Linearization Methods for the Optimization in Recovered Paper Production

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Recovered Paper nowadays is the most important resource in the paper production. Before recovered paper can be used to produce new paper from it, it has to be prepared in several steps. One of these steps is the so-called fine screening, where the pulp is especially cleaned from tacky particles, called stickies. These impurities could cause much trouble in the later paper manufacturing process, resulting in production losses. In this process, the suspension is piped through a multi-stage screening system, usually consisting of three up to six screens.

The aim of our work is to find the optimal layout of such a screening system and simultaneously the optimal adjustment of each of the built-in screens depending on the composition of the pulp. This problem is mathematical challenging because of the combination of the nonlinearities arising from the screening process itself and its combinatorial nature originating from the choice of the layout.

In order to solve this MINLP, we approximate the nonlinear functions by piecewise linear ones, and incorporate these in our model, resulting in an MILP, which for example can be solved by state-of-the-art branch-and-cut algorithms. For this purpose we introduce two approaches. On the one hand the bivariate nonlinear function resulting from the screening process are approximated on triangular grids. On the other hand we develop a technique for transforming these functions to functions of one variable, and methods for approximating these. We determine the resulting approximation error of the original two-dimensional function and demonstrate the advantages of the later technique. Some numerical results are presented. Finally open questions are adressed.