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Perturbation of the Compliance Functional Due to the Apperance of a Small Cavity in an Elastic Body

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The paper proves that the known methods of assessing an increment of strain energy due to the appearance of small cavities in elastic solids lead to one equivalent result. The following approaches are discussed: the compound asymptotic method by Mazja, Nazarov and Plamenevskii, the topological derivative method and the method of Eshelby. A new method of computing the topology derivative relevant to weakening the domain by a small cavity (or hole) of arbitrary shape is proposed here. The method is based on the velocity method of shape optimisation. The speed vector field is chosen as a linear function in the space variable. This method is applied for confirming the Eshelby-Mazja formula by a new manner. Moreover, a new exterior topological derivative is introduced, thus making the evolutionary optimisation algorithm reversible with respect to the usual process of removing the material from the feasible domain.

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