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Computing the convex envelope of bivariate piecewise linear-quadratic (PLQ) functions

We introduce a linear-time algorithm for computing the convex envelope of bivariate piecewise linear-quadratic (PLQ) functions and establish that the biconjugate is piecewise rational defined over a polyhedral subdivision. Our approach consists of the following steps: (1) compute the convex envelope of each quadratic piece obtaining piecewise rational functions (quadratic divided by linear function) defined over a polyhedral subdivision;(2) compute the conjugate of each resulting piece to obtain piecewise quadratic functions defined over a parabolic subdivision; (3) compute the maximum of all those functions to obtain the conjugate of the original PLQ function as a piecewise quadratic function defined on a parabolic subdivision; (4) compute the conjugate of each resulting piece; and finally (5) compute the maximum over all those functions to obtain the biconjugate as rational functions (quadratic divided by linear function) defined over a polyhedral subdivision.