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The parallel approximation problem and subset sums

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Abstract

We study a basic problem, that we call “Parallel Approximation”: “Given an integral vector a , find an integral vector p , which has much smaller norm than a , while being almost parallel to it”.

In a more general version, a should be approximated with a combination of k integral vectors.

We prove a bound on the quality of the approximation, and show one application: if in a subset sum problem the left hand side vector (the vector of the item weights) has sufficiently large norm, then for almost all right hand sides the problem has a simple proof of infeasibility. This result is related to the work of Lagarias and Odlyzko and Furst and Kannan on subset sum.

Our original motivation comes from Integer Programming, but in a sense Parallel Approximation is a well solved problem in search of applications: it is quite possible that it will find uses in other areas of computational mathematics.

Join work with Mustafa Tural (UNC Chapel Hill).