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Korn and Poincaré-Korn inequalities: A different perspective

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Korn's inequality and its variants are essential tools in the mathematical analysis of both linear and nonlinear elasticity. They play a central role in establishing existence and regularity results for partial differential equations involving symmetric gradients. In this talk, I will present a conceptually simple derivation of the first and second Korn inequalities for general exponents $1 < p < \infty$, applicable to a wide class of domains, including Lipschitz and extension domains. Our approach bypasses the traditional reliance on singular integral estimates and intricate geometric arguments, instead relying on the classical and q-Riesz representation theorems. In the case $p = 2$, the argument becomes especially transparent, requiring only basic Hilbert space methods and Weyl's lemma. I will also discuss associated Poincaré–Korn inequalities in both bounded and unbounded domains, which remain valid even in the limiting case $p = 1$. These inequalities not only ensure the coercivity of variational problems in elasticity but also serve as a key preliminary step in the proof of the first Korn inequality.

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