On the efficient Solution of Nonlinear Programming Problems and Applications to Mechanics

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The parallel numerical solution of realistic mechanical problems, such as large-deformation contact between an elastic body and a rigid obstacle, often gives rise to nonlinear and possibly non-convex optimization problems. Thus, in order to succeed in computing a local minimizer of such optimization problems their solution is most oftenly carried out employing globalization strategies, i.e., Trust-Region (cf., [Conn,Gould,Toint 2000]) and Linesearch methods (cf., [Nocedal,Wright 2006]).

The paradigm of globalization strategies is to compute and to damp a search direction in order to achieve a descent in the value of a given objective function. As it turns out, in SQP strategies, search directions are computed as the solution of constrained quadratic programming problems. But, even if these quadratic programming problems are solved exactly, the damping of the search directions might yield a slow convergence of the overall scheme.

Therefore, in the last two decades several domain decomposition approaches were presented which aim on an extension of "standard" globalization strategies. Moreover, as has been shown in numerical simulations, the resulting nonlinear multigrid methods and inherently parallel globalization strategies enhance the rates of convergence of the solution method. On the other hand, for these methods one can show convergence to first-order critical points under standard assumptions.

Therefore, in this talk we will review the concept of Trust-Region methods and consider nonlinear domain decomposition methods, such as MG/Opt [Nash 2000], Rmtr [Gratton,Toint,Sartenaer 2006] and a novel, globalized version of the inherently parallel Aspin strategy [Gross,Krause 2011]. Furthermore, we present numerical examples, in order to illustrate the behavior of the respective strategies.

References

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