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(ε, η)-Approximating Partitions

If δ is a positive function on a closed interval $[a, b]$, a δ-fine partition of $[a, b]$ is a collection $\{(I_1, x_1), \ldots, (I_p, x_p)\}$ where $I_1, \ldots, I_p$ are nonoverlapping closed intervals with union $[a, b]$ such that $x_i \in I_i$ and $\mathrm{diam}(I_i) < \delta(x_i)$ for $i = 1, \ldots, p$. Cousin's lemma assures that such a δ-fine partition always exists—a fact that is essential to the definition of the Generalized Riemann Integral. Recently, Washek F. Pfeffer has given a Riemann type definition of an integral in $\mathbf{R}^m$ which is coordinate free and for which a general divergence theorem holds (see [Pfeffer, *A Riemann Type Definition of a Variational Integral,* to appear]). In this definition, the simple δ-fine partitions of the Generalized Riemann Integral are replaced by a partitioning concept which is more general in several directions. Among the generalizations: intervals are replaced by sets in $\mathbf{R}^m$ with finite perimeters in the sense of De Giorgi; the partitioning points are not allowed to lie in a prespecified exceptional set; and the partition is only required to cover "most" of the set being partitioned. The purpose of this talk was to show how to prove a Cousin-like existence lemma for these more general partitions. The proof uses ideas from [Howard, *Analyticity of almost everywhere differentiable functions,* Proc. American Math. Soc., at press].