On the efficient computation of sparse Hessians using Automatic Differentiation

ANDREA WALTHER[1] <awalther@math.tu-dresden.de>

In constraint optimization, the usage of exact sparse Hessians instead of only inexact second order information stabilizes and accelerates frequently the optimization process. In this talk we will present a strategy to compute the sparsity pattern of the Hessian for a scalar-valued function given as computer program. A complexity estimate for this new algorithm will be given yielding a quadratic behaviour in the maximal number of nonzeros per row. Subsequently, I will analyze a new vector version of the second order adjoint mode of Automatic Differentiation. Once again, the complexity of this method to compute second order information is analyzed.

As a result, the efficient and exact calculation of the nonzero entries of the Hessian can be performed employing the sparsity pattern, recent graph coloring algorithms and the new variant of the second order adjoint information provided by Automatic Differentiation. The implementation of the presented computation of sparse Hessians is integrated into ADOL-C, a tool for the Automatic Differentiation of C and C++ codes.

The presented complexity estimates will be illustrated by some numerical results achieved with ADOL-C. For this purpose, the run times computed for some problems of the CUTE test set collection are presented and analyzed.

[1]Institut für Wissenschaftliches Rechnen, Technische Universität Dresden