Graduation Project

Numerical solution of a saddle point linear system

Research context. All height systems in the world use a particular equipotential surface of the Earth's gravity field as a reference surface. TU Delft computes this reference surface under contract of the Dutch government for an area which comprises the Dutch mainland, the Wadden Islands, the Dutch continental shelf and large parts of the North Sea. Recent developments in satellite sensor technology have provided new data sets of unprecedented accuracy and spatial resolution. When combined with terrestrial and airborne data, they allow the realization of a new height reference surface with a spatial resolution of a few kilometres and an accuracy of about one centimetre. Least-squares techniques are frequently used to compute such a surface from all available data. From a numerical analysis point of view, the problem can be reduced to the numerical solution of a saddle point linear system. The numerical solution of this system is complicated due to the fact that the number of unknowns are considerable (of the order of 10^6), that the involved matrices are dense, and highly ill-conditioned. Therefore, tailored algorithms need to be developed for a parallel computational environment, which are able to compute a numerically stable solution including full noise variance-covariance matrix.

Purpose of the research. The main goal of this project is to investigate the performance of an iterative solver for the saddle point linear system. This also comprises the choice of a suitable pre-conditioner and the implementation in Fortran95 on a parallel machine. Real data will be used throughout the project.

Supervision. The work is a cooperation between the Department of Geoscience and Remote Sensing (GRS) and the Department of Applied Mathematical Analysis. Daily supervision will be provided by Prof. Dr.-Ing. habil. Roland Klees (GRS) and Dr. Martin van Gijzen (Applied Mathematics). The project can be started immediately.

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