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MISALIGNMENT TOPOLOGY OPTIMIZATION

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Abstract: Topology optimization problems aims at the minimization of an objective function while satisfying various constraints. This objective function has been based on "compliance formulation" since Bendsøe and Kikuchi (1988) as it provides solutions where the displacements are globally controlled. However, this formulation doesn't take into account special needs over local displacements or even relative displacements such as the misalignment between two gears. This point is of paramount importance to achieve the best efficiency. Although critical, this domain is especially challenging as very few contributions exist on the subject. Coupling topology optimization with the misalignment minimization can provide promising results once chosen the right formulation. The misalignment can be expressed in various ways. In this work a small amount of formulations were tested on a simple case study composed of two axes to be align. This allowed us to choose a promising expression for the misalignment and furthermore to investigate its efficiency on a 2D problem. The former consists of a box clamped on both sides where a load is applied in its center. The objective is to minimize the misalignment between two horizontal bars located at the middle of each clamped edges. This optimization problem was implemented in our in-house MATLAB code. Different issues were already highlighted during this simple test. The first one was an unclear optimized material distribution as well as a non-converged solution. This typical result of topology optimization has been investigated throughout the years and interesting methods were developed to tackle this issue. For our case study we have chosen to impose a constraint on the measure of discreteness in our optimization formulation to impose a more black-and-white solution with actual engineering meaning. The second issue was a disconnection of the structure coming from an ill-posed optimization formulation as only local constraints are taken into account and no global performance of the problem is required. This issue is furthermore emphasized by imposing a constraint on the measure of discreteness. Thusly a natural way to deal with it is to introduce a constraint on the global compliance of the solution. According to our tests we obtained interesting and engineering meaningful solutions on a 2D case. Our formulation of misalignment and our side constraints were furthermore also tested on a 3D torsion problem.