Seminar on Combinatorial Computing
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Room 6417, Graduate Center
365 Fifth Avenue, New York

Robust shape fitting via peeling and grating coresets

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Abstract

A (k, ε)-*kernel* of a finite point P is a subset of P that approximates the directional width of P for any direction when k outliers can be ignored in that direction. We show that a (k, ε)-kernel of a set of n points in $\mathbf{R}^d$ can be computed in time $O\left(n + k^2/\varepsilon^{d-1}\right)$. A (k, ε)-kernel is instrumental in solving shape fitting problems with k outliers, like computing the minimum-width annulus covering all but k of the input points. The new algorithm works by repeatedly "peeling" away $(0, \varepsilon)$-kernels from the point set.

We also present a simple incremental algorithm for $(1 + \varepsilon)$-fitting various shapes through a set of points with at most k outliers. The algorithm works by repeatedly "grating" critical points into a working set, till the working set provides the required approximation. We prove that the size of the working set is independent of the input size, and thus results in a simple and practical, near-linear-time algorithm for shape fitting with outliers in low dimensions.

For further information contact Janos Pach at pach@cims.nyu.edu, or visit our website
http://www.math.nyu.edu/p̃ach/public_html/combinatorics_seminar.html