# Optimal Periodic Scheduling of Continuous Multiproduct Plants

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## Overview

Two mixed-integer nonlinear programming (MINLP) models are given for solving the periodic scheduling problem. They both rely on the Resource-Task Network (RTN) process representation despite the fact that the general concept of tasks and resources is not explicit in the model variables. Instead, the latter are linked to the process entities like processing units, products and stages, to facilitate model comprehension. This is possible in cases dealing with a multistage network structure rather than the more general multipurpose type.

Conceptually, they differ in the way time is treated, with both of them being continuous-time formulations. Model STG uses a single time grid to keep track of the events taking place in all processing units, where model MTG uses a different grid for every unit. STG is more general and can potentially lead to better solutions since it can produce a product in multiple units at a given stage. In contrast, MTG assumes production in a single unit but has the advantage of requiring time grids with fewer event points, leading to a much better computational performance. In practice, this translates into the ability of tackling larger problems.

The number of event points (|T|) required by the two models to represent a particular schedule is illustrated next, where *H* represents the cycle time. Bear in mind that, in periodic scheduling, tasks ending past the duration of a cycle can be viewed simply as being wrapped-around to the beginning of the same cycle. In Figure 1, the things to highlight for STG are: (i) the production of a certain product may span multiple time intervals; (ii) each cleaning task requires one time interval; (iii) the duration of a time interval may be higher than the duration of the cleaning task taking place (e.g. interval 5). In Figure 2, it can be seen that MTG: (a) considers combined processing and changeover tasks that last a single time interval, with the first index indicating the product being processed and the second the one that immediately follows; (b) assumes the same number of event points for all time grids, even though the solution could typically be obtained with fewer events in some units (e.g. 1 in M2 and 2 in M3).

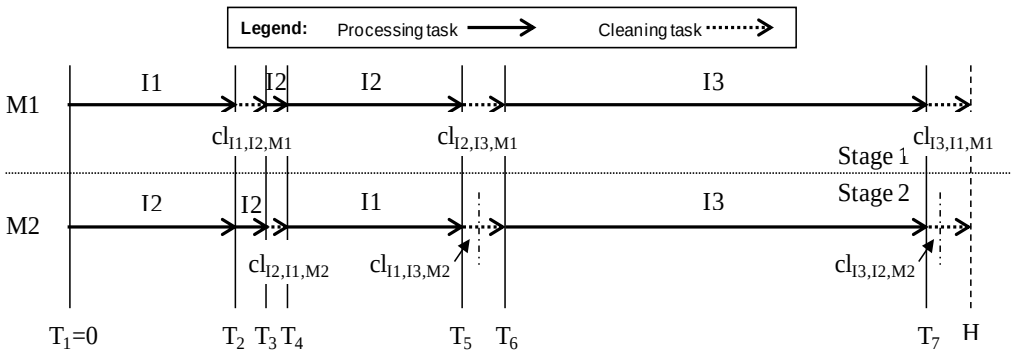


Figure 1. Possible solution from single time grid formulation STG (|T|=7 for |I|=3, |M|=2, |K|=2).

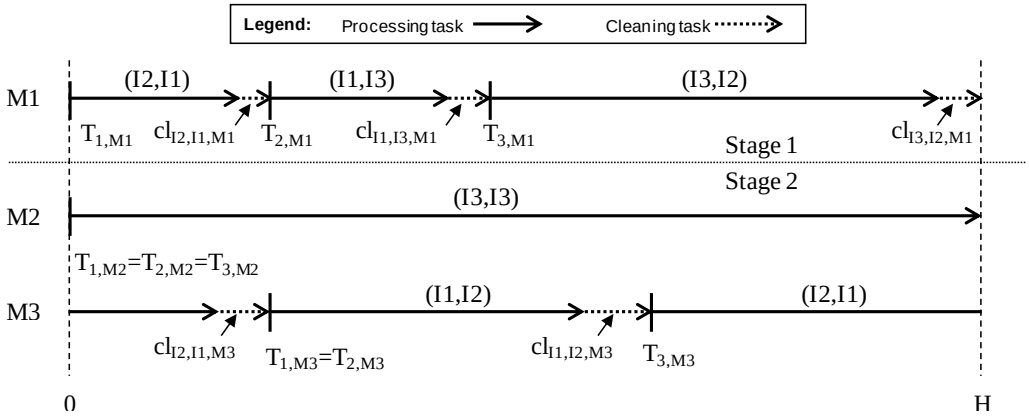


Figure 2. Possible solution from multiple time grid formulation MTG (|T|=3 for |I|=3, |M|=3, |K|=2).

## Reference

Pedro M. Castro & Augusto Q. Novais, *Optimal Periodic Scheduling of Multistage Continuous Plants with Single and Multiple Time Grid Formulations*, Ind. Eng. Chem. Res. 2007, 46, 3669-3683