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and **Jian Liang**, **Tsz Wai Wong** and **Hongkai Zhao**. *Geometric Understanding of Point Clouds  
Using Laplace-Beltrami Operator*.

In many problems in science and engineering, data is commonly represented as a collection of points, referred as a point cloud, sampled from a  $k$ -dimensional manifold in an  $n$ -dimensional space. Analyzing and inferring the underlying structure from the point clouds is critical in many fields such as 3D modeling, face recognition, image processing, manifold learning, computational biology etc. However, it is a challenge to extract global and nonlinear information hidden in the point clouds due to the lack of global connectivity. In our recent work, two systematical methods are proposed to solving PDEs on point clouds. We use the proposed methods to define the Laplace-Beltrami (LB) operator on point clouds, which provides us a bridge to link local and global information together. With this operator, we propose a few key applications to geometric understanding for point clouds, including computation of LB eigen-systems for point clouds, extraction of global skeletons structure from point clouds, extraction of conformal structures from point clouds, and intrinsic comparisons among point clouds. (Received September 10, 2012)