# Adaptive Neighborhood Search with Constraint Programming for Hybrid Flow Shop Sequence Dependent Group Scheduling Problems

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## Abstract

In the present work, we address the Hybrid Flow Shop Sequence Dependent Group Scheduling (HFSDGS) problem. This problem is known to be NP-hard and widely exists in many industrial systems and manufacturing industries. We consider both sub-problems: arrangement of groups and the arrangement of jobs within each group. Jobs belonging to the same group are processed without interruption on the same machine. The factory is composed of n stages. Each stage consists of Ms Parallel identical machines. The objective is to minimize the makespan of the schedule. In the Literature dealing with this problem, we notice that the HFSDGS problem had and still have a great attention by many researchers and scientists. So many related works have been conducted in recent year. We can summarize the methods used to deal with such problems in two classes: the exact methods (MILP and CP) and some heuristics. In this work we present a new Mixed Integer Linear Programming (MILP) model and a Constraint programing (CP) model for our problem. We test the correctness of the mathematical model of HFGSP by using CPLEX and Gurobi. For the CP model we use the IBM CP optimizer. We propose a variant of VNS searching heuristic: a constraint programming-based adaptive neighborhood search. The search abilities of the large neighborhood search and the constraint propagation abilities offered by a constraint programming paradigm are combined to determine the feasibility of any proposed modification to the incumbent solution.
The performance of the proposed algorithm is investigated through a large number of numerical experiments.

## Keywords
Hybrid flow shop, group scheduling, MILP, Constraint programming, Variable neighborhood search

## Biographies
**Ahmed Boulahoual** is an assistant professor at the EST of Safi and a member of the LAPSSII laboratory at Cadi Ayyad University, Morocco. A.BOULAHOUAL is the co-author of some publications, author and co-author of some scientific communications.

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