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8. Analysis

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Harnack inequality for heat semigroups and log-Sobolev inequalities

A dimension free Harnack inequality is established for heat semigroups with curvature bounded below. As applications, some dimension free estimates of log-Sobolev constant are presented for compact manifolds, and furthermore, some integral conditions and differentials ones are obtained for the log-Sobolev inequality on noncompact Riemannian manifolds. Let P_t be a diffusion semigroup with curvature bounded below by $-K, K \geq 0$. Then

$$[P_t f(x)]^\alpha \leq P_t f^\alpha(y) \exp[\alpha K d(x,y)^2/2(\alpha-1)(1 \exp(2K)-1)], \;\; \alpha > 1, f \geq 0.$$

The log-Sobolev inequality holds if there exists $r > 0$ such that $\exp[(K + r)d(p,\cdot)^2]$ is integrable w. r. t. the invariant probability measure. Here, p is a fixed point and d is the Riemannian distance.