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Variational characterization of certain calibrated submanifolds

Fix a compact, oriented, embedded submanifold L of a manifold M. Consider the volume $\mathcal{V}(g)$ of L as a functional of the ambient Riemannian metric g on M. We show that when g is induced from a special geometric structure (specifically a $\mathrm{U}(m)$, a G_2, or a $\mathrm{Spin}(7)$ structure) and is varied only in a particular special way, then g is a critical point of $\mathcal{V}$ if and only if L is a calibrated submanifold of M. This generalizes a result of Arezzo-Sun (which was established only for Kahler manifolds) to a much wider class of special ambient geometries, with no assumption on torsion. The $\mathrm{Spin}(7)$ case is particularly interesting, as it behaves somewhat differently from the other cases. This is joint work in progress with Da Rong Cheng and Jesse Madnick.