Optimization @ ARUP: Towards Practical Coordinate Descent Methods for Truss Topology Design

(Maximaths Proposal)

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Introduction: ARUP is a global engineering and design company with 97 offices in 37 countries. Among projects it has worked on belong the following: Sydney Opera House (Australia), Beijing National Aquatics Centre (China), Pompidou Centre (France), Angel of the North, 30 St Mary Axe, Terminal 5 at Heathrow Airport and Scottish Parliament Building (all UK). ARUP is interested in numerical and optimization methods related to their operations such as structural design, truss topology design, shape design, cost minimization and buildability maximization. Recently, (Richtárik–Takáč 2011) have designed and analyzed the complexity of a coordinate descent method suitable for solving huge-scale instances of the truss topology design (TTD) problem (tens of millions of potential bars).

Objectives: In this project we plan a sequence of meetings with ARUP, identifying their needs for optimization algorithms for which i) there might exist modern efficient methods in the literature (for the benefit of ARUP), ii) for which there are currently no suitable methods known (for potential benefit of the academic partners). In the process, we will investigate the potential for the application of the coordinate descent algorithm developed in (Richtárik–Takáč 2011) to existing design problems of ARUP, using their data, and will seek to understand its limitations.

References (Selected):

Richtárik P., Takáč M., Iteration complexity of randomized block-coordinate descent methods for minimizing a composite function, ArXiv 2011.

Richtárik P., Takáč M., Efficient serial and parallel coordinate descent methods for huge-scale truss topology design, to appear in Operations Research Proceedings, Springer, 2011.

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