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On closest pair in Euclidean metric: monochromatic is as hard as bichromatic. (English)

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From the introduction: Given a set of \( n \) points in \( \mathbb{R}^d \), the (monochromatic) Closest Pair problem asks to find a pair of distinct points in the set that are closest in the \( \ell_p \)-metric. Closest Pair is a fundamental problem in Computational Geometry and understanding its fine-grained complexity in the Euclidean metric when \( d = \omega(\log n) \) was raised as an open question in recent works.

In this paper, we show that for every \( p \in \mathbb{R}_{\geq 1} \cup \{0\} \), under the Strong Exponential Time Hypothesis (SETH), for every \( \epsilon > 0 \), the following holds:

No algorithm running in time \( O(n^{2-\epsilon}) \) can solve the Closest Pair problem in \( d = (\log n)^{\Omega(\epsilon)} \) dimensions in the \( \ell_p \)-metric.

There exists \( \delta = \delta(\epsilon) > 0 \) and \( c = c(\epsilon) > 1 \) such that no algorithm running in time \( O(n^{1.5-\epsilon}) \) can approximate Closest Pair problem to a factor of \( (1 + \delta) \) in \( d \geq c \log n \) dimensions in the \( \ell_p \)-metric.

MSC:

68U05 Computer graphics; computational geometry (digital and algorithmic aspects)
68Q17 Computational difficulty of problems (lower bounds, completeness, difficulty of approximation, etc.)
68Q25 Analysis of algorithms and problem complexity

Keywords:
closest pair; monochromatic; bichromatic

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References:


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