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A novel technique for prediction of time points for scheduling of multipurpose batch plants

Reshid Seid[a], **Thokozani Majozi**[a, b],

[a] Department of Chemical Engineering, University of Pretoria, Lynnwood Road, Pretoria 0002, South Africa
[b] Modelling and Digital Science, CSIR, Pretoria, South Africa

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Abstract

This paper presents a mathematical technique for prediction of the optimal number of time points in short-term scheduling of multipurpose batch plants. The mathematical formulation is based on state sequence network (SSN) representation. The developed method is based on the principle that the optimal number of time points depends on how frequent the critical unit is used throughout the time horizon. In the context of this work, a critical unit refers to a unit that is most frequently used and it is active for most of the time points when it is compared to other units. A linear model is used to predict how many times the critical unit is used. In conjunction with knowledge of recipe, this information is used to determine the optimal number of time points. The statistical R^2 value obtained between the predicted and actual number of optimal time points in all the problems considered was 0.998, which suggests that the developed method is accurate in determining optimal number of time points. Consequently this avoids costly computational times due to iterations. In the model by Majozi and Zhu (2001) the sequence constraint that pertains to tasks that consume and produce the same state, the starting time of the consuming task at time point p must be later than the finishing time of the producing task at the previous time point $p-1$. This constraint is relaxed by the proposed models if the state is not used at the current time point p. This relaxation gives a better objective value as compared to previous models. An added feature of the proposed models is their ability to exactly handle fixed intermediate storage (FIS) operational philosophy, which has proven to be a subtle drawback in published scheduling techniques..

Keywords: Scheduling; Multipurpose; Optimization; MILP; Optimal; Continuous-time; Time point