On the solution of nonlinear systems arising from topology optimization of structures under geometrical nonlinearities

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One of the most common problems in topology optimization consists in minimizing the compliance of a structure, subject to its static equilibrium conditions and to a prescribed volume of material. Some structures are subject to geometrical nonlinearities, meaning that the material used to construct it has a nonlinear relation between deformations and displacements. In this case, to compute the objective function, it is necessary to solve a nonlinear system of equations (associated with the static equilibrium conditions of the structure), usually solved using Newton's method. It can be observed that the assembly of the Jacobian matrix of these nonlinear systems demands the largest computational effort involved in this process. We present some strategies based in modifications of Newton's method, with the aim of obtaining approximate solutions of the aforementioned nonlinear systems in an affordable way. Preliminary computational results show a worth cost-benefit of the proposed strategy in combination with the Sequential Piecewise Linear Programming method for obtaining optimal structures.