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Introduction to the theory of varifolds with applications to the min-max theory

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The construction of critical points of the area, that are not necessarily area minimizers, typically requires to pass to the limit a sequence of almost critical submanifolds with area bounds, in order to find a limit that is critical for the area. To this aim, currents are not very effective, since the mass is only lower semicontinuous and we could end up with a trivial limit. This is not an issue for the Plateau problem, because of the assigned nontrivial boundary or homology class. To solve this problem, F. J. Almgren introduced varifolds in 1965, following an earlier notion of generalized surfaces by L. C. Young in 1951. The main difference compared to currents is that the mass of varifolds is continuous in compact sets. This allows to obtain one of the most important applications of the theory of varifolds: the min-max construction of closed minimal hypersurfaces in closed Riemannian manifolds.

In this mini-course, we will give an introduction to the theory of varifolds, and we will discuss how we can use varifolds to construct (possibly anisotropic) minimal hypersurfaces via the min-max theory.

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