

Optimality in the management of hydroelectric power stations in cascade

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Abstract

We consider a simplified model for a cascade of hydro-electric power stations where some of the stations have reversible turbines. The problem is considered in the framework of optimal control theory. The control variables are the turbined/pumped volumes of water for each reservoir. Our aim is to find optimal controls and corresponding volumes in the reservoirs that maximize the profit of selling energy. A high price corresponds to a high need of energy and inversely a low price corresponds to a low need.

Numerical results are obtained using available software. Taking into account the profile of solution given by the numerical approach we apply some mathematical tools to validate such solution. More specifically we use the maximum principle of Pontryagin and some new sufficient conditions of optimality for a particular class of optimal control problems which includes our problem. Properties of periodicity of the solution for the case of periodicity of price are also investigated.

It is a challenging problem since the cost function is nonconvex and besides constraints in the control it involves also pure state constraints.

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