual Selection MOEA**	min time and max completion rate	MO-ND	time and completion rate result	HI, IGD, epsilon-indicator****
Hartono et al. [14]	Bees Algorithm**	max profit, energy savings, environmental impact reduction	SO	disassembly sequence, direction, tools, recovery options	Statistical Performance Metric (SPM)****
Hartono et al. [31]	Bees Algorithm**	max profit, energy savings, environmental impact reduction	SO	disassembly sequence, direction, tools, recovery options	n.a.
Hartono et al. [4]	Multi-objective Bees Algorithm, NSGA-II, PESA-II**	max profit, energy savings, environmental impact reduction	MO, MO-ND	disassembly sequence, direction, tools, recovery options	HI,NFE,POSs
Laili et al. [30]	Greedy search, Genetic Algorithm, Bees Algorithm**	min time	SO	disassembly time	disassembly time****
Laili et al. [60]	Mathematics model formulation	compilation of objectives from previous research	n.a.	n.a.	n.a.
Laili et al. [61]	IBEA, MOEA/D, NSGA-II, NSGA-III, Dual Selection MOEA**	min time	MO-ND	time and completion rate result	HI, IGD, epsilon-indicator****

Author(s)	Approach	RDSP objective(s)	Single/ Multi	Output	Performance Measurement
Ye et al. [62]	Bees Algorithm, Fuzzification of Disassembly Sequence Planning**	min time	SO	disassembly sequence, direction	solution quality and time
Prioli et al. [63]	CAD files to matrix	disassembly matrix	n.a.	disassembly sequence, direction	n.a.
Yang et al. [64]	Deep Learning, Bees Algorithm, Genetic Algorithm**	min time	SO	disassembly sequence, direction	disassembly time***
Liu et al. [65]	Bees Algorithm, Genetic Algorithm**, Digital Twin and Deep Q-learning	min time	SO	disassembly sequence, direction	run time
Cui et al. [66]	Deep Q-learning, Genetic Algorithm, Bees Algorithm**	min time	SO	disassembly sequence, time	disassembly time***

Note: ** metaheuristic, *** statistic descriptive, **** statistic test, bold = sustainability-related objective

Table A.2. Robotic Disassembly Line Balancing (until May 2023)

Author(s)	Approach	RDLB objective(s)	Single/ Multi	Output	Performance Measurement
Radaschin et al. [76]	Expert Petri net	concept testing	n.a.	Concept and implementation on prototype	n.a.
Minca et al. [77]	Synchronised Hybrid Petri Nets model	min cycle time	n.a.	A real-time control structure	-
Minca et al. [78]	Mathematical model	min cycle time	n.a.	Mathematical representation	-
Filipescu et al. [79]	Simulation and real-time control	disassembly after assembly	n.a.	Simulation and real-time control	-
Liu et al. [19]	Bees Algorithm, Artificial Bee Colony, Genetic Algorithm**	min workstation, workload balance, disassembly priority of high demand parts	MO-ND	Disassembly sequence, direction, robotic assignments	Iterations and population sizes***
Gao et al. [34]	Multi-objective Artificial Bee Colony**	min cost, work load, energy consumption	MO-ND	Disassembly line schedule	n.a.
Alshibli et al. [25]	Simulated Annealing**	min robot, balanced load, hazard, demand	MO	Disassembly sequence, destructive/not , task allocation	n.a.
Octavian et al. [80]	Concept testing assembly/disassembly	control strategy	n.a.	Concept and implementation on prototype	n.a.
Fang et al. [81]	IBEA, NSGA-II, MOEA/D, PBEA**	min cycle-time, total energy consumption, peak workstation energy consumption, number of robot	MO-ND	Objective and performance metric results	HI**** (wilcoxon rank sum)
Fang et al. [82]	MOEA/D, NSGA-II, NSGA-III, Improved NSGA-III**	min line length and energy consumption	MO-ND	Performance measurement	HI,IGD
Ming et al. [83]	Illustrative example	min cycle time, peak and total energy consumption, cost of hazardous tasks	SO	Using only min cycle time to shows the example task and robot assignment	n.a.
Liu et al. [84]	MBGA, NSGA-II, SPEA-2, MOEA/D**	min robot, open multi-robotic workstation, load density, cost of hazardous task	MO-ND	Performance measurement	HI, IGD
Cil et al. [85]	RS, GA, IACO, ISIACO**	min cycle time	SO	Task and robot assignment	RPD
Fang and Xu [86]	MOEA/D**	min cycle time, robots	MO-ND	Performance measurement	IGD, HI
Fang et al. [87]	NSGA-II, MOEA/D, PBEA**	min cycle time, robots	MO-ND	Task and robot assignment	HI, IGD

