



PhD Proposal 2017

School: Ecole Centrale de Lille	
Laboratory: CRIStAL	Web site: http://lagis.ec-lille.fr
Team: OPTIMA (OSL)	Head of the team: Slim Hammadi
Supervisor: Khaled MESGHOUNI	Email: khaled.mesghouni@ec-lille.fr
Collaboration with other partner during this PhD: Simon COLLART-DUTILLEUL In France: IFSTTAR-ESTAS, EC-Lille-OSL Team	simon.collart-dutilleul@ifsttar.fr In China:

Title: Optimization of scheduling problems in guided transport and manufacturing systems: Problem with deadlock constraints
Scientific field: Logistics / Operation Research
Key words: : Guided transport Scheduling, Flexible job-shop, Optimized train operation plans and control, railway planning and control, Meta-heuristics, Genetic Algorithms, Deadlock Avoidance, Petri Nets.

Details for the subject:

Background, Context:

The French railway infrastructure is the one which use the highest number of train for kilometers. This matter of fact shows that the capacity of the infrastructure is a critical parameter. Nevertheless, there exist some deadlock scenarios, which may have a deep impact on the traffic flows.

Using the same point of view, manufacturing companies knew great changes from production to competitiveness. This competitiveness passes by work diversification. Production equipment became increasingly flexible where production control is increasingly complex. The purpose of the production control is to provide tools allowing control and planning of production process. Scheduling process within a FMS is an essential problem for production system management and piloting. The use of automated means of production (machines, automatic control, storage systems, robots, etc.), the use of production lines with buffer stocks of limited capacity between the machines. This new organization must be controlled and managed in order to avoid deadlock situations where a robot to load a product on a machine when the machine needs the robot so that it is discharged from the product they just executed. This is one example of undesirable situations in the production process. The objective is to propose feasible schedules (without deadlock) and optimal preferences to sense one or more criteria. We will bring to emulate and adapt the processes proposed in this type of problem that interests us namely planning with blocking railways lines

Research subject, work plan:

To do this, we must be able to detect deadlock situations and therefore provide guidance (solutions) that we avoid these situations. The use of Petri nets is expected to build on the analytical conditions that avoid exploring the possible space solutions. Although more research needs to be undertaken to provide criteria for developments that would guide the algorithm. The approach aims to achieve a permissible and optimal scheduling using meta-heuristics such as genetic algorithms and / or ants colonies.

The constraints of time intervals:

As we can see and confirm a more thorough literature search in the field manufacturing industry one often calls upon processes whose operational time varies between a minimum and maximum bound. It is the case study of communication protocols, in chemical industry who involves the use of chemical reactions for the parts treatment, and in the food processes, that the non-conformity of a food product can affect absolutely unacceptable public health. The same problem of maximal duration spent for a given travel can be found in transport systems, especially in the case of passengers transport. Several studies describe models based on Petri nets time for such processes to time constraints.

The interval constraints on any parameter:

In many processes another parameter can be a determining factor for the quality, cost, and more generally the acceptability of the system outputs. It must belong to a very strict at intervals of validity. It will then give guarantees compliance with these specifications. Therefore, an appropriate model, rich in analytical properties is necessary for the synthesis of real-time scheduling and control. Accession to a state where the interval constraints are not respected feature a forbidden state, ie a system crash, this will have serious consequences for the users using the system

Robustness criterion for a scheduling problem with deadlock:

The proposed approach seeks to characterize the space of acceptable states. Furthermore, the integration of certain indeterminism behavioral will be study. It will then prove that there exists a valid state trajectory in the presence of a class of given perturbation. We therefore seek to build robustness indicators used by the scheduling layer. In this way, the relevant

selection criteria will be provided to deal with the large combinatorial. Moreover, the scheduling will have the capacity to adapt to extend range.

The first phase of the work will include an extensive literature review to acquire such a knowledge base on the state of the art of the various tools consideration like manufacturing systems, planning and control railways. In a second step, the proposed theoretical approaches will be considered and compared in order to obtain appropriate solutions to various case studies. In the third part, the work will be to validate the proposed approaches on the one reel railways problems. And the other part of the work is devoted to the dissemination of knowledge: publications in international conferences and journals.

References:

[T-1] "Robust cyclic scheduling applied to container management of medium sized seaport"

PhD thesis defended at Ecole Centrale de Lille, France, 10 december 2014, Hongchang ZHANG.

(Directors K. MESGHOUNI and S. COLLAT-DUTILLEUL)

[J-1], "Optimization of a train traffic Management Problem under Uncertainties and Disruption",

Studies in Informatics and Control journal, Vol. 23, No. 4, December, 2014

A. El Amraoui, K. MESGHOUNI

[J-2] "A flexible control of manufacturing automated electroplating lines", international journal for manufacturing & Production, Vol 8, Numb 1, pages 33-48, 2007

F. CHETOUANE, J-P. DENAT, S. COLLAT-DUTILLEUL

[J-3] "*Resolution approach for multi objective problems with uncertain demands*" European Journal of Operational Research, vol.197, No. 2, pp. 403-414, 2008

D. BERKOUNE, K. MESGHOUNI

[J-4] "Localization Algorithm of Time Disturbances in Tolerant Multi-product Job-shops",

Studies in Informatics Control, Vol 16 N°1, 2007

N. JERBI, S. COLLAT-DUTILLEUL, E. CRAYE, M. BENRJEB

[IC-1] "Cyclic Scheduling Steady-State Analysis and Improved Mathematical Models". 19th IFAC World Congress., 24-29 August, 2014, Cape Town, South Africa

H. Zhang, K. Mesghouni, S. Collart-Dutilleul

[IC-2] "Train Scheduling Networks under Time duration uncertainty" 19th IFAC World Congress., 24-29 August, 2014, Cape Town, South Africa

A El Amraoui, K Mesghouni

[IC-3] "Meta-Heuristic Optimization Based On P-Time Petri Nets Model For Deadlock Avoidance In Flexible manufacturing Systems". 21st International Conference on Production Research

ICPR 21, Innovation in Product and Production, July 31, August 4, 2011, Stuttgart, Germany

F. ABDICHE, K. MESGHOUNI, L. SEKHRI

[IC-4] "A Multi-Objective Simulated Annealing for the Multi-Criteria Dial a Ride Problem", 11th IFAC, Symposium on Analysis, Design, and Evaluation of Human-Machine Systems, August, 2010, Valenciennes, France.

I. ZIDI, K. MESGHOUNI, K. ZIDI, K GHEDIRA

[IC-5] "Temporal requirements checking in a safety analysis of railway systems", Eleventh International Conference on Computer System Design and Operations in the Railway and Other Transit Systems Forms/format'08, October 2008, Budapest Hungrier

F. DEFOSSEZ, S. COLLAT-DUTILLEUL, P. BON