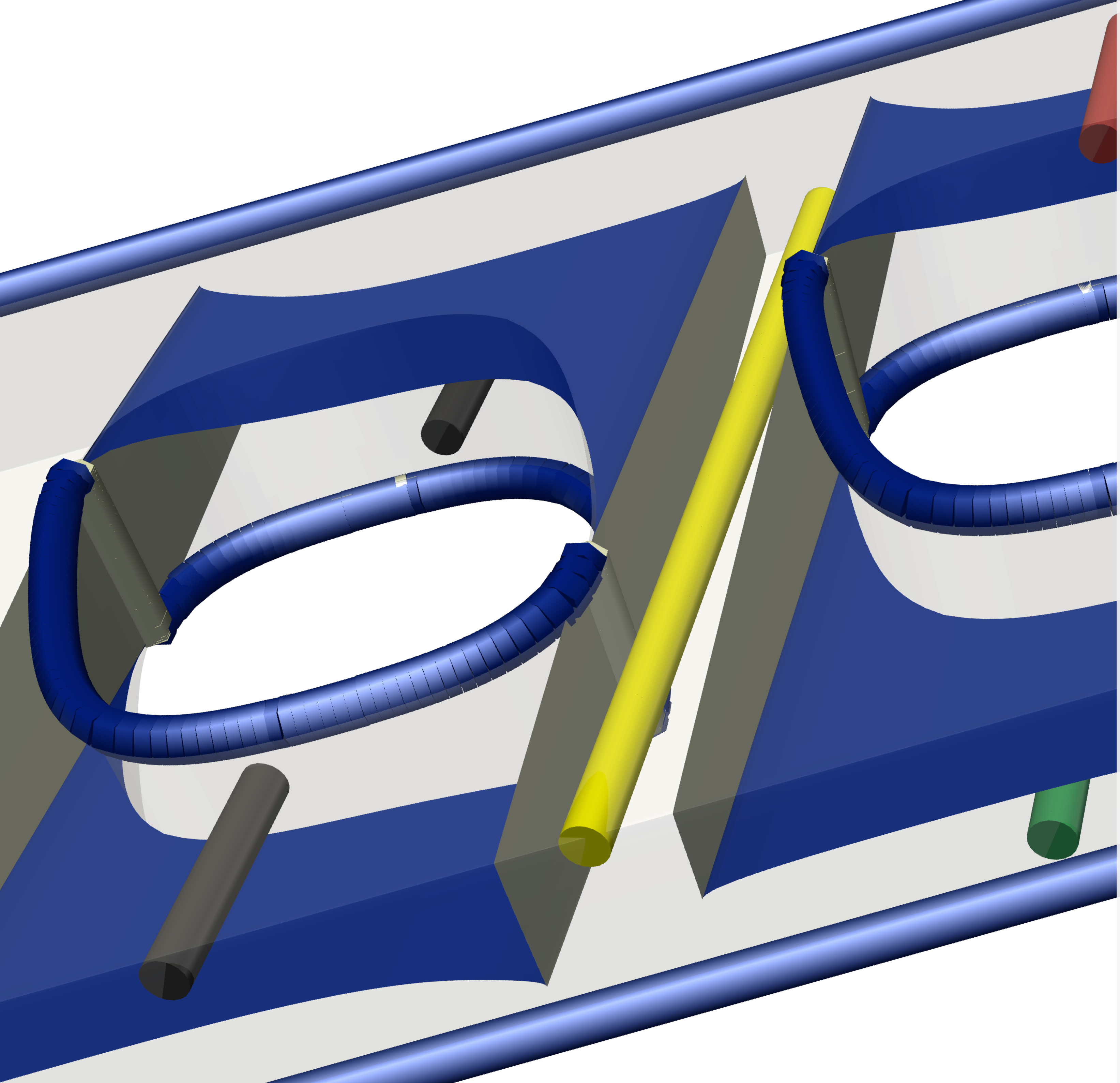

Jacobi Fiber Surfaces for Bivariate Reeb Space Computation

Proc. of IEEE VIS 2016,

Best Paper Award

IEEE Transactions on Visualization and Computer Graphics Vol. 23(1)

This paper presents an efficient algorithm for the computation of the Reeb space of an input bivariate piecewise linear scalar function f defined on a tetrahedral mesh. By extending and generalizing algorithmic concepts from the univariate case to the bivariate one, we report the first practical, output-sensitive algorithm for the exact computation of such a Reeb space. The algorithm starts by identifying the Jacobi set of f, the bivariate analogs of critical points in the univariate case. Next, the Reeb space is computed by segmenting the input mesh along the new notion of Jacobi Fiber Surfaces, the bivariate analog of critical contours in the univariate case. We additionally present a simplification heuristic that enables the progressive coarsening of the Reeb space. Our algorithm is simple to implement and most of its computations can be trivially parallelized. We report performance numbers demonstrating orders of magnitude speedups over previous approaches, enabling for the first time the tractable computation of bivariate Reeb spaces in practice. Moreover, unlike range-based quantization approaches (such as the Joint Contour Net), our algorithm is parameter-free. We demonstrate the utility of our approach by using the Reeb space as a semi-automatic segmentation tool for bivariate data. In particular, we introduce continuous scatterplot peeling, a technique which enables the reduction of the cluttering in the continuous scatterplot, by interactively selecting the features of the Reeb space to project. We provide a VTK-based C++ implementation of our algorithm that can be used for reproduction purposes or for the development of new Reeb space based visualization techniques.

Paper Video Code