Author(s)	Approach	RDLB objective(s)	Single/ Multi	Output	Performance Measurement
Liu et al. [15]	Bees Algorithm, Genetic Algorithm, Particle Swarm Optimisation**	min cycle time, workstation, smoothness index, max working time	MO	Disassembly sequence, direction, robotic workstation assignments	Fitness value and run time
Fang et al. [88]	NSGA-II, RSA, PDSAEA**	min cycle time, peak and total energy consumption	MO-ND	Performance measurement	Execution time, RPF, CP,HI
Fang and Xu [89]	NSGA-II, MOEA/D**	min cycle time, energy consumption	MO-ND	Performance measurement	HI, IGD
Chen et al. [67]	NSGA-II, MOEA/D, IBEA**	min workstation, idle time, demand index of disassembly part	MO-ND	Performance measurement	HI, IGD
Dong et al. [90]	MOEA/D, NSGA-II, MALA	max profit, min energy	MO-ND	Performance measurement	HI, GD(N) ,IGD, Epsilon(N)
Zhang et al. [91]	MOMVO, NSGA-II, MOEA/D, MOCGA**	max profit, min carbon emissions	MO-ND	Performance measurement	IGD, HI, Epsilon
Lei et al. [92]	CDG, MOEA/D, NSGA-II**	max profit, min idle time	MO-ND	Disassembly sequence, robot, performance measurement	IGD, HI, Epsilon
Wang et al. [35]	MOABC, MOPSO, NSGA-II, SPEA-2**	min makespan and min energy consumption	MO-ND	Disassembly scheme (example output of sequence, allocation, time)	HI, IGD, Spread ++
Mei and Fang [93]	DQN, DDQN, PRDQN	min idle time, high demand priority, min energy consumption	MO-ND	Performance measurement	HI, IGD
Tseng et al. [94]	PSO, Genetic Algorithm, ACO**	min total make span	SO	Objective results	Objective results***
Zeng et al. [95]	IGSA, NSGA-II, NSGA-III,SPEA-2, EMOGA, MOABC**	min cycle time, energy consumption, smoothness index, max profit	MO-ND	Disassembly sequence, robot workstation, performance measurement	HI, Spread, Pure Diversity, DV++
Zhou and Bian [96]	MBOHHO, NSHHO, MOPSO, MOEO, MOGWO**	min cycle time, min energy consumption	MO-ND	Performance measurement	POSs, GD, SS, IGD**** (statistic descriptive and statistical test one way ANOVA for mean value)
Yin et al. [97]	MILP and HDA, NSGA-II, NSGA-III, PDSAEA**	min cycle time, peak energy consumption, total energy consumption, improved hazardous index	MO-ND	Task and robot assignment, performance measurement	HI**** (t-test)

Author(s)	Approach	RDLB objective(s)	Single/ Multi	Output	Performance Measurement
Laili et al. [98]	Genetic Algorithm, PSO, Bees Algorithm,MOEA, MOEA/D, IBEA**	n.a.	SO, MO-ND	Description of Evolutionary optimisation to solve RDSP and RDLB	n.a.
Laili et al. [60]	Mathematical model	n.a.	n.a.	Mathematical representation	n.a.
Laili et al. [61]	NSGA-II, IBEA, MOEA/D, PBEA**	min time, min total energy consumption, min peak workstation energy consumption, the number of robots	MO-ND	Performance measurement	HI**** (and statistic test wilcoxon rank sum test on HI value)
Zhang et al. [99]	Tabu search**	max profit	SO	Disassembly objective results	n.a.
Zhang et al. [100]	IMMO, NSGA-II, MOEA/D, MOCGA**	max profit, min carbon emissions	MO-ND	Disassembly sequence, performance measurement	IGD,HI****
Laili et al. [101]	IBEA, MOEA/D, NSGA-II, NSGA-III, BCE-MOEA/D, BCE-IBEA**	balance, direction change, cost, number of hazardous tasks, energy cost, line efficiency, total profit	MO-ND	Performance measurement	HI,IGD, D-metric**** (chi square and p value friedman test)
Xu et al. [102]	PIMBO, MODGWO, MOABC, NSGA-II, MOEA/D**	max profit, min energy consumption, max balancing rate	MO-ND	Disassembly sequence, performance measurement	C-metric, IGD ,HI
Qin et al. [103]	IMMO, MOCGA, MOEA/D, NSGA-III**	max profit, min carbon emissions	MO-ND	Performance measurement	IGD, HI, epsilon-indicator
Liu et al. [16]	IDBA, Enhanced Discrete Bees Algorithm, Genetic Algorithm, PSO**	min cycle time, min number of workstation, min smoothness index	MO	Disassembly sequence, direction, robotic workstation assignments, simulation	Iterations and population sizes***

Note: ** metaheuristic, *** statistic descriptive, **** statistic test, bold = sustainability-related objective

