Generalizations of Donati's and Saint Venant's Theorems with Applications to Linearized Elasticity

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The main objective of this presentation is to describe extensions of Donati's and Saint Venant's theorems that hold under very weak regularity assumptions on the strain tensor field. It is based on a joint work with C. Amrouche, P. G. Ciarlet, and S. Kesavan, that recently appeared in J. Math. Pures Appl.

There, we also showed that these results allow to reformulate in a novel way the pure traction problem and the pure displacement problem of linearized three-dimensional elasticity as constrained quadratic minimization problems with the strain tensor as the primary unknown. This intrinsic approach presents the great advantage of directly providing the stress tensor field, since the constitutive equation of a linearly elastic material is invertible.

The next stage, partly under progress, is to carry out similar extensions of these classical results for getting characterizations of matrix fields as linearized change of metric and change of curvature tensors on surfaces, with applications to linear shell theory.

One worthwhile conclusion of this work is that our extension of Saint Venants theorem is in fact nothing but the matrix analog of a weak form of Poincaré's lemma.