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Constrained inversion for basal and englacial properties

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When inverting for basal slipperiness and (C retrieval) the rate factor in Glen's flow law (A retrieval) using surface data, the inversion needs to be constrained for the retrieved values to be positive. Some other constraints may also have to be imposed on the retrieved fields. There are various ways of enforcing such constraints. Using an adjoint model of the shallow-ice stream equations, several different algorithms are tested and compared with respect to rate of convergence and cost per iteration. These methods included the projected gradient method, the limited-memory projected BFGS method, the interior-point method, and an incomplete Newton iteration using a barrier function. All these methods perform favourably for small problem sizes (O(1000) unknowns). It is shown that for large-scale optimisation problems the convergence rate for A retrieval is generally lower than for C retrieval. Both projection methods suffer from slow convergence for large problem sizes (O(100 000) unknowns.) Interior-point methods, especially when coupled with an incomplete inner iteration of the Newton system appear to give the best large-scale performance.