

Modifier Adaptation for Real-Time Optimization – Basic Idea and Recent Developments

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Abstract: Real-time optimization (RTO) encompasses a family of optimization methods that incorporate process measurements in the optimization framework to drive a real process (or plant) to optimal performance, while guaranteeing constraint satisfaction. The typical sequence of steps for process optimization includes process modeling, numerical optimization using the process model, and application of the model-based optimal inputs to the plant. In practice, this last step is quite hazardous—in the absence of additional safeguards—as the model-based inputs are indeed optimal for the model, but not for the plant unless the model is a perfect representation of the plant. This often results in suboptimal plant operation and in constraint violation.

RTO methods can be classified depending on how the available measurements are used. There are basically three possibilities, namely, the measurements are used to update (i) the process parameters, (ii) the cost and constraint functions, and (iii) the inputs directly. This talk deals with the second class. For instance, this is the philosophy of Constraint Adaptation (CA), wherein the measured plant constraints are used to shift the predicted constraints in the model-based optimization problem, without any modification of the model parameters. This is also the main idea in Modifier Adaptation (MA) that uses measurements of the plant constraints and estimates of plant gradients to modify the cost and constraint functions in the model-based optimization problem without updating the model parameters. Input-affine corrections allow matching the first-order conditions of optimality upon convergence. The advantage of MA lies in its proven ability to converge to the plant optimum despite structural plant-model mismatch.

This paper presents the basic idea of MA as well as an overview of the recent developments of MA schemes for real-time optimization of uncertain processes. We also give an overview of the application studies available in the literature. Finally, the paper briefly discusses open issues so as to promote future research in this area.

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