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Minimal surfaces and G_2 geometry

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Recall that Morse theory allows one to find the homology groups of a finite dimensional manifold by studying the critical points and the gradient flow lines of a function.

Given an oriented 4-dimensional Riemannian manifold X, there is a functional F on the (infinite-dimensional) space of surfaces in the twistor space Z(X) such that the critical points of F correspond to minimal surfaces in X and the gradient flow lines correspond to associative submanifolds in Z(X) x R. Therefore, if we try to apply Morse homology to F the Euler characteristic of the chain complex could be interpreted as the signed count of minimal surfaces in the manifold X.