Mathematics > Differential Geometry

The Log-Convex Density Conjecture and vertical surface area in warped products

Sean Howe

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We examine the vertical component of surface area in the warped product of a Euclidean interval and a fiber manifold with product density. We determine general conditions under which vertical fibers minimize vertical surface area among regions bounding the same volume and use these results to conclude that in many such spaces vertical fibers are isoperimetric. Our main hypothesis is that the surface area of a fiber be a convex function of the volume it bounds. We apply our results in the specific case of $\mathbb{R}^{n}-\{0\}$ realized as the warped product $(0,\infty)\times_{r}S^{n-1}$, providing many new examples of densities where spheres about the origin are isoperimetric, including simple densities with finite volume, simple densities that at the origin are neither log-convex nor smooth, and non-simple densities. We also generalize the results of Kolesnikov and Zhdanov on large balls in $\mathbb{R}^{n}$ with increasing strictly log-convex simple density. We situate our work in relation to the Log-Convex Density Conjecture of Rosales et al. and the recent work by Morgan, Ritor\'e, and others on formulating a generalized log-convex density/stable spheres conjecture.

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