A Multi-Objective Optimization Approach to Solve a 2-Dimensional Cutting Stock Problem in the Aerospace Industry

Abstract

This study aims to optimize the manufacturing operations in the aerospace industry involving the cutting of regular and/or irregular (nesting problem) two dimensional shapes by addressing a multiple criteria such as material scrap as waste, storage constraints, customer due date considerations, material handling or tractability requirements and cutting machine setup time. The 2D cutting stock problem (2D-CSP) with only a scrap minimization criterion is a computationally challenging and a 'strongly NP Hard' problem. The additional requirements increase the complexity of the 2D-CSP because now a cutting plan or method has to satisfy potentially conflicting criteria which transforms the conventional single objective problem into a multiple-objective optimization problem. This study uniquely formulates and solves this multi-objective combinatorial optimization problem to yield a cutting plan that gives a compromise or trade-off for the competing multiple criteria. Non Dominated Sorting Genetic Algorithm (NSGA II), a state of the art solution algorithm, is proposed to solve this formulation giving a range of Pareto plans that will have an impact on the efficiency and material utilization for manufactures in the aerospace industry.

Keywords
Cutting Stock, Multi-Objective Optimization, NSGA-II

Biographies

Dr Malik has worked as a Professional Engineer for 7 year in Pakistan and Australia. He has also taught and held academic positions for 6 years in three countries namely Pakistan, Australia and United Arab Emirates. With an engineering background and a PhD from AACSB accredited UWA Business School, Dr Malik has the skills and experience to groom the future managers and to solve complex decision making problems in management.

Dr. Salam Abdallah is an IS&T academic and practitioner. Dr. Abdallah has a PhD in Information Systems from Australia and an MSc degree from United Kingdom. He has over 15 years of experience working as an IT consultant before joining United Nations Relief and Works Agency for Palestine refugees overseeing ICT facilities and curriculum development at schools and vocational training centers in UNRWAâ€™s entire field of operations. He is a founder member of Special Interest Group of the Association of Information Systems: ICT and Global Development. Dr. Abdallah is also an active researcher in the field of Information Systems and has published articles in local and international conferences and journals. Dr. Abdallah has received research grants, teachersâ€™ awards, and innovation awards at the university level.