Optimization

Data Assimilation as PDE-Constrained Optimization

One of the most challenging problem areas in numerical optimization is the solution of very large problems whose major constraints are partial differential equations (PDEs). The optimization procedure requires repeated execution of the PDE simulation, a task that is by itself complex and computationally intensive.

An important PDE-constrained optimization problem known as variational data assimilation, which arises in atmospheric and oceanic sciences and other applications. Data assimilation has become an important tool in forecasting at major weather prediction centers, where it is used to produce initial values for regional and global weather forecasts several times a day. The PDE in the data assimilation problem describes the evolution of the atmosphere from a given initial state, while the unknown is the state of the atmosphere at a given time point in the recent past. The objective function measures the goodness of fit between the simulated state and actual observations of the atmospheric state at various time points. The optimal state obtained from the data assimilation problem is then used as the initial condition in the evolution equations that produce a forecast.

In this project large sclae optimization methods will be applied to variatiaonal data assimilation with aim to improve the quality of forecats and make the algorithms more effficient.

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