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Optimal Particle Size Distribution Control in a Pharmaceuticals Batch Dryer Using a Hybrid Genetic Algorithm-Pattern Search Optimization Strategy

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This contribution describes the dynamic optimization of a pharmaceuticals batch dryer. The optimal control problem is based on the control vector discretization or single shooting method, thus a non-linear programming (NLP) problem is obtained. The target of the open loop optimization problem is the batch time minimization and the control variables are the On/Off intervals of the mixer and the mixer rotation speed. In order to implement a relevant scenario from practical point of view the following constraints are applied: the on and off intervals have same duration, the stirrer speed is constant during the entire batch drying process and the final moisture specification must be met. Finally, an upper limit on the fines fraction in the particle size distribution is set. The dryer model [1] consists of a system of partial differential equations coupled to a population balance model which describes the breakage process. The optimization problem presents several local minima and low gradient regions, thus a gradient based method fails to converge to the minimum. Therefore, a genetic algorithm-pattern search (simplex) method is used to ensure convergence of the optimization problem. The relevance of the work is highlighted by recent contributions which deal with the operation optimization of this unit operation [2–5].

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