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Lisbeth Buschkühl

Multi-Level Capacitated Lotsizing with Setup Carryover

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Preface

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Cologne, July 2008 Lisbeth Buschkühl

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List of Symbols

α^l	smoothing coefficient to stabilize convergence of the Lagrangean multipliers
δ^{Dn}_{kts}	production quantity of item k on machine n in period t to satisfy demand in period s
Δ_{kts}	fraction of the cumulated demand of item k in periods t to s, which is satisfied by production in period t
δ_{kts}	fraction of demand of item k in period s, which is satisfied by production in period t
δ^D_{kts}	demand of item k in period s, which is produced in period t ($\delta^D_{kts} = \delta_{kts} \cdot D_{ks}$)
γ_{kt}	binary setup variable
γ^n_{kt}	binary setup variable on machine n
λ^l_u	stepsize for the update of the Lagrangean multiplier of the inventory balance constraint for item k in period t at iteration l
λ^l_v	stepsize for the update of the Lagrangean multiplier of the capacity constraint for resource m in period t at iteration l
λ^l_w	stepsize for the update of the Lagrangean multiplier of the setup carryover constraint for resource m in period t at iteration l
Ω	great number
ω_{kt}	binary setup state variable for item k at the beginning of period t

ω_{kt}^{n} binary setup state variable for item k on machine n at the beginning of period t

$\overline{D}_k$ average demand of item k

$\overline{D}_{m\hat{t}t}$ minimum average capacity consumption through production times on resource m in periods $\hat{t}$ to t

ς_t^{ml} subgradient of the setup carryover constraint for resource m in period t at iteration l

ϑ_t^m dummy variable to prohibit a changeover, when the setup state of the same item k is carried over from period $t-1$ to period t and from period t to period $t+1$

ϑ_{kt} dummy variable to indicate a consecutive carryover for item k from period $t-1$ to t and to $t+1$

$\widehat{b}_t^n$ available capacity of an individual resource n in the case of parallel machines in period t

$\widehat{q}_{kt}$ quantity to be assigned on parallel machines for item k in period t

$\widehat{y}_k$ initial inventory of item k at the beginning of the planning horizon

$\widetilde{b}_t^m$ modified available capacity of resource type m in period t

$\widetilde{s}_k$ modified setup cost coefficient of item k

ξ_t^{ml} subgradient of the capacity constraint for resource m in period t at iteration l

ζ_{kt}^l subgradient of the inventory balance constraint for item k in period t at iteration l

a_{kj} production coefficient (quantity of item k, which is directly needed to produce one item j)

b_t^m total capacity of resource m in period t in time units

d_{kts} cumulated demand of item k in periods t to s

D_{kt} total (external and derived) demand of item k in period t

d_{kt} external demand of item k in period t

e_k echelon holding cost coefficient of item k

h_k full holding cost coefficient for item k

K total number of items

k items, $k = 1, \ldots, K$

K_m set of items k that are produced on the same resource m

L_m cumulated lead time of resource m

M total number of non-identical resources

m non-identical resources, $m = 1, \ldots, M$

n parallel machines, $n = 1 \ldots P_m$

N_k set of direct successors of item k

P_m number of parallel machines of resource type m

q_{kt} production quantity of item k in period t

s periods, $s = 1, \ldots, T$

s_k setup cost coefficient for item k

T length of the planning horizon

t production periods, $t = 1, \ldots, T$

tb_k time needed to produce one unit of item k

tr_k time needed to set up a resource for the production of item k

U_m capacity utilization of resource m

u_{kt} Lagrangean multiplier for the inventory balance constraint

V_k set of direct predecessors of item k

v_t^m Lagrangean multiplier for the capacity constraint

w_t^m Lagrangean multiplier for the constraint of total number of setup carryovers

y_{kt} inventory of item k available at the end of period t

List of Abbreviations

ACO	Ant Colony Optimization
B&B	Branch&Bound
B&C	Branch&Cut
BO	Backorders
C&B	Cut&Branch
CC	Consecutive setup carryover (over more than one adjacent period transition)
CG	Column Generation
CLSP	Capacitated Lotsizing Problem
CLSPL	Capacitated Lotsizing Problem with Linked Lotsizes
CSLP	Continuous Setup Lotsizing Problem
DLSP	Discrete Lotsizing and Scheduling Problem
DW	Dantzig-Wolfe Decomposition
EA	Evolutionary Algorithms
ELSP	Economic Lot Scheduling Problem
EOQ	Economic Order Quanitity
EP	Evolutionary Programming
ES	Evolutionary Strategies
F&R	Fix&Relax

GA	Genetic Algorithms
GH	Greedy Heuristics
GLSP	General Lotsizing and Scheduling Problem
I&L	Inventory&Lotsize
ILS	Iterated Local Search
LD	Lagrangean Decomposition
LP	Linear Programming
LR	Lagrangean Relaxation
LR-MLCLSPL	Lagrangean Relaxation of MLCLSPL
MA	Memetic Algorithms
MIP	Mixed Integer Program
MLCLSP	Multi-Level Capacitated Lotsizing Problem
$MLCLSP_{SPL}$	Simple Plant Location Formulation of the Multi-Level Capacitated Lotsizing Problem
$MLCLSP_{SR}$	Shortest Route Formulation of the Multi-Level Capacitated Lotsizing Problem
MLCLSPL	Multi-Level Capacitated Lotsizing Problem with Linked Lotsizes
$MLCLSPL_e$	Multi-Level Capacitated Lotsizing Problem with Linked Lotsizes with echelon holding costs
MLCLSPLCC	Multi-Level Capacitated Lotsizing Problem with Linked Lotsizes and Consecutive Carryover
MLCLSPLPM	Multi-Level Capacitated Lotsizing Problem with Linked Lotsizes and consecutive carryover on Parallel Resources
MLULSPL	Multi-Level Uncapacitated Lotsizing Problem with Linked Lotsizes
MRP	Material Requirements Planning
MP	Mathematical Programming
NFA	Network Flow Algorithm
PLSP	Proportional Lotsizing and Scheduling Problem
PM	Parallel (identical) resources

RH	Rounding Heuristic
SA	Simulated Annealing
SLULSP	Single-Level Uncapacitated Lotsizing Problem (also referred to as Wagner-Within ProblemWagner and Whitin (1958))
SLULSPL	Single-Level Uncapacitated Lotsizing Problem with Linked lotsizes
SP	Set Partitioning
SPL	Simple Plant Location
SPP	Set Partitioning Problem
SR	Shortest Route
TA	Threshold Accepting
TBO	Time between orders
TS	Tabu Search
VI	Valid Inequalities
VNS	Variable Neighborhood Search