A Real-Time Sequential Convex Programming Method and Applications in Optimal Control

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Abstract: Consider the following parametric optimization problem which can arise from numerical methods for solving optimal control problems

$$\min F(w), \quad \text{subject to } G(w) + Mx^0 = 0,\ w \in \Omega, \tag{OP}$$

where $F : \mathbb{R}^{n_w} \to \mathbb{R}$ and $G : \mathbb{R}^{n_w} \to \mathbb{R}^{n_e}$ are twice-continuously differentiable, F is convex, Ω is a closed convex subset in $\mathbb{R}^{n_w}$, M is a real matrix with consistent dimension and $x^0 \in X_0 \subset \mathbb{R}^{n_x}$ is a parameter.

In this presentation, firstly, we introduce a kind of iterative method for solving the parametric nonlinear optimization problem (OP) which we call the "real-time sequential convex programming" method (RTSCP). We combine the idea of real-time iterations scheme introduced in [2] cf. [1] with so called "sequential convex programming" methods (SCP) to solve problem (OP). The main advantage of this approach is in producing a sufficiently fast algorithm to be applied to real-time process optimization. Moreover, many available methods and software can be efficiently exploited to solve the convex optimization subproblems resulting from the RTSCP formulation. We apply our method to solve two Nonlinear Model Predictive Control (NMPC) problems, one of them arising from a hovercraft control problem [3]. We close this presentation by some conclusions and the outline of future work.

References

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