Injective elastic deformations via vanishing self-repulsion

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For many models of elastic solids, injectivity of deformations is a crucial constraint because it represents non-interpenetration of matter. On the theoretical level, this is usually achieved by imposing the well-known Ciarlet-Nečas condition. Beyond mere heuristics, its approximation, especially mathematically rigorous and computationally efficient approximation, is much less well understood, though. I will present recent theoretical and practical progress in this area, using self-repulsion terms concentrated on or near the domain boundary. These penalize self-interpenetration, possibly even preventing it completely for finite energy, while correctly reproducing the injectivity constraint in a limiting sense. Sobolev-Slobodeckiĭ seminorms of the inverse of the deformation map serve as a role model.

This is joint work with Philipp Reiter (TU Chemnitz).

References

[1] Stefan Krömer and Philipp Reiter. Nonlinear elasticity with vanishing nonlocal self-repulsion. Preprint arXiv:2206.09594 (2022).