Title: PLANNING AND SCHEDULING OF PROCESS OPERATIONS UNDER UNCERTAINTY

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Abstract

In the real industrial application, optimization of planning and scheduling is an ongoing dynamic process where unexpected disruption of the optimization parameters is inevitable. The objective of this thesis is to develop a general methodology to consider uncertain parameters in production planning and scheduling problems. Different challenges that arise at the level of planning and scheduling are associated with model formulation issues, and computational times when solving large-scale problems. Nevertheless, the implementation of such models improves the overall efficiency of manufacturing systems.

In the first part, we consider the problem of integration of production scheduling and maintenance activities. The approach is based on unit-specific continuous time-domain representation using state-task-network (STN) process representation leading to mixed integer linear programming (MILP) formulation. Between the two models considered, it is observed that model M1 gives the optimal solution with a smaller number of events when compared to the other model M2.

In the second part, we formulate practical reactive scheduling approaches for multipurpose batch plants. In this work, a two-stage solution technique is formulated for short-term rescheduling problems using an efficient MILP model. Two models with three types of disturbances are considered. It is observed that model M1 gives better profit when compared to model M2 for the case of unit breakdown.

In the third part, a robust MILP model for planning of carbon capture and storage (CCS) retrofit is developed to maximize CO2 emission reduction. In the model, the end time of operating life of CO2 sources, maximum storage capacity for different sinks, and compensatory power makeup, carbon footprint are considered as uncertain parameters. When compared with the worst-case based robust approach, the robust MILP formulation provides significant solution options.

In the fourth part, we present an innovative approach for nominal short-term scheduling of multi-stage multiproduct batch plants based on a unit-specific continuous time-based MILP model. The novelty in the presented formulation is to explore the possibility of allowing the processing of orders across different stages to be at the same event point. Three different

objectives are solved. The obtained results show that the developed model is much more effective in finding the optimal solutions using a fewer number of events than its global event-based counterpart.

All the proposed methodologies are validated on examples from the literature. The improved and converged objective function values are obtained with a lesser number of events.

Keywords: Planning and Scheduling, Preventive scheduling, Reactive scheduling, Robust optimization, Carbon capture and storage, Multi-stage scheduling