Approximated solution of linear systems arising from topology optimization of structures

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Resumo/Abstract:
A common problem in topology optimization is the minimization of the compliance of a static structure, subject to a volume constraint. No matter what method is used to solve this problem, the computational cost is dominated by the solution of the system of equations associated with the equilibrium conditions. If the structure has an elastic material and is subjected to small displacements, one linear system need to be solved at each iteration of the optimization algorithm, in order to obtain the nodal displacements, which are used to evaluate the objective function. Since the stiffness matrix of the structure is symmetric and positive definite, this linear system is frequently solved using the Cholesky factorization, although this method can be expensive for large-scale problems. To overcome this difficulty, Amir, Bendsoe & Sigmund (2009) presented a strategy based on the combined approximations approach, proposed by Kirsch (1991), which consists basically in reusing the Cholesky factorization. In this work, we combine this approach with the Sequential Piecewise Linear Programming method, proposed by Gomes & Senne (2014), and discuss the reduction of the computational cost of the solution of the linear systems when this strategy is applied to a classical problem.