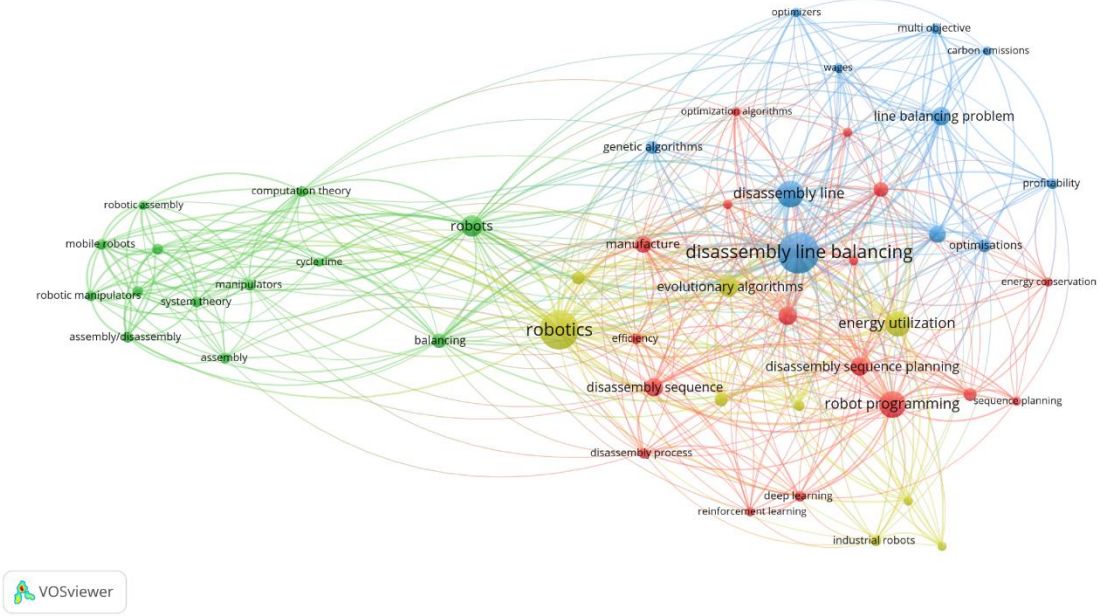

Figure A.1. Keywords Analysis

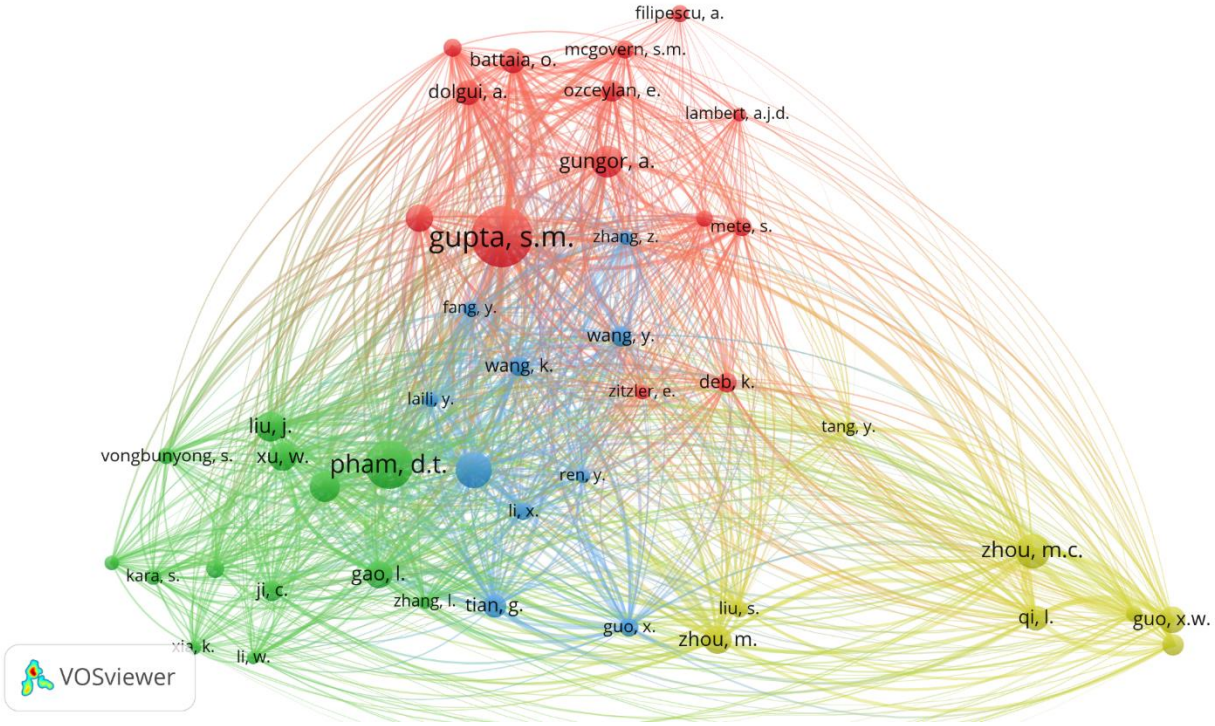

Figure A.2. Co-citations Analysis