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Noncommutative geometry on discrete spaces

The approximation theory of partial differential equations on smooth manifolds can take several aspects. The various methods rely on the intuitive geometric idea that the fine structure of space is discrete. The resulting discretized space is governed by a small parameter $\hbar$ which plays the role of infinitesimal.

A natural question is to determine a general framework, i.e. a unifying treatment of continuous and discrete geometries. Noncommutative differential geometry, and more specifically the construction of spectral triples, offers a promising direction to formalize approximation theory of differential operator using the same tool as classical differential geometry.

In this talk, we will start by reviewing how to associate a spectral triple to a triangulation of a given smooth manifold. Then, we will show how a sequence of spectral triples, associated to a sequence of refined triangulations, can be related at the limit $\hbar \to 0$ to the spectral triple on a spin manifold. In fact, we observe a convergence in average when the Dirac operators are taken as random matrices with a suitable distribution on the coefficients.