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Compact-defined decompositions of spaces with applications to calculus of variations in Sobolev spaces and to Bochner integral in Fréchet spaces

Given a complete locally convex space E , let $\vec{E}_C = \{E_C\}$ be system of the subspaces of E spanned by all absolutely convex compacta $C \subset E$, endowed with the Banach norms generated by C . System \vec{E}_C forms an inductive spectrum. The fundamental fact is that in case of an arbitrary Fréchet space E the inductive limit of \vec{E}_C topologically coincides with the initial space: $E = \varinjlim \vec{E}_C$. In addition, in Hilbert case it suffices to consider only Hilbert subspaces of E spanned by the all compact ellipsoids in E . Our approach can be applied, in particular, to calculus of compact variations in Hilbert-Sobolev spaces $E = W_2^n$, creating new tools of convex analysis and obtaining strong compact characteristics of mappings.