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Vietoris–Rips complexes of spheres.

If a dataset is sampled from a manifold, then as more and more samples are drawn, the persistent homology of the Vietoris–Rips complex of the dataset converges to the persistent homology of the Vietoris–Rips complex of the manifold. But very little is known about the homotopy types of Vietoris–Rips complexes of manifolds. An exception is the case of the circle: as the scale parameter increases, the Vietoris–Rips complex of the circle obtains the homotopy types of the circle, the 3-sphere, the 5-sphere, the 7-sphere, $\ldots$, until finally it is contractible. The Vietoris–Rips complex of the n-sphere first obtains the homotopy type of the n-sphere, and then next the $(n+1)$-fold suspension of a (topological) quotient of the special orthogonal group $\mathrm{SO}(n+1)$ by an alternating group A_{n+2}. Nothing is known at later scales, although one could conjecture that the critical scale parameters of Vietoris–Rips complexes of spheres are related to Lovász' strongly self-dual polytopes. (Received September 02, 2019)