Cutting Plane Algorithms are Exact for Euclidean Max-Sum Problems

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This paper studies binary quadratic programs in which the objective is defined by a Euclidean distance matrix, subject to a general polyhedral constraint set. This class of nonconcave maximisation problems includes the capacitated, generalised and bi-level diversity problems as special cases. We introduce two exact cutting plane algorithms to solve this class of optimisation problems. The new algorithms remove the need for a concave reformulation, which is known to significantly slow down convergence. We establish exactness of the new algorithms by examining the concavity of the quadratic objective in a given direction, a concept we refer to as directional concavity. Numerical results show that the algorithms outperform other exact methods for benchmark diversity problems (capacitated, generalised and bi-level), and can easily solve problems of up to three thousand variables.

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