Master's thesis project

Implementation of a numerical method for solving optimization problems with matrix inequality constraints

A matrix $\boldsymbol{A} \in \mathbb{R}^{m \times m}$ is said to be positive semi-definite if $\boldsymbol{y}^T \boldsymbol{A} \boldsymbol{y} \geq 0$ for all $\boldsymbol{y} \in \mathbb{R}^m$; we write this using the notation "$\boldsymbol{A} \succeq \boldsymbol{0}$". A non-linear optimization problem (NLP) with matrix inequality constraints, then, is a problem of the following form:

$$\begin{aligned} &\underset{\boldsymbol{x} \in \mathbb{R}^n}{\text{minimize}} \quad f(\boldsymbol{x}) \\ &\text{subject to} \quad \begin{cases} \boldsymbol{g}(\boldsymbol{x}) \leq \boldsymbol{0} \\ \boldsymbol{A}(\boldsymbol{x}) \succeq \boldsymbol{0}, \end{cases} \end{aligned}$$

where f, $\boldsymbol{g}$ and $\boldsymbol{A}$ are non-linear functions; the latter matrix-valued. Problems of this type are frequently encountered in structural optimization and control theory, and it is therefore interesting to develop efficient numerical methods for solving such problems.

The aim of this project is to implement and test a numerical method for solving NLPs with matrix inequality constraints. The project is suitable for a student/pair of students with strong background in programming and mathematics, especially optimization theory. Of particular interest are applications in structural optimization, so knowledge on this topic is a merit.

If the above seem interesting, please contact Carl-Johan Thore at the Division of Mechanics.